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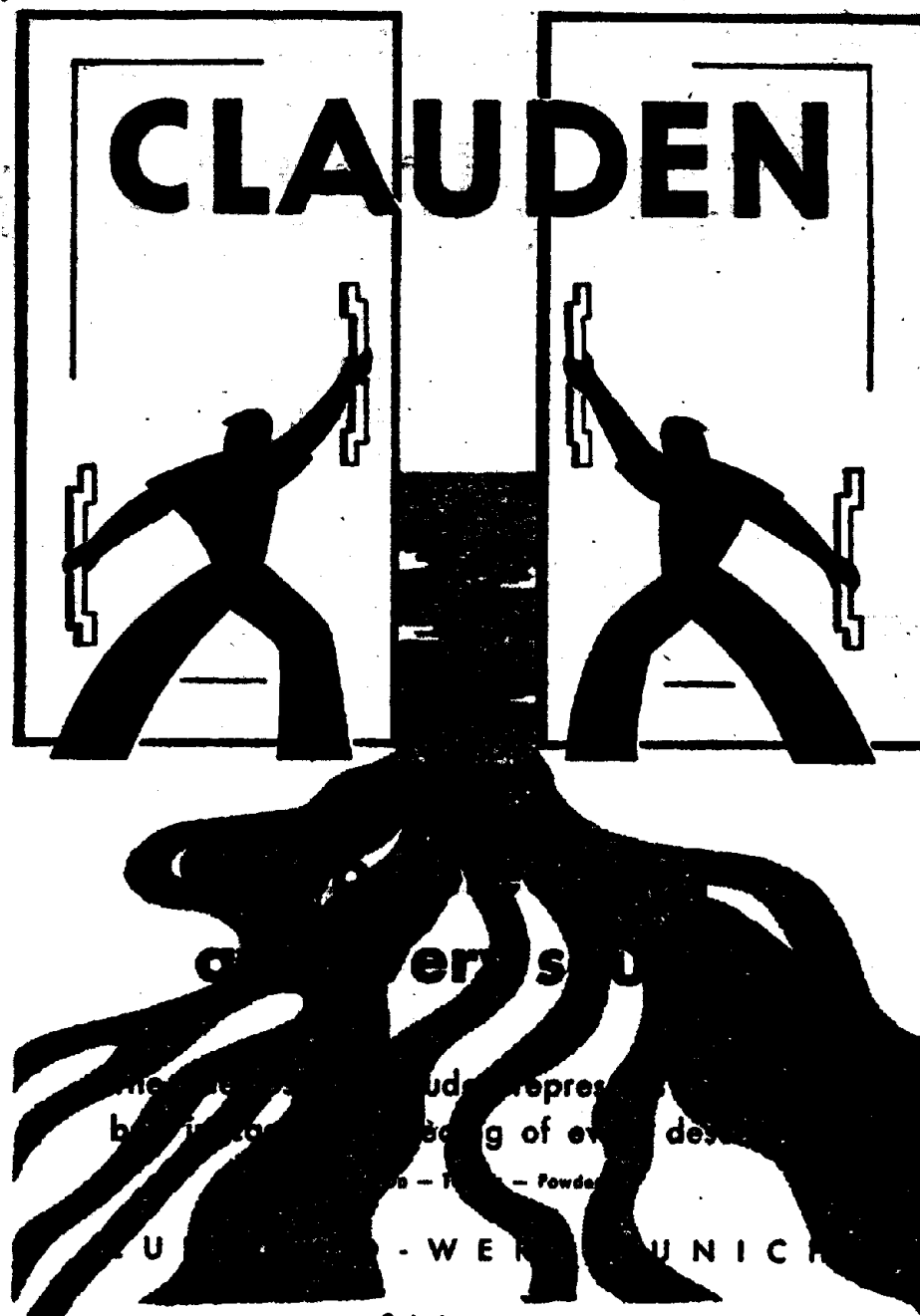


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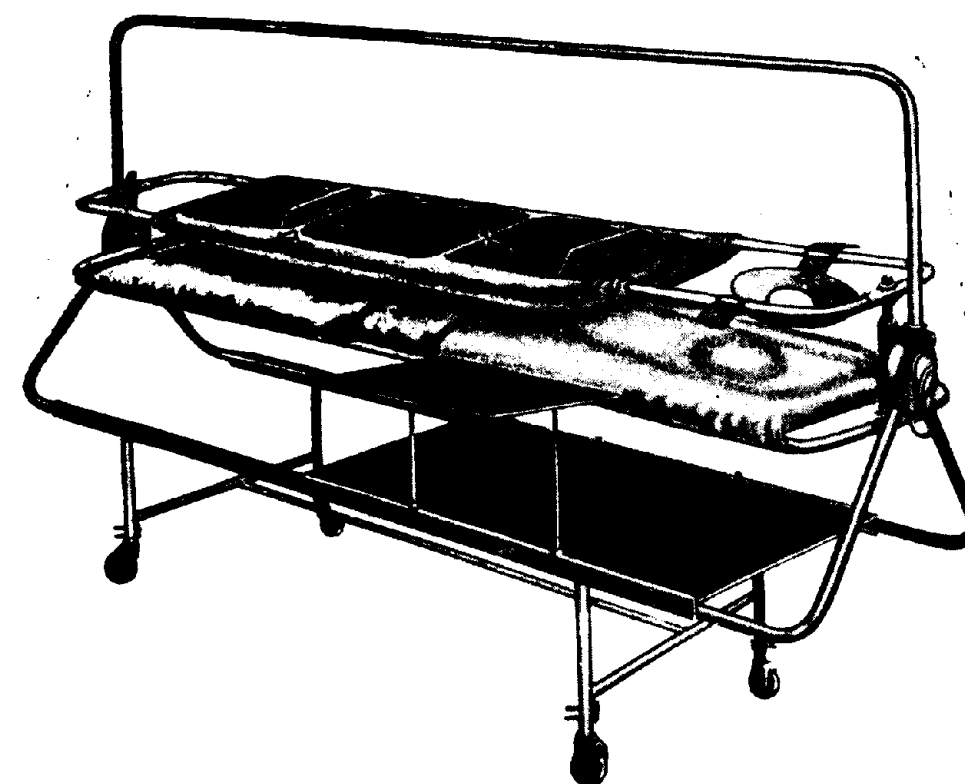
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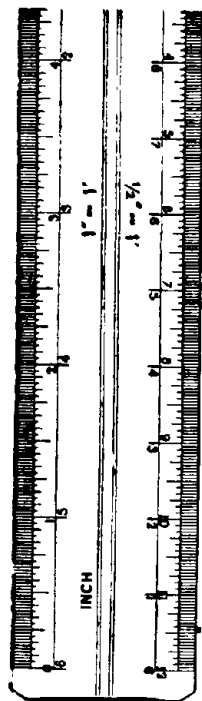
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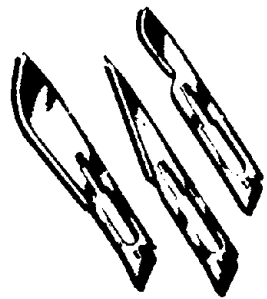
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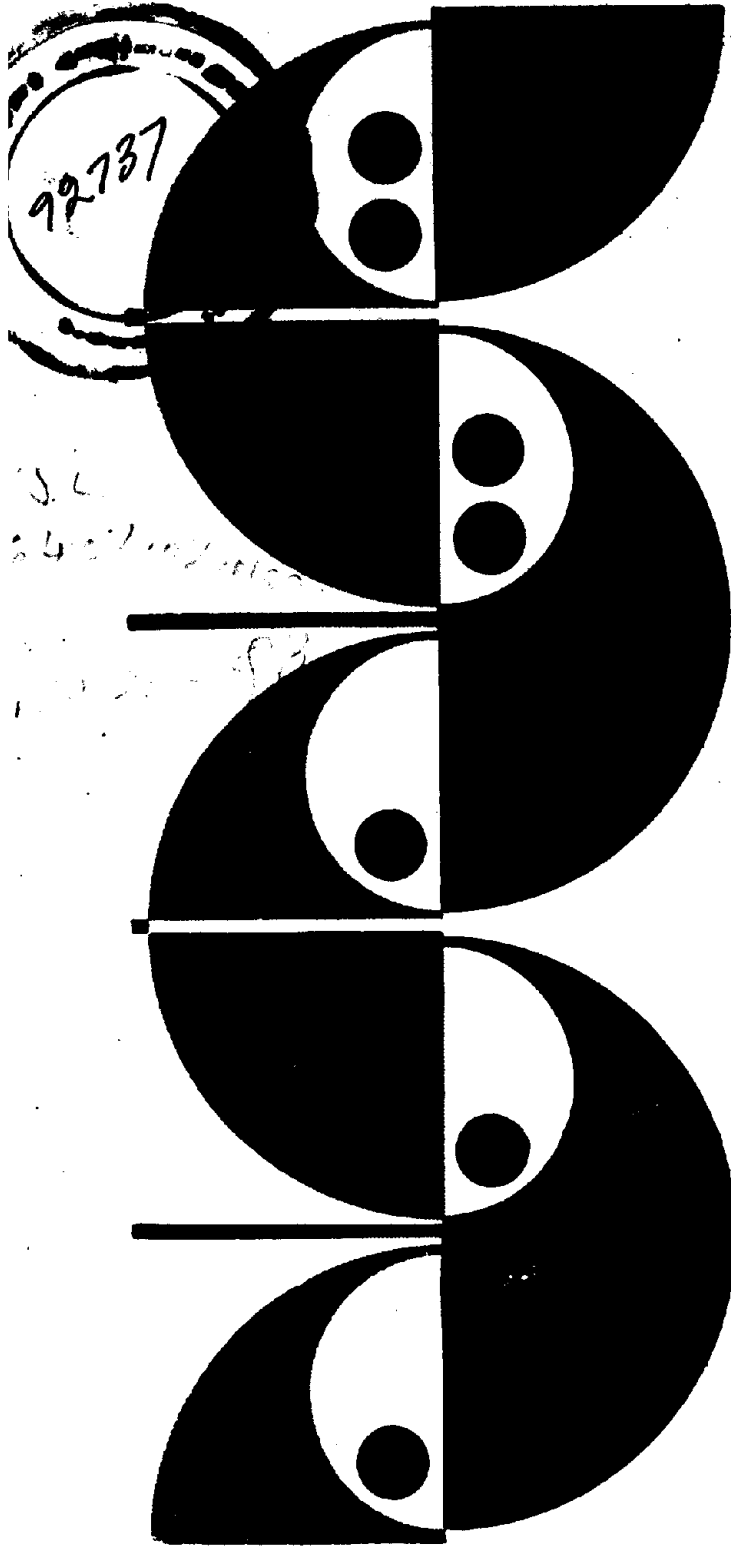
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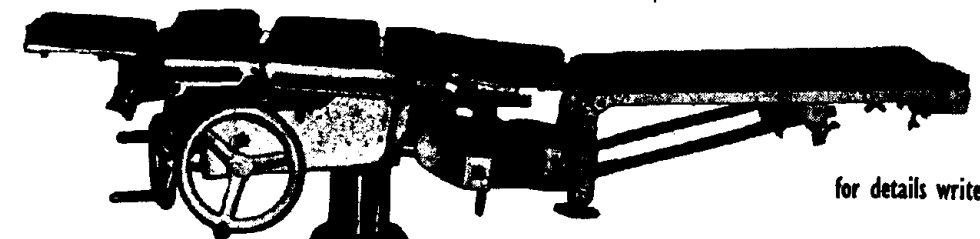
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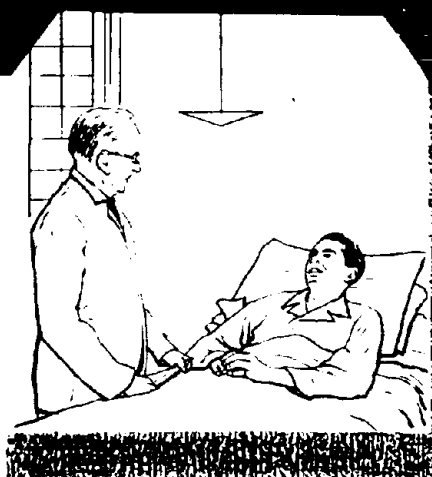
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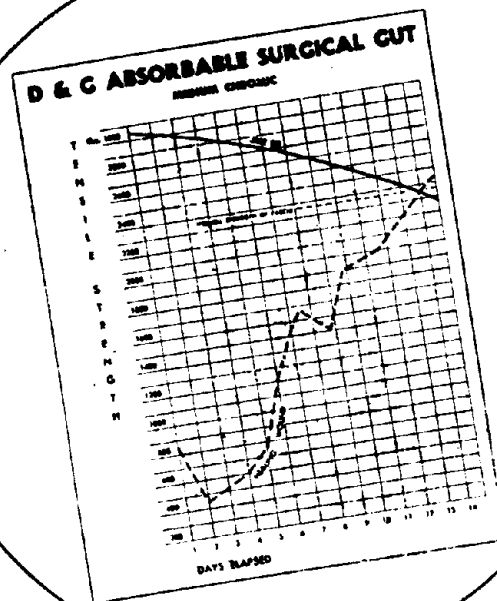
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THE INDIAN JOURNAL OF SURGERY

Vol XXIII

APRIL 1961

No. 2

CARCINOMA OF RECTUM AND ANAL CANAL

(Review of 82 patients)

BY

A. B. BHAJEKAR and D. J. JUSSAWALLA, Bombay.

Introduction

Cure for cancer entails a formidable task for the medical man all over the world. After tiding over infectious diseases and metabolic disorders, we encounter cancer oftener, today.

In the follow up clinics of the Tata Memorial Hospital, Bombay, it was interesting to see patients walking in with a smile of gratitude, although going through their case papers revealed that a radical surgery with a permanent colostomy had been done to eradicate malignant growths of the rectum and anal canal. Malignant tumours of the rectum and anal canal constituted 1.7 per cent of the total number of proved cancer patients which attended the Tata Memorial Hospital, from 1941 to 1955.

The purpose of this dissertation is to emphasize the ease with which radical treatment can be carried out for malignant growths of the rectum and anal canal and to put forward certain observations and conclusions about post-operative management, complications and sequelae peculiar to this disease.

All the malignant tumours of the rectum and anal canal are considered together for

their management because the treatment of choice for all is the same - "radical surgery with permanent colostomy".

Material

The dissertation is based on a detailed study of all patients (31) treated surgically in the four services of the Tata Memorial Hospital from August 1955 to August 1957. A review of other cases who attended the hospital during the same period and who were treated by alternative methods either because they were considered inoperable or because they refused radical surgery is also made. These latter cases are followed up and utilised only for statistical purposes and to emphasise that treatment other than radical surgery is futile. In all, 82 patients of proved malignant tumours of the rectum and anal canal attended the clinics of the Tata Memorial Hospital, of which 31 cases were treated by radical surgery.

Method of Study

As the new patient attended the outdoor clinic:—

- (1) Detailed history of the patient was taken.

- (2) Complete clinical examination was done.
- (3) Punch biopsy from the lesion was taken immediately.
- (4) Fluoroscopic examination of the chest was done for evidence of metastasis or Koch's infection.
- (5) Barium enema was done.
- (6) One week later, when reports of the investigations were ready, evaluation of the case was done and the line of treatment was decided.
- (7) Adequate treatment was given.
- (8) Patients were followed up regularly.
- (9) Results were assessed.

Management

Management of malignant tumours of the rectum and anal canal consists of the following stages :—

- I. Arriving at a definite diagnosis.
- II. Evaluation and selection of treatment.
- III. Treatment.
 1. Surgical treatment including—
 - (a) Pre-operative preparation.
 - (b) Operation,
 - (c) Post-operative management,
 - (d) Complications,
 - (e) Sequelae.
 2. Palliative surgery.
 3. Place of radiation in the treatment.
 4. Medical treatment.

IV. Follow up examinations.

V. Assessment of the results.

Arriving at a definite diagnosis

- (A) *History*: Pain in the perineal region, painful defaecation and bleeding per rectum were the common symptoms. Difficulty in defaecation, tenesmus, dysuria and sciatic pain were other symptoms encountered. In a patient above 40 years of age, bleeding per rectum, a symptom for lower rectal regions, and alternating diarrhoea and constipation, a symptom complex for upper rectal and colonic lesions, needs thorough clinical examination and adequate investigations before a carcinoma can be ruled out.

- (B) *Clinical Examination* including thorough digital examination of the rectum and anal canal.

(C) Investigations :

1. Proctoscopy (Sigmoidoscopy, if necessary).
2. Punch biopsy of the lesion.
3. Barium enema.

The site of the lesion, its type, extent, microscopic variety are the important points in diagnosis.

Site.—‘Rectum and anal canal’ is divided into two regions :

- (a) Upper rectum : The portion of the rectum above the peritoneal reflection or approximately the upper one-third of the rectum.
- (b) Lower rectum and anal canal.

In this series, it has been found that lesions of the lower rectum and anal canal were present in 97.5 per cent of cases which is a

much higher figure than that reported from other centres. It may be conjectured that in India, patients cannot afford to pay attention to the minor complaints like loss of rhythm in bowel actions but seek advice only when there is profuse bleeding per rectum or severe pain, symptoms which are common in the lesions of the lower rectum and anal canal.

Types.—Plaque formation with induration, polypoid type, cauliflower type, ulcerative type, and annular type with or without stricture formation are the types of lesions met with. In this series the ulcerative lesion is very common (93%). The lesion may start as a malignant ulcer, and almost all lesions become ulcerative in the final stages. As patients seek medical advice in the late stage of this disease, (more so in our country), we come across ulcerative lesions oftener.

Extent.—The disease may spread locally upwards, downwards and laterally, into the pararectal tissues, or to the viscera or may metastasise to the inguinal or iliac lymph nodes. The liver or lungs may be involved. It is very important to judge the local extent and fixity of the disease, although inflammatory adhesions make fixity a fallacious sign. This is the only way to judge the operability of the disease clinically. In the present series 14 cases showed local fixity, but only 6 were found inoperable on exploration. (Duke's classification, although based on the extent of the disease, is discussed later on as it has only prognostic significance).

Microscopic Diagnosis.—Microscopic diagnosis is the only way to distinguish between various malignant lesions pre-operatively. Punch biopsy from the edge of the suspected lesion has proved very reliable. In the present series, only in case No. 13 biopsy showed squamous carcinoma but on resection of the

growth the diagnosis was malignant melanoma. Gabriel has given a 98 per cent reliability for this method of diagnosis⁴.

In this series, the following varieties of malignant tumours of the rectum and anal canal were seen :

1. Squamous carcinoma	...	8
2. Adenocarcinoma	...	18
3. Adenocarcinoma with colloid change	...	4
4. Malignant Melanoma	...	1
Total	...	31

Statistics from the Pathology department of the Tata Memorial Hospital show that malignant melanoma, leomyosarcoma and fibrosarcoma were encountered, as additional varieties before August, 1955.

Broder's classification for carcinoma is not of much value and treatment is not based on it⁵.

Barium enema is done to confirm the site, estimate the extent and detect double lesions and polyposis. It was not possible to do barium enema in all cases, as barium could not be retained due to pain and rectal irritability. In this series, polyposis and double lesions were not encountered. Barium enema of Case No. 3 gave suggestive evidence of a carcinoma of the upper rectum.

Spread.—Epithelial tumours spread by infiltration and by lymphatics; blood spread is rare and late. Mesodermal tumours spread both by lymphatics and blood stream. The liver is the main site of distant metastasis. In the present series 3 cases developed metastasis, 2 in the inguinal nodes and liver (Nos. 2 and 25) and one in the liver (No. 6). Melanoma is the most malignant of all the tumours of the rectum and anal canal and spreads rapidly with a fatal outcome. The

Case No. 13 in the present series was alive without evidence of metastasis, five months after the operation.

The lymphatics of the rectum and anal canal consist of intramural and extramural parts which drain into the superior rectal, (median) sacral, and internal iliac glands and those from the anus and surrounding skin which drain into the inguinal lymph nodes.

The superior rectal artery, a continuation of the inferior mesenteric artery, the middle rectal artery, the median sacral artery and the inferior rectal artery, branch of internal pudendal artery, bring oxygenated blood while the veins drain into corresponding venous channels.

The various methods of treatment available are :

1. Radical surgery.
2. Radical surgery and radiotherapy.
3. Radiotherapy alone.

4. Palliative surgical treatment.

(i) Resection.

(ii) Colostomy.

5. Advanced cases - No treatment.

Table I shows the method of treatment adopted in the present series and the results.

Surgical Treatment

History¹¹.—Lis Franc in Paris did probably the first resection of the rectum for cancer in 1826. In Heidelberg, Czerny did it with success in 1879. Modern surgery with radical trend was practised and preached by Ernest Miles. Babcock (1932) contributed the pull through operation, Dixon (1944) did anterior resection, Hartman kept a *cul-de-sac* of lower rectum and anal canal and removed the growth with terminal colostomy. Gabriel has shown very good results with perineo-abdominal resections, starting the operation from the perineum. The main types of surgery for rectal cancer and their relative merits and demerits are tabulated (Table II).

TABLE I
Various Treatments for Rectal Cancer and their results

No.	Mode of treatment.	No. of patients.	Result.
1.	Radical Surgery	28	1 dead. 26 living, free of disease. 1 could not be followed up.
2.	Radical Surgery and Radiotherapy	3	All developed metastasis.
3.	Radiotherapy alone— (a) Curable cases refusing surgery (b) Advanced cases— Palliative	8 14	All dead.
4.	Palliative Surgery— (a) Resection (b) Colostomy	None 4	All dead.
5.	No treatment— (a) Refused treatment (b) Very advanced cases	17 8	3 could be followed up - dead. Not followed up.

TABLE II
The Main Types of Surgery for Rectal Cancer and their Relative Merit and Demerits

TYPE OF OPERATION	SALIENT STEPS	MERITS	DEMERITS
1. Radical resection of rectum (a) Abdomino-perineal (Miles) (b) Perineo-abdominal (Gabriel) (c) Synchronous (Lloyd Davies)	Resection of the distal sigmoid, rectum and anal canal with their lymphatic field and perineal colostomy.	1. Radical operation. 2. The best chance of survival and 5 year cure.	1. Inconvenience and complications and colostomy.
2. Conservative resection (Dixon)	Resection of rectum with preservation of anal sphincters and procto-sigmoidostomy.	1. Natural defaecation.	1. Indicated for lesions of upper 1/3rd of rectum only. 2. Chances of recurrence and leak at the line of anastomosis.
3. Pull through operation (Babcock)	Resection of the rectum and anal canal with perineal (anal) colostomy.	1. Anal defaecation. 2. Applicable to all rectal cancers not anal canal.	1. Incontinent perineal colostomy is worse than abdominal one. 2. Higher mortality in most hands. 3. Doubtful viability of the pulled bowel. 4. Comparatively complicated technique.
4. Hartman's Operation	1. Excision of diseased bowel. 2. Abdominal colostomy. 3. Preservations of lower rectal <i>cul-de-sac</i> .	As an escape operation when anterior resection fails.	1. Not applicable as a routine operation, being not radical.
5. Two stage operations	Colostomy followed by radical resection of rectum later on.	In acute obstruction with low general conditions it is an ideal procedure.	1. Prolonged treatment. 2. Operative risk doubled.
6. Pelvic Exsiccation (Brunschwig's)	Radical resection rectum, and pelvic viscera with wet colostomy.	Relief from pain and bleeding in advanced cases with involvement of pelvic viscera.	1. High operative mortality 20-30%. 2. Hope of life only for an year after the operation.

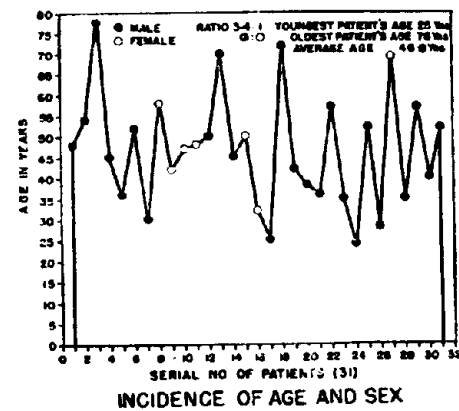


Fig. 1



Fig. 2
Ba. enema in Case No. 3.
Showing filling defect in upper rectum
and sigmoid.



Fig. 4
Colostomy in Case No. 12.



Fig. 3
Case No. 12. Four weeks after abdomino-
perineal resection of Rectum.

(1) Radical surgery involves removal of the anal canal, rectum, and lower half of the sigmoid colon with the para-rectal tissues, peri anal skin, tissues and lymphatics followed by a permanent terminal colostomy. This treatment should be undertaken in all cases with only three contra-indications.

- (i) Marked local fixity due to infiltration.
- (ii) Massive liver metastases.
- (iii) General causes *i.e.* marked cardiovascular inefficiency or advanced metabolic disorders.

All suspicious cases must be explored and evaluated by actual feel and sight, clinical judgment being fallacious as mentioned before.

In cases of highly malignant lesions *i.e.* malignant melanoma, no time should be wasted after biopsy proves the disease and radical surgery should be undertaken immediately. In case No. 13, there was some delay due to wrong diagnosis (Epidermoid carcinoma, Grade II).

There is a trend to execute radical surgery with preservation of anal sphincters in cases of carcinomas of the upper 1/3rd of rectum *i.e.* growths above the peritoneal reflection. This treatment is based on the observation that carcinomas of the upper rectum do not as a rule spread downwards and sphincters are generally free. The advantage of this method is obvious, a natural defaecation and avoidance of all the complications of colostomy. The disadvantages are chances of leak, stricture formation, incontinence and recurrence. Many surgeons continue to be radical, as a complete cure is more likely with a more radical procedure. In the present series only one case (No. 3) of upper rectal carcinoma was operated on, and at

this time the surgeon in charge decided to be more radical and to err if at all, on the safer side.

Naunton Morgan, a great advocate of anterior resection has reduced the incidence of recurrence at the suture line from 21 per cent to 2 per cent by cleansing the bowel ends with 0.2 per cent mercury perchloride before performing the anastomosis.

In the present series 31 cases were treated by radical surgery, the details of which are discussed.

Radical Surgery

(1) *Pre-operative preparation.*—All cases were admitted in the hospital a week before the due date of operation. Complete clinical examination, blood studies, urinalysis and chest screening were carried if they had not been done already within the last fortnight. Minor nutritional deficiencies were corrected. Five days prior to the operation bowel cleaning and sterilisation were started and the patient was kept on a light diet. Sulphathiazole tablets 2 Gms. four times a day and Streptomycin tablets 500 mg. twice a day were given with a daily bowel wash. Three days prior to operation 1.6 Gms. of piperazine hydrochloride were given in two doses in the form of syrup or tablets (Helmacid, Glaxo). This new procedure was tried in 3 cases (Nos. 10, 12 and 14), 2 of which (Nos. 12 and 14) passed 6 and 8 round worms each after it, with smooth post-operative period following. This special pre-operative preparation was based on the fact that 3 consecutive cases (Nos. 13, 16 and 17) developed subacute intestinal obstruction post-operatively, one (No. 16) felt better after the passing of round worms on his own, the other two (Nos. 13 and 17) passed 33 and 16 round worms each after taking piperazine hydrochloride (1.6 Gm.) with disappearance of the obstructive signs.

As it is difficult to find round worm ova in casual stool examinations amidst blood and mucous, and as round worm infestation is very common in our country, routine administration of piperazine hydrochloride should be done pre-operatively. Piperazine hydrochloride is the drug of choice in the treatment of round worm infestation as it is strongly heeminticidal, and kills the worms without causing convulsive movements. It does not need a purgative and is non-toxic in therapeutic doses.

(b) *Operation*.—Three standard methods are known for the radical surgery of the rectum and anal canal all based on the same principle.

1. Abdomino perineal resection of Ernest Miles⁹.
2. Perineo-abdominal resection of Gabriel⁵.
3. Synchronous resection of Lloyd Davies⁶.

In this series a modified synchronous resection of the rectum and anal canal was done.

Anaesthesia.—Hyperbaric nupercaine 2 cc. was used as a spinal anaesthetic and intratracheal nitrous oxide and oxygen as a

supplementary general anaesthetic. Scoline and Flexedil were used as relaxants whenever necessary.

Operative technique (in brief)—Position—"Lithotomy Trendelenburg's".

An indwelling catheter was fixed on to an Asepto syringe. A left paramedian infra-umbilical rectus splitting incision was made and the abdomen explored for local spread and metastases. At this stage the case was evaluated once again. If radical surgery was decided upon, two vertical incisions were made in each leaf of the sigmoid mesocolon, continued by the side of rectum and joined in front to push the bladder away. The inferior mesenteric vessels were dissected, caught, cut and transfixed one inch above the sacral promontory. The vessels were tied high up just distal to the origin of the left colic artery when there were palpable nodes in the lower position. The rectum was then dissected anteriorly from the bladder, prostate and seminal vesicles in the male and uterus and vagina in the female. The fascia of Denonvilliers has to be incised in this procedure. The rectum was then separated from the sacrum by finger dissection and finally the lateral

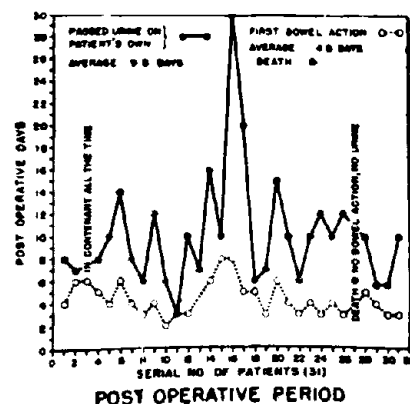


Fig. 5

Progress in post-operative period.

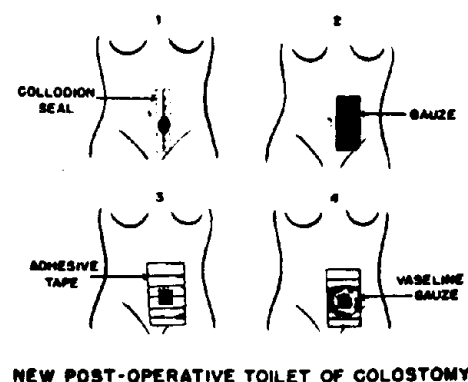


Fig. 6

Management of colostomy post-operatively.



Fig. 7

Abdominal wound and colostomy 12 days after operation in Case No. 10.

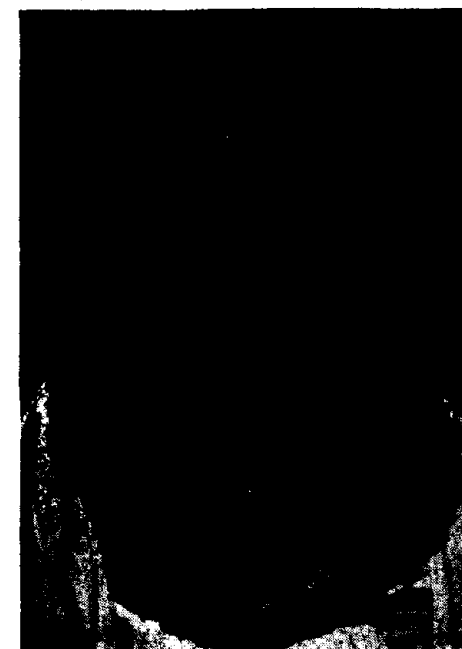


Fig. 8

Abrasions and ulcers of skin produced after using metal colostomy bag in Case No. 17.

attachments were severed. The middle rectal vessel (a variable structure) may have to be caught, cut and ligated. At this stage, the perineal dissection was started and at the same time the operator cut the sigmoid in the most distal viable pulsatile part using Zachary Cope's modification of DeMartel's clamp. Both stumps were covered with rubber gloves. The posterior peritoneum was sutured after pushing the rectum down and the abdomen was sutured in layers. The colostomy stump was kept in the centre of the wound and with a gap of one finger each on all the sides, was loosely fixed to the layers of the surrounding tissues. The perineal dissection was done with a cutting cauter current. A circular incision was made about one inch beyond the anus and the rectum was delivered from below after cutting the fascia of Waldeyer posteriorly, separating the prostate anteriorly, and cutting the levator ani laterally. A rubber glove

packed with gauze was kept in the gap to support the weak pelvic floor and the perineum sutured.

The whole procedure was done within 1½ to 3 hours, and there was negligible blood loss and alteration in pulse rate and blood pressure. 500 c.c. of 5 per cent glucose water and occasionally 350 c.c. of blood were given whenever necessary.

Brief discussion on special points in operative technique

(1) To avoid retraction of the colostomy, it has been a practice to keep about an inch of the terminal sigmoid beyond the skin. In no case has retraction occurred.

(2) During the perineal dissection the coccyx was never removed, as is done as a routine in many centres. Without removing the coccyx one can have adequate exposure

and the radicality of the operation is not at all diminished. Wass states non-interference with the coccyx avoids the pain which follows its removal¹⁰.

(3) In all cases terminal colostomy was done in the wound and not in the left iliac region as is done in many centres.

Advantages of the incisional colostomy are :—

- (i) Quicker and simpler procedure, a great advantage.
- (ii) Less chances of strangulation of the colostomy.
- (iii) Less chances of stenosis of the colostomy.
- (iv) Good control of defaecation.
- (v) More convenient for defaecation.

Just stooping over a kidney tray is enough, and no patient has complained of any inconvenience, in our series.

Disadvantages :—

- (i) Chances of wound infection and subsequent complications. This can decidedly be avoided by a special toilet as mentioned later on and by the use of appropriate antibiotics.
- (ii) Herniation (was not seen in this series).

(4) Angio-invasion by malignant cells while operating was emphasized by Cole and was confirmed by Fisher and Turnbull. As soon as local operability is judged without handling the growth as far as possible, the inferior mesenteric vessels were ligated. Further 'dissection' was done, only after completing this important step.

(c) *Post-operative management.*—Patient was kept in (10°) Trendelenburg's position to reduce the weight on the pelvic floor and kept sedated for the first 24 hours. Antibiotics were given in the event of pulmonary, urinary or wound infections.

Feeds.—2,000 c.c. of fluids were given on the first day intravenously and from the second day oral feeds were given gradually to reach a light diet by the fourth day.

Colostomy was opened on the second day (48 hours). It may be opened earlier whenever there is distension and colicky pain.

Perineal wound.—The pack was partially removed on the 3rd day and completely on the 4th, followed by gentle irrigations with Condy's lotion and light repacking. Perineal sutures were removed on the 10th day. Perineal wound healed by granulation in three weeks time on an average.

Urine.—Indwelling catheter was kept in for four days and was drained continuously in a sterile bottle or kept corked and opened every 3 hours. On the 5th day the patient was encouraged to pass urine after removal of the catheter.

Mobilisation.—The patient was allowed to sit up on the 4th day and to move about on the 12th day. Deep breathing exercises and movements of limbs were encouraged from the first day.

(d) *Complications.*—(i) *Urinary :* (i) *Infection :* Two cases (Nos. 11 and 17) developed infection which responded to a combination of Streptomycin and Penicillin in 3 days.

(ii) *Retention :* Denervation and lack of support to the bladder cause bladder dysfunction. John L. Emmet emphasizes the importance of surgical trauma and resultant lack of support to bladder and prostatic urethra in bladder dysfunction¹.

On an average patients passed urine voluntarily on the 9th day.

Pin point meatus, urethral stricture and prostatic enlargement, which are other causes of retention of urine were not seen in this series.

(iii) One patient (Case No. 22) developed perineal fistula which finally healed after draining the bladder. The damage to the prostatic urethra has been mentioned in the literature¹.

(2) *Cardiac.*—Case No. 27 died on 6th post-operative day of coronary thrombosis, this being her second attack.

(3) *Intestinal obstruction.*—For the first 4 days there was always a moderate amount of distension till the bowel was opened. Four cases (Nos. 13, 16, 17 and 31) developed subacute intestinal obstruction which settled down with conservative treatment of gastric aspiration and adequate intravenous feeding. Three cases (Nos. 13, 16 and 17) out of these had round worm obstruction.

Causes of intestinal obstruction mentioned in the literature are herniation and strangulation of the bowel through the pelvic floor, or by the side of the colostomy, pull on the ileo-colic region by tight suturing of the peritoneum, volvulus of the terminal part of the sigmoid, and adhesions of the bowel to the pelvic floor.

Intestinal obstruction not responding to conservative line of treatment is best tackled by surgery.

(4) *Burst abdomen.*—One patient (No. 12) developed "burst abdomen" on the 3rd post-operative day. The wound was resutured, following which he made an uneventful recovery and went home on the 24th day after operation.

(5) *Shock, haemorrhage, peritonitis, pulmonary complications, thrombophlebitis, uraemia and sacral hernia,* mentioned in the literature were not seen in the present series.

Complications of Colostomy

(i) *Infection of the wound.*—This complication is the major objection for doing a colostomy in the original incision. Out of

31 cases, 20 had only minor infection just by the side of the colostomy, 2 (Nos. 11 and 14) had gross infection of the wound and 5 (Nos. 5, 10, 15, 16 and 31) healed by first intention.

A special toilet was tried in Case No. 10, an anaemic lady, 45 years of age, resulting in healing by primary intention. We got a repeat performance in another case (No. 15). After closure of the wound, the skin was cleaned with spirit and painted with iodine. A collodian seal was done and then a layer of gauze pieces and resealing with adhesive tape. A rectangular gap was kept for the colostomy which was then surrounded by vaseline gauze and "Gauze cotton pad" superficial dressing was applied on top of that. Complete dressing as described above was done on the 5th and 10th days again. Alternate sutures were removed on the 10th day and the rest on the 12th day. We can obviate infection very easily by careful dressing of the wound.

(ii) Retraction of the colostomy, peritonitis, non-function, stricture, volvulus and hernia were not seen in the present series.

(iii) Case No. 31 developed recurrence on the colostomy.

(e) *Sequelae : Urinary.*—Night wetting and occasional incontinence persisted for almost a couple of months. One case (No. 3) had incontinence for 6 months. All the rest are free of urinary complaints.

Colostomy.—In all cases colostomies are functioning well and there is no appreciable inconvenience to the patients. Use of colostomy bags is not advisable. Ordinary washable cotton and linen covering is clean, convenient and cheap. Metal colostomy rings produce ulcers as shown in the photograph and rubber rings get sodden and smell badly.

Impotency.—A special study was done in male patients under the age of fifty (15 cases). Eleven patients are impotent with loss of erection and emission. One patient (No. 12) does not like to have a coitus lest his wife will take a distaste for him because of colostomy. Two patients (Nos. 1 and 21) state that they enjoy coitus but have, as yet, not been able to impregnate. One patient (No. 4) could not be followed up.

Thus, 72.6 per cent of patients are impotent after the radical resection of rectum. (Table III).

TABLE III
Effect of Radical Rectal Surgery
on Potency

S. No.	Case No.	State.	Age in years.	Months after operation.
1	1	Potent	40	13
2	4	...	45	Cannot be followed up
3	5	Impotent	36	16
4	7	Impotent	30	21
5	12	Impotent	50	5
6	11	Impotent	45	4
7	17	Impotent	25	8
8	19	Impotent	42	6
9	20	Impotent	38	19
10	21	Potent	36	19
11	23	Impotent	35	10
12	24	Impotent	50	11
13	26	Impotent	28	10
14	28	Impotent	35	20
15	30	Impotent	40	9

The cause of impotency is probably damage to the para-sympathetic sacral outflow of nerves (nervi erigentes).

If the urinary bladder can pick up its function inspite of gross damage to its nerves, why the ejaculatory system should be affected is a problem which needs further study.

Palliative Surgery

(i) **Resection.**—Palliative resection relieves pain, bleeding and discomfort; in no case in this series was it done as all advanced cases refused operation.

(ii) **Colostomy.** Colostomy as a palliative measure in inoperable cases has not been done, as in no way it is considered helpful. It is uncomfortable, pain in the perineal region persists and intestinal obstruction which it is meant to prevent may not supervene at all, as expected. It was done in 4 cases of obvious intestinal obstruction which is its only absolute indication. All the four patients refused radical surgery, later on.

The Place of Radiation in the Treatment (Table IV)

(a) It has been established that radiation has no place in the cure for rectal cancer. "Radiotherapy for cure should only be reserved for patients who are bad risks for operation and offered reluctantly to those who absolutely refuse surgery".

(b) Palliative radiotherapy has failed to give comfort in 10 out of 14 cases.

(c) After an attempt at radical surgery, if the cut edge shows microscopic evidence of the disease deep X-rays are given to that region.

In the present series 3 cases (Nos. 2, 6 and 25) were given deep X-rays post-operatively, all developed metastases later on.

TABLE IV
Radiotherapy after Surgery ***

Case No.	Microscopic Report.	Duke's Classification.	Radiotherapy.	Result.
2	Adenocarcinoma Gr. III. Cut edge shows infiltration in left pararectal tissues.	III	2000r × 2	No cure. Inguinal nodes and liver metastasis.
6	Epidermoid carcinoma Gr. III. Cut edge shows infiltration in left pararectal tissues.	III	2800r × 2	No cure. Liver metastasis.
25	Epidermoid carcinoma Gr. III. Cut edge in sacral region shows infiltration.	III	2000r × 2	No cure. Inguinal nodes and liver metastasis.

Medical Treatment

Analgesics and modern tranquillisers have replaced neurectomies, heroic chordotomies and frontal leucotomies, for advanced cases. We have given aspirin and opium in one form or other; chlorpromazine hydrochloride and recently tranquillisers have been combined with analgesics to ease the pain.

Follow up Examination

Out of 31 patients, one (No. 27) died of coronary thrombosis on the 6th post-operative day, three (Nos. 6, 22 and 25) have developed metastasis in the liver and are advanced problems. One (No. 4) could not be followed up. Case No. 31 developed recurrence at the colostomy. Twenty-five patients are alive and free of disease (80.64%), nineteen patients are active and doing useful work.

Assessment of Results

(1) **Operability rate.**—Out of 37 patients explored, 31 patients were found to be operable, giving 83 per cent as operability rate. Naunton Morgan gives 97 per cent operability rate in his series.

(2) **Operative mortality.**—Only one patient (No. 27) died of coronary thrombosis on the 6th post-operative day giving 3.2 per cent as the mortality rate.

In the Mayo Clinic 305 resections of the rectum were done during 1952-1955 with 4.9 per cent operative mortality rate¹⁰.

(3) **Survival Rate.**—Cuthbert Dukes classified rectal cancer with reference to its local spread and offered prognosis of the operated case on a scientific basis. In his series of 1940, high five year survival rates for early carcinomas of the rectum are evident.

In this series, Dukes Class A and B have 100 per cent survival and Dukes Class C has 59.4 per cent survival (in two years). (Table V).

TABLE V
Assessment of Results by Dukes
Classification
(Maximum Two years)

Category.	No. of Cases.	Result.
Dukes A	10	All living and free of disease.
Dukes B	7	All living and free of disease.
Dukes C	14	1 died. 3 developed metastasis. 1 not followed up. 1 developed recurrence at colostomy. 8 living and free of disease.

Summary

(1) Thirty-one cases of malignant tumours of the rectum and anal canal, treated by radical surgery, were studied in detail.

(2) Method of arriving at an early diagnosis is mentioned.

(3) Brief discussion of various treatments given is done.

(4) Piperazine hydrochloride (helminthicide) has been given a place of importance in the pre-operative preparation.

(5) Radical surgery, as the only rational treatment, is discussed in full.

(6) Modifications in the operative technique adopted are mentioned.

(7) The value of careful toilet of the colostomy is emphasized in preventing infection of the operation wound.

(8) Complications and sequelae following surgery are enumerated.

(9) Impotency and sterility are discussed as an important after effect of radical surgery on the rectum.

(10) Radiotherapy and palliative surgery are discussed in brief.

(11) Operated patients have been followed up and results assessed.

Acknowledgements

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CONGENITAL AORTIC STENOSIS AND ITS SURGICAL CORRECTION UNDER DIRECT VISION*

BY

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Case Reports

Case 1.—Boy aged 7 years admitted in March 1959 complaining of slight breathlessness on exertion of 1 year's duration. The general appearance of the boy was average and while in the hospital, he was relatively asymptomatic and his exertional ability appeared to be normal.

Pulse 80 P. M., Respiration—20 P. M., B. P.—95/65 mm. Hg.

Apex beat.—Left 5th intercostal space on the mid-clavicular line—heaving in character. There was a systolic thrill in the right 2nd intercostal space close to the sternum. There was a rough pan systolic murmur on the aortic area with conduction towards the main vessels. The aortic second sound was faint.

X-Ray.—Plain X-ray suggested slight left ventricular hypertrophy and a large aortic impression on the Barium filled oesophagus.

E. C. G.—Suggested left ventricular hypertrophy.

Left Ventricular and Aortic Catheterisation.—Pressure gradient of 110 mm. Hg. Left ventricular pressure—220 mm. Hg. Aortic pressure—110 mm. Hg. (Fig. 1.)

Angiocardiogram.—(a) By left ventricular puncture, showed post stenotic dilatation of aorta with suggestion of stenosis at valve level.

(b) Venous angiocardiogram showed similar appearance.

Aortic Catheter. The catheter got obstructed at the valve level.

Operation.—(27-10-59) Hypothermia. Surface cooling started with oesophageal temperature of 37.2°C. Cooling stopped at 32°C. (Fig. 2).

Exposure.—Mid line sternotomy exposure. Pericardium opened extensively in 4 flaps.

Findings.—Ascending and arch of aorta dilated. Systolic thrill on the ascending aorta marked. No thrill in subaortic region.

Congenital obstruction of the outflow tract of the left ventricle has not attracted as much attention from the Cardiac surgeons as has that of the right ventricle. However, the importance and the frequency of such obstruction is being gradually understood in recent times and the many problems in relieving such types of stenosis are nearer solution. This type of obstruction constitutes about 3% of all congenital heart diseases and 7% of the acyanotic group (Campbell and Kauntze 1953). Of 50 consecutive cases of aortic stenosis operated on at the Guy's Hospital— as many as 20 were considered to belong to the congenital variety (Baker and Somerville 1959).

The stenosis may occur either at the valvular or at the sub-valvular level. Valvular stenosis is more common although Brock (1959) has recently reported on 16 cases of the subvalvular group. The subvalvular stenosis may vary from a thin flimsy diaphragm to enormous fibro-muscular obstruction. The valvular obstruction is usually of the crateriform type (as in congenital pulmonary stenosis) and the individual commissures of the aortic valve are not always evident.

In India, as far as we know, no case of this type of abnormality has been positively diagnosed or surgically corrected and reported in the literature. We therefore present 2 cases of congenital aortic stenosis who were recently under our care.

*This paper was presented at the Annual Conference of the Association of Surgeons of India held at Jaipur in December 1959.

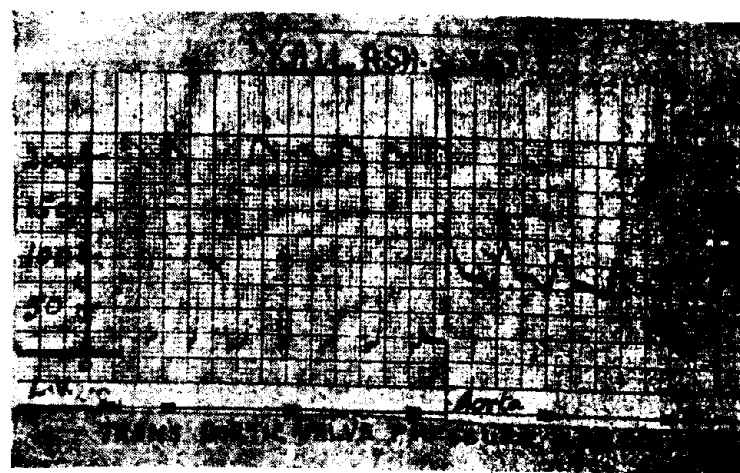


Fig. 1

Shows the trans-aortic valve pressure gradient of 110 mm. Hg.



Fig. 2

Shows the pulse rate, the Blood pressure and the temperature level during operation of Case 1.

Procedure.—Both pleural cavities were opened widely. Two snares were passed around both lung hila, I. V. C., S. V. C., Innominate and Left common carotid arteries. Ligature tied to the tip of auricular appendix for retraction. Adventitia was dissected from the anterior aspect of ascending aorta from the level of its root to the innominate artery and Beck's aortic clamp put on the aorta enclosing $\frac{1}{2}$ of the circumference. A linear incision was made in the aortic wall included within the clamp. Two stitches were put in at the upper and lower ends of the incision to avoid splitting. Two other sutures were passed on the lips of the aortic incision. Patient was fully oxygenated followed by tightening and occlusion of the two lung hilar tourniquets and those of the I. V. C. and S. V. C., innominate and common carotid vessels. After 30 seconds, the aortic clamp was opened. Blood was sucked away. The stenosed aortic valve was well seen. The valvular orifice was about 5 cm. in diameter and situated in the centre of a crateriform valve. No definite commissures could be seen. The fused cusps were divided on either side by a strong pair of curved scissors so as to make the valve bicuspid (Fig. 3). The index finger was then introduced through this opening into the left ventricle. No subaortic stenosis was detected. During this digital exploration a

small (2 to 3 mm.) tear occurred at the proximal end of the aortic incision. 50 cc. saline was injected into the left ventricle through a polythene nozzle to expel air. The lung hilar snares were then released and blood was allowed to flow out of the aortic incision and the aortic clamp was put back. The caval snares were released and then the snares around the head vessels. There was some leakage of blood through the tear in the aortic wall. The aortic clamp had to be put back into position further down below the tear. Some blood was lost during this process. The total period of inflow occlusion was 2 minutes 50 seconds. The action of the heart was feeble for a little while but there was no fibrillation and the heart recovered quickly. The incision in the aortic wall was repaired with a little difficulty.

At the end of the operation, the oesophageal temperature was 30.2°C and Blood pressure was 70 mm. systolic. Rewarming was stopped at 34°C. The patient was conscious at this time.

Post-Operative.—Except for a transitory period of hyperpyrexia, recovery was uneventful.

Present Position.—It is too early yet to assess the true improvement and post-operative pressure studies will be made 6 months later. There is a faint

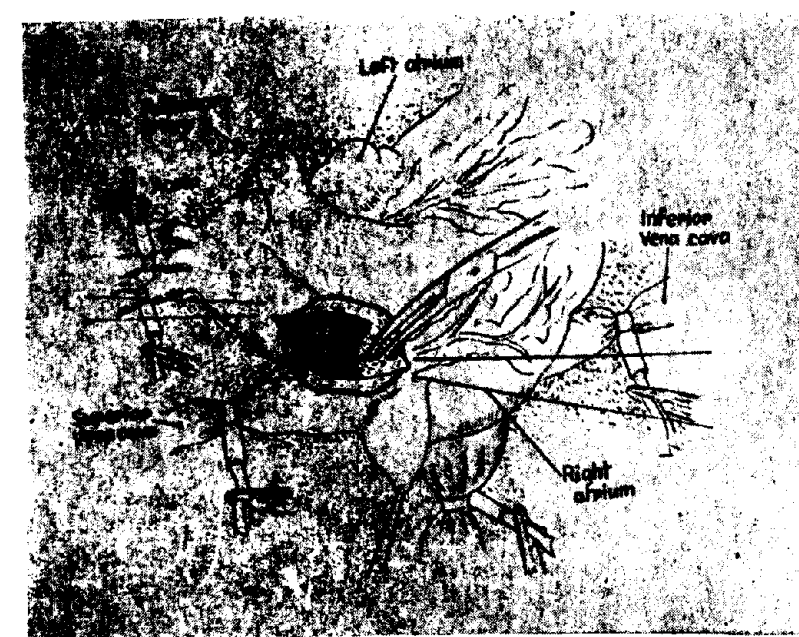


Fig. 3

Line drawing showing the method of exposure of the aortic valve after incision of the aortic root with inflow and outflow occlusion of the heart under hypothermia.

systolic and diastolic murmur over the aortic area indicating the presence of slight regurgitation.

A repeat left heart catheterisation study 3 months after operation demonstrated that the gradient across the aortic valve had been completely abolished.

Case 2.—Girl aged 12 years, was first admitted in January 1959 with Grade II exertional dyspnoea.

Her general development was good. B. P.—105/65 mm. Hg. There was a systolic thrill and Grade III pansystolic murmur over the aortic area conducted towards the head vessels. The aortic second sound was audible and was not split.

Skiagraphy.—Suggested slight left ventricular enlargement and a large aortic impression on the oesophagus.

E. C. G.—(January 1959)—Showed normal course of cardiac events.

Left Ventricular Puncture and Left Brachial Artery Pressure Study:

Showed that the gradient was 35 mm. Hg.

Left ventricular pressure—110 mm. Hg.

Left brachial artery pressure—75 mm. Hg.

In view of the small gradient and the relative absence of symptoms, operation was not advised at this time.

This patient came back in November 1959 with a history of two recent syncopal attacks while at school and increasing fatigability on exertion. A repeat catheterisation study was performed and this time the gradient was found to be 65 mm. Hg. (Fig. 4).

Left ventricular pressure—140 mm. Hg.

Left brachial artery pressure—75 mm. Hg.

In view of the 2 recent syncopal attacks and increase of fatigability and in view of the increase in the pressure gradient between the ventricle and the brachial artery, operation was advised.

Operation.—Under Hypothermia.

Cooling started at 37.2°C and stopped at 32°C. Rapid afterdrop to 27°C caused some anxiety but rewarming by circulating hot water through covering hypothermia blankets stopped the drift and brought the temperature up slowly and the important part of the operation was done at about 30°C. (Fig. 5).

Findings.—Ascending aorta markedly dilated. Systolic thrill on the ascending aorta.

Procedure.—Exactly same as in Case 1. On opening the aorta, the aortic valve was seen fairly easily. There was no evidence of stenosis at the valve level but on introducing the finger through the valve into the ventricle, resistance was immediately met. There was subvalvular obstruction of the diaphragmatic type. A two bladed expanding dilator of the Brock type was introduced through the valve and the stenosed area was first ruptured and then dilated to the full in two directions. After this, the finger could be introduced into the ventricle up to the apex easily.

The rest of the operation was uneventful.

Except for a period of auricular fibrillation, the heart behaved well. Beats returned and were quickly forcible after release of the occlusion and at the end of the operation, Blood pressure was 90 mm. systolic.

Post-operative recovery was uneventful.

It is too early to comment upon the final outcome but as the subvalvular obstruction has been relieved well and there is no question of regurgitation, it is expected that this patient will have a good result.

Discussion

Diagnosis.—Although congenital aortic stenosis is often diagnosed at an early age, in many cases it may escape detection until later years. The disability in the early years is usually well tolerated and most patients remain asymptomatic in early childhood (Morrow et al 1958). However, once the signs of left ventricular strain begin to be manifest, the prognosis becomes extremely poor and the patient goes rapidly down hill.

The broad spectrum of symptomatology is about the same as in acquired aortic stenosis: Fatigability on exertion occurs early. Angina on effort, exertional syncope and later evidences of left ventricular failure follow. General development is usually normal. The systolic pressure in the peripheral vessels may be normal but the pulse pressure is usually low. There is marked

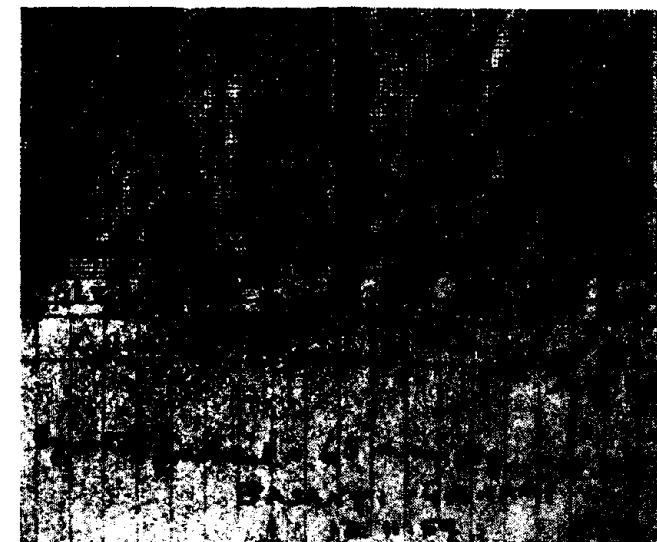


Fig. 4

Shows the trans-aortic valve gradient of 65 mm. Hg. in Case 2.

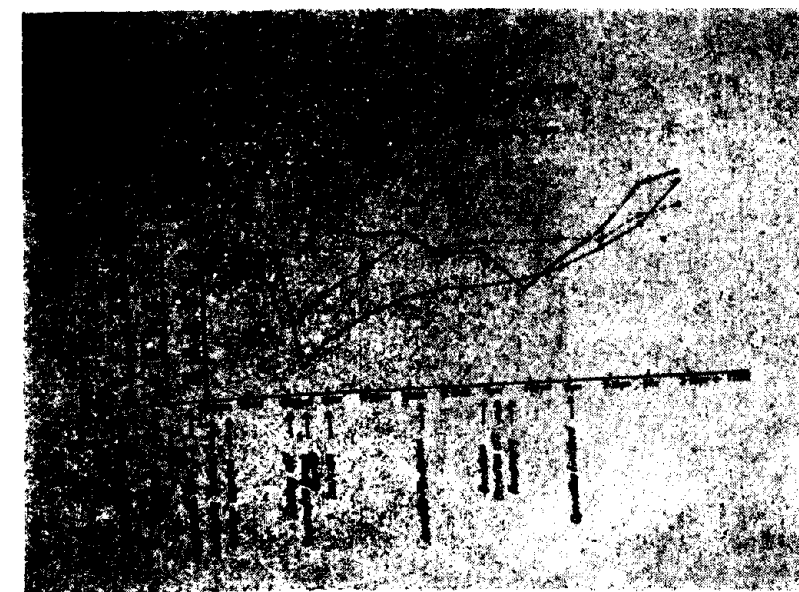


Fig. 5

Shows the Blood pressure, pulse rate and the oesophageal temperature during operation under hypothermia in Case 2.

thrill and a systolic murmur over the aortic area which is transmitted to the aortic branches. On fluoroscopy and x-ray, the heart size may be slightly enlarged, particularly the left ventricle as seen in the left oblique view. There may be some post-stenotic dilatation of the ascending aorta but never to the extent that we associate with congenital stenosis of the pulmonary artery. Calcification of the aortic valve has sometimes been seen as early as in the 16th year. Angiography may be of some help (as in our Case 1) in determining the site of obstruction. E. C. G. may reveal a normal pattern but usually shows some left ventricular hypertrophy. When evidences of strain are present like S. T. depression and marked T wave inversion in left sided chest leads, the prognosis is poor and urgent relief of the obstruction is imperative (Brock 1959).

Left Heart Catheterisation.—The most fruitful and informative method of study is left heart catheterisation by direct left ventricular puncture (Fleming & Gibson 1957). Demonstration of a significant pressure gradient between the left ventricle and the aorta or the brachial artery is positive evidence of aortic stenosis. The magnitude of the gradient and the absolute value of the left ventricular pressure establish the severity of the stenosis and the load on the myocardium and therefore indicates the urgency of the operation. Measurement of the cardiac outputs during rest and exercise will give additional information about sufficiency or otherwise of the left ventricular myocardium. Calculation of the absolute size of the valve orifice is also possible and may be needed in some cases (Morrow et al 1958).

To determine accurately the site of the obstruction—whether at the valvular or the subvalvular level—a withdrawal pressure study of the left heart catheter is essential.

The polythene catheter is threaded through the ventricular needle and manipulated through the aortic orifice into the aorta. It is connected to the electromanometer and is made to withdraw into the subvalvular region and then into the true ventricular cavity. A running trace is taken during the withdrawal of the catheter. Subvalvular stenosis may be diagnosed with certainty by a characteristic pressure record in the subvalvular region, the systolic pressure being lower than that in the main ventricular cavity and identical to that in the aorta while the diastolic pressure is lower than that in the aorta and similar to that in the ventricle.

Surgical Correction.—Being a mechanical obstruction in the outflow tract of the left ventricle, it is obvious that relief can only be afforded by surgical correction of the abnormality. Until recently congenital aortic stenosis was considered to be a relatively benign lesion considering that patients in the early age groups can be completely asymptomatic or may have only slight fatigability with exertion. It is known, however, that lack of symptoms in early years gives a false sense of safety and that once evidences of left ventricular strain appear compensation begins to fail quickly and the clinical state rapidly goes down hill. In the Guy's Hospital series, out of 16 cases of subvalvular stenosis, there were only 3 patients beyond the age of 20 and only one beyond the age of 30. It is likely therefore that patients with congenital obstruction of the outflow tract die young. Operative correction should be advised before an irreversible state supervenes and this means that patients (as in patent ductus arteriosus) should have their operation in the early relatively asymptomatic stage.

It is recommended that operations should be advised if the pressure gradient between the left ventricle and the aorta exceeds

60 mm. Hg. - particularly if there have been one or two episodes of syncope or anginal pain in the recent past. Ordinarily in an asymptomatic patient with normal E. C. G. and radiological appearances operation can perhaps be deferred until the child is 8 to 10 years old. In our first patient, operation was decided upon at the 7th year, because the pressure gradient exceeded 100 mm. Hg. and there were evidences of left ventricular hypertrophy in the electrocardiogram. In the second patient, although operation was at first deferred because of the small gradient and lack of symptoms, there were syncopal attacks subsequently and a second catheterisation study revealed a gradient of 65 mm. Hg. Operation was therefore decided upon.

The stenotic obstruction can be tackled either by the closed transventricular route or as was done in these 2 cases by the open heart operation with hypothermia and inflow occlusion through the aortic root. For congenital valvular stenosis, the open heart operation has been generally accepted by most Cardiac surgeons (Swan et al 1956, Lewis et al 1956). The results of closed transventricular operation have been generally unsatisfactory as witness the experience of Marguis & Logan (1955). In 4 out of 6 cases in this series severe aortic insufficiency was produced, vitiating the good result of relief of the obstruction. This is not surprising since the closed operation would not allow precise anatomical separation of the congenitally fused leaflets of the aortic valve.

However, the management of the subvalvular stenosis has occasioned marked differences of opinion. Brock (1957 & 1959) has recently championed the use of the closed transventricular operation. In his series of 16 cases, seven were treated by open operation with 2 deaths and 9 by closed operation with one death. Amongst the

difficulties of the open operation that he has mentioned are the technical difficulties of attacking the subvalvular obstruction through a limited opening in the aorta, the difficulties of punching with cutting forceps from above and the difficulties of using a knife. According to him, if the site of obstruction could not be ascertained prior to operation, a withdrawal catheter study should be made on the table. If valvular stenosis is diagnosed, venovenous cooling should be instituted and open transaortic method of valvotomy should be done after inflow occlusion. On the other hand, if subaortic stenosis is diagnosed, closed transventricular operation should be performed without hypothermia.

In our two cases, we were not absolutely certain about the precise level of the obstruction prior to the operation. Withdrawal pressure study was tried in both cases but was unsuccessful. We therefore preferred the open operation as it would enable us to accurately visualize the site and type of obstruction and deal with it properly under vision.

To perfect the technique, this type of open heart operation was first tried in 6 animals. The many problems met with were gradually overcome and the last 2 animal operations were successful. We tried the exposure obtained by bilateral trans-sternal thoracotomy incision as well as that by mid line sternotomy incision. The exposure was adequate by both incisions but the latter was less traumatising and we decided to use this incision. We also concluded that the main part of the operation, namely, visualization of the stenosis and its correction could be complete in about 4 minutes without hurry.

It is too early yet to analyse accurately the results of the operation. That the

obstruction has been relieved adequately in both cases admits of no doubt. In the 1st case, the crateriform valve orifice was divided transversely by scissors up to the aortic ring and a bicuspid valve resulted. In the 2nd, the membranous type of subvalvular diaphragm was split and the opening dilated by the expanding dilator. In both cases, the index finger was introduced into the left ventricle up to the knuckle joint. We intend at a later period to repeat the catheterisation study and determine the post-operative gradient between the left ventricle and the brachial artery. In the 1st case, slight regurgitation has been produced and the pulse pressure is slightly high but the child is up and about and is none the worse for the operation. It is expected that the heart would enlarge and compensate for the slight aortic leak. In the second case, there is no regurgitation and her systolic murmur is scarcely discernible. She should have a very good result.

Summary

2 Cases of congenital obstruction of the aortic outflow tract—one of valvular stenosis and another of subvalvular stenosis are

presented. Both were operated upon by open cardiomy through the aortic root under hypothermia and with inflow occlusion. Both patients tolerated the operations well and the obstructions could be adequately relieved.

The salient features of the diagnostic criteria have been outlined. It is emphasized that the only accurate method of differentiating between the two types is to perform withdrawal pressure study from the aorta to the ventricle.

The methods of surgical correction—whether by the closed transventricular method or by the open method as practised here have been discussed and the advantages and disadvantages of each type of operation have been outlined.

For the valvular type of obstruction, the closed type of operation has little place and may produce severe regurgitation. For subvalvular stenosis, particularly of the rigid muscular or fibrous type, the closed operation may have some advantages; for the thin diaphragmatic type as in the 2nd case, the open operation will give very good results.

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BLOOD CALCIUM AND PHOSPHORUS IN SURGICAL STRESS*

BY

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Introduction

Stress in the biologic sense is the interaction between damage and defence, just as in physics tension or pressure represents the interplay between a force and the resistance offered to it (Selye 1950). Anything that causes stress endangers life unless it is met by adequate adaptive responses; conversely anything that endangers life causes stress and adaptive responses.

In 1936, it was demonstrated by a series of experiments on animals that the organism responds in a typical manner to a variety of widely different factors and infection, intoxication, trauma, nervous strain, heat, cold, muscular fatigue and X-radiation.

Tisdall and Harris (1922) observed an increase of phosphorus in surgical stress which was confirmed by Eddy and Heft (1923). They observed that this increase was associated with cicatrization of nonosseous tissues and in surgical operations. Cuthbertson (1930) had similar findings in four cases.

After this primary investigation Duncan (1943) described an increase of phosphorus due to muscular trauma. Same observations were recorded by Neufeld, Toby and Noble (1943), Mylon, Winternitz and Suto-Nagy (1943), Green (1943), Bellman and Flock (1944), Allison, Cole, Holmes and Root (1947), Willhelmi (1948), Meyer and Potter (1949).

Eliel, Pearson and White (1952) found increase of blood phosphorus in the first

four post-operative days which gradually came down to normal.

This increase of phosphorus has been shown by Cuthbertson (1942) and Beattie (1947) to be related to an increase in the urinary excretion of phosphorus and calcium, an increase of phosphorus in erythrocytes and increase in blood creatinin.

Eliel, Pearson and White (1952) recorded increased excretion of calcium in the urine in the post-operative period. They surmise that low serum calcium, and high blood phosphorus in the post-operative period are due to hyperadrenocortical activity.

Variations of blood phosphorus have been mentioned in connection with dextrose tolerance test - Pincus (1950). The pursuit meter test in fractures - Eddy and Heft (1923), Gyorgy and Sulzer (1925), Cuthbertson (1930); Postural stress - Allison and Cole (1944); ether anaesthesia - Maggie and Glenie (1927-28) Golfred, Murphy and Wilson (1950); orthopaedic operations - Howard, Parsonaand and Igham (1945); muscular trauma - Neufeld, Toby and Noble (1943).

The effect of ether and cyclopropane anaesthesia was studied by Folders, Murphy and Wilson (1950). They found that there was elevation of serum phosphorus during general anaesthesia and decrease in spinal anaesthesia. Manzanilla et al (1953) worked on Serum Calcium and phosphorus under surgical stress in one series. They found that calcium tends to go down and phosphorus has a tendency to rise.

* This is a part of the thesis submitted for M. S. Examination of Vikram University, Ujjani.

The present study was undertaken to find out the effect of surgical stress on calcium and phosphorus.

Material and Methods

In the introduction surgical stress has been defined. This condition of stress was studied in patients who underwent major or minor surgical procedures.

The patients were taken at random from the surgical wards of the J. A. Group of Hospitals, Gwalior.

The following are a few of the operations that were performed, though the list is incomplete.

1. Operation for Uni and Bilateral vaginal hydrocele.
2. Appendicectomy.
3. Lumbar Ganglionectomy.
4. Herniorrhaphy.
5. Prostatectomy.
6. Osteotomy.
7. Trendelenburg's operation for varicose veins.
8. Orchidopexy.
9. Laminectomy (General Anaesthesia).
10. Exploratory Laparotomy (General Anaesthesia).
11. Nephrectomy for Hydronephrosis.
12. Excision of Fibro-lipoma back.
13. Rib resection for Empyema.
14. Amputation for Buerger's disease.
15. Ligation of piles.
16. Skin grafting (for chronic ulcers after burns).

Observations

The normal values of calcium, and phosphorus of control cases conformed with the figures given in the text-books but they appeared more towards the higher side of the normal figures.

The values in the pre-operative blood and in the second sample taken just before the operation were almost the same. The variation in level was observed during the operation and after the operation. Five samples of blood were taken from each patient; the first sample - 24 hours before the operation, second and third samples - just before, and at the end of, the operation, respectively, fourth sample - 48 hours after and the fifth 7 days after operation. This scheme was followed in the first fifty cases.

In the second group of cases, the first, second and third samples were taken as in the first group but the fourth sample was taken 24 hours after operation and the fifth sample on the 5th day after the operation. This change was adopted to find out changes which occur (1) in the first 24 hours and (2), between the 2nd and the 5th day after operation.

Blood was taken from the patients who were operated on under spinal anaesthesia only, so that the chemical effect of the anaesthetic was as minimal as possible. The second sample of blood was taken as soon as the anaesthetic was effective. For comparison a few cases were investigated who were operated on under general anaesthesia (Induction Inj. IV Pentothal, Pethidine and

Curare and maintenance by Nitrous oxide and oxygen).

In all cases 6 ml. of blood were withdrawn each time in a dry sterile syringe (4 ml. of blood were collected in a sterile vial as whole blood and 2 ml. in an oxalated vial). Serum and plasma separated within 1-2 hours of withdrawal and were stored at 4°C.

Calcium and phosphorus were estimated according to the methods described in E. J. King's book of Micro-analysis in Medical Bio-chemistry.

Observations

(Observations were made on most of the cases who were operated on under spinal anaesthesia. A few cases who underwent operations under general anaesthesia were also investigated for comparison). We observed in some cases that changes occurred right from the beginning of operation. In others there was no change in the levels of calcium, potassium or phosphorus as a result of stress.

It was observed that in the majority of cases the calcium level recorded a fall during the operation (surgical stress), whereas the phosphorus level tended to rise during the same period. This change in the levels came back to the original values in the post-operative period.

In a certain number of cases, the phosphorus level showed a fall and the calcium level a rise during the operation.

In the first fifty cases of Plan I it was found that the calcium level comes back to the original level within 48 hours but the phosphorus does not. Phosphorus gradually falls to the original level by the seventh day. In the second fifty cases of Plan II, the fourth sample of blood was taken after twenty four hours and the fifth five days after operation to find out if any changes occur during this time. It was observed that calcium comes back to the original level within twenty four hours of operation, but phosphorus does not. However, they come back to normal pre-operative level by the fifth post-operative day in most of the cases.

Calcium

In 70 cases there was a fall during operation, varying from 0.3 mgm. to 1.6 mgm.

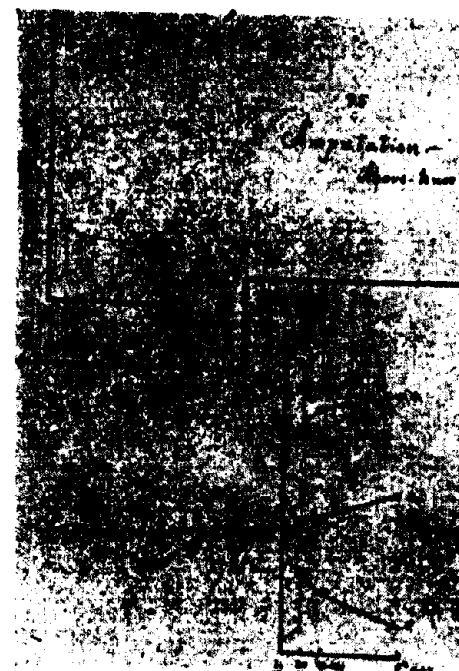
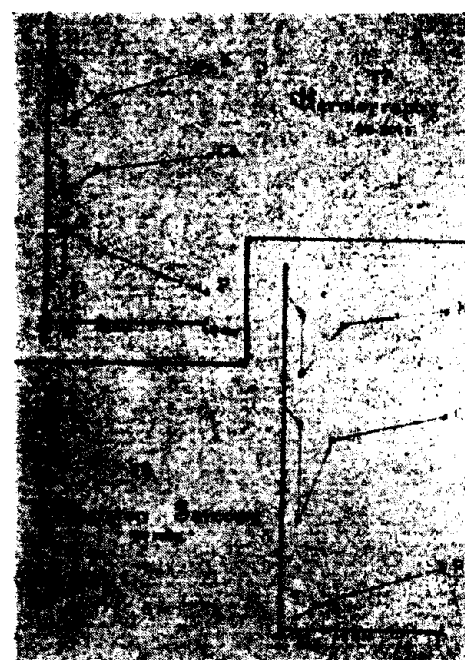
In 24 cases there was a rise in calcium level varying from 0.3 mgm. to 1.8 mgm.

In 6 cases there was no change as a result of stress.

Phosphorus

In 75 cases - there was an elevation in its level during the operation with a maximum and minimum of 2.0 mgm. and 0.1 mgm. respectively. In 20 cases a fall was observed with a maximum of 2.3 mgm. and minimum of 0.3 mgm.

In 5 cases no variation in the levels were found—



The following things are shown in the graphs

Ordinate denotes - The levels of Calcium, Potassium and Phosphorus in mgm./100 cc. of blood.
 A bscissa - Time interval. 24 hrs. (Hours) Pre-operative level.
 BO. - Before operation. AO. - After operation - *Period of Stress*.
 48 hrs. - Level at 48 hours after operation. 7th day - Level on 7th day after operation.

The behaviour of calcium and phosphorus under surgical stress as studied in relation to different age groups

A. Age group—10-20 years

7 cases were observed in this age group. A rise in the levels was observed in calcium - 2 cases; phosphorus - 7 cases. A fall in the level of calcium - 5 cases and phosphorus - nil.

No. of cases.	Rise.	Ca.	P.
7	Maximum.	1.5 mgm.	0.9 mgm.
	Minimum.	0.3 mgm.	0.3 mgm.

Age group—10-20 years

No. of cases.	Fall.	Ca.	P.
7	Maximum.	0.9 mgm.	Nil.
	Minimum.	0.4 mgm.	Nil.

B. Age group—20-30 years

30 cases were investigated in this age group.

Calcium—26 cases showed fall, rise in 2 cases. No change in 2 cases.

Phosphorus—Rise in 26 cases, fall in 2 cases. No change in 2 cases.

No. of cases.	Rise.	Ca.	P.
30	Maximum.	2.3 mgm.	2.0 mgm.
	Minimum.	0.4 mgm.	0.2 mgm.
	Fall.	Ca.	P.
30	Maximum.	3.0 mgm.	1.5 mgm.
	Minimum.	0.3 mgm.	0.3 mgm.

C. Age group—30-40 years

30 cases

Rise in the levels of calcium - 8 cases and phosphorus in 22 cases.

Fall in the levels of calcium in 22 cases and phosphorus in 8 cases.

No. of cases.	Rise.	Ca.	P.
30	Maximum.	1.0 mgm.	1.4 mgm.
	Minimum.	0.3 mgm.	0.1 mgm.
	Fall.	Ca.	P.
30	Maximum.	2.6 mgm.	2.5 mgm.
	Minimum.	0.4 mgm.	0.4 mgm.

D. Age groups—40-50 years

16 cases

Calcium showed a rise in 4 cases and fall in 12 cases.

Phosphorus showed a rise in 13 cases, fall in 2 and no change in 1.

No. of cases.	Rise.	Ca.	P.
16	Maximum.	1.5 mgm.	1.0 mgm.
	Minimum.	0.3 mgm.	0.2 mgm.
	Fall.	Ca.	P.
16	Maximum.	1.2 mgm.	1.0 mgm.
	Minimum.	0.2 mgm.	0.3 mgm.

E. Age group - 50 years and above 17 cases

Calcium showed a fall in 16 cases and rise in 1 case.

Phosphorus level rose in 15 cases and fell in 2.

No. of cases.	Rise.	Ca.	P.
17	Maximum.	0.9 mgm.	0.9 mgm.
	Minimum.	0.3 mgm.	0.3 mgm.
	Fall.	Ca.	P.
	Maximum.	1.2 mgm.	1.1 mgm.
	Minimum.	0.3 mgm.	0.4 mgm.

The behaviour of the minerals under surgical stress—as studied in relation to duration of operation

The duration of the operation meant the period between the effectiveness of the spinal anaesthetic to the closure of the wound.

The duration of operation was divided into 3 groups.

- (1) 0-30 minutes.
- (2) 30-60 minutes.
- (3) 60 minutes and above.

I. Duration of operation—0-30 minutes.

A total number of 26 cases were investigated in this category. Calcium registered a fall during stress in 20 cases, a rise in 4 cases and no change in 2 cases. Phosphorus showed rise in 20 cases, fall in 5 cases. No change in 1 case.

II. Duration of operation—30-60 minutes.

48 cases were studied in this group. Calcium showed fall in 34 cases rise in 11 cases and no change in 3 cases. Phosphorus showed rise in 39 cases fall in 5 cases and no change in 4 cases.

III. Duration of operation—60 minutes and above.

Fall in levels of calcium
—14 cases; Phosphorus—3 cases.
Rise in levels of calcium
—2 cases; Phosphorus—14 cases.

There was no change in calcium level in 1 case.

There were some variations from the usual pattern in certain cases. In one case, calcium level rose during and even after the operation, eventually coming down to normal. Like this there were a few more variations which could not be accounted for.

Discussion

Cuthbertson (1932) said that metabolic disturbances are independent of the use of anaesthetics but manipulation produces more metabolic changes than direct injury. Cuthbertson (1936) found in patients after injuries to bones that there was an increase in the excretion of phosphorus which though less than the increase in the excretion of nitrogen and sulphur was related to it in time. From these observations he concluded that the urinary excretion of phosphorus after injury was due to katabolism of tissue, probably muscle. Howard et al (1949) have reported contrary to this—the quantity of phosphorus is not exactly what is expected if all the excess of these substances came from the same tissue source and metabolised muscle. Surgical stress activates the pituitary—cortico adrenal and medullo-adrenal systems, which deal with the secretion of corticoids and epinephrine—according to the studies of Roche, Hills and Thorn (1950); Eliel, Hellman, Pearson and Kats (1951).

Tisdall and Harris (1922) observed an increase of blood phosphorus. This was confirmed by Eddy and Heft (1923) who

also observed this increase associated with the cicatrization of nonosseous tissues and in surgical operations. Cuthbertson (1930) confirmed the observation in 4 cases. Duncan described an increase of phosphorus due to muscular trauma. The same observations were observed by Neufeld, Toby, and Noble (1943), Winternitz and Suto-Nagy (1943), Green (1943), Bellman and Flock (1944).

They thought that the electrolyte comes from tissue cells distal to the site of trauma that are damaged during the period of operation. The augmented serum phosphorus may be an expression both of a major discharge of this electrolyte in the circulation and a coincident depression of the kidneys to eliminate it. Total serum calcium is practically unaffected but ionized calcium is slightly changed. The effects observed are caused by surgical stress, since variation has been produced during the stress period, with return to prestress level within the fifth day of operation. In the present series the reaction of calcium and phosphorus are equally marked. Manzanilla et al (1953) report that they found more changes in serum phosphorus than in serum calcium during stress.

In considering the inherent factors in surgical stress that may cause the changes in blood phosphorus and account for the variations observed, the following factors may be taken into account:—

Local.—During operation, tearing of tissues and cutting of blood vessels occur, causing ischaemia and anoxia. Shorr (1943) observed in vitro the effect of the anoxia, manifested by an increase of phosphorus and a decrease of phospho-creatinin. Allison, Cole and Holmes (1947) conclude that the increase of phosphorus is caused by the destruction of muscular phospho-creatinin.

General.—Surgical operation produces general effects throughout the anteropituitary

—cortico—adrenal systems and perhaps in part through the parathyroid, which in turn modifies cortico-adrenal function. The effects produced by ACTH and corticoadrenal hormones on serum phosphorus and its excretion are contradictory, some authors observed an increase after ACTH administration, others a decrease, and still others no variation. The action of the pituitary gland on blood phosphorus appears to be due to the growth hormone, since it has been shown that hypophysectomy produces a decrease in blood phosphorus.

Manzanilla et al (1953) observed low serum calcium and raised serum phosphorus during stress. They also observed that serum phosphorus increases in young persons and decreases in old persons. However, in the present series this relation of increase and decrease with age was not found. Even in the cases in which the general factors mentioned were responsible for the variation observed in this work, it does not explain the reactions of increase and decrease.

Summary

Surgical stress is defined as the condition of stress when a person undergoes a surgical operation. During the condition of stress there is disturbance in the levels of different electrolytes in the blood.

Blood calcium and phosphorus were investigated in 100 cases who underwent operation in the J. A. Group of Hospitals, Gwalior. The calcium level goes down during the operation and the phosphorus level goes up. The variations are explained by the activation of pituitary corticoadrenal systems.

Acknowledgement

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SACRO-COCCYGEAL TUMOURS AND CYSTS

BY

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The term 'sacrococcygeal tumour and cysts' has been used loosely to cover a wide range of tumours and cysts round about this region. Though the term seems to be mainly a topographical one, yet by a common understanding it is applied to tumours arising from embryonic structures or of a complex nature *e.g.* a Teratoma. In the following discussion the common connective tissue or epithelial tumours are not included. Tumours can arise over the posterior aspect of the sacrum, between the tip of the coccyx and the anus, and in front of the sacrum, *i.e.* between the rectum and sacrum and even in the rectum itself.

The sacrococcygeal area is one of the commonest situations for teratoma and teratomata are perhaps the commonest of all tumours here. Our knowledge of these interesting tumours is far from complete. Perhaps because of the many embryological events taking place in this situation teratomata are so common here. In our series teratomata were found in 6 out of 8 cases.

The classification of the tumours of the sacrococcygeal region has been done in many ways. They have been classified according to the original structure from which they arise and also according to the anatomical situation. The actual pathological nature of the tumour must also be taken into consideration. Lahay and Eckerson² have classified these tumours on the combined basis of anatomical site and embryological nature. Bacon¹ classified these tumours according to the structure they arise from. Raven⁴ has given a comprehensive classification.

While it is quite easy to diagnose a teratoma in this area it is difficult to trace the site and the tissue of origin of the uncommon tumours. Tumours other than teratomata could be classified as follows:

The tumours entirely posterior to the sacrum could be classified into (a) tumours from obliterated portions of the medullary canal and (b) tumours from 'sequestered' skin *e.g.*, pilonidal cyst. Of these the pilonidal cyst is the commoner.

Tumours anterior to the sacrum could be classified into (a) tumours from the neurenteric canal (b) tumours from the post-anal gut (c) tumours from the proctodaeal membrane and (d) tumours from the remnants of the notochord. This classification combines the anatomical location with the tissue of origin of the tumours.

For the sake of completeness we have to mention (a) parasitic foetuses and (b) connective tissue tumours.

In our discussion we have confined our attention to the anterior sacral tumours as they are more important.

Though not actually a tumour in the pathological sense a meningocele could present through one of the sacral foramina—quite a rare event. Raven mentions and illustrates one such case.

Tumours from the neurenteric canal

Tumours arising from this structure are very rare. Galletly (quoted by Raven) states

that simple presacral cysts lined by squamous or columnar epithelium probably originate from the cells of the neurenteric canal.

Tumours of the post anal gut

The post anal gut lies dorsal to the cloaca. Tumours of this structure, therefore, arise in the antesacral (or retrorectal) area and may present between the anus and the tip of the coccyx. Middleroff, quoted by Lahey and Eckerson², was the first to have recognised the post anal gut as the site of cystic tumours. These have also been called 'congenital cystic sarcoma of Braune'. These cysts are lined by columnar epithelium, which may even show ciliation in some places. Mucous glands may also be present. Malignant tumours arise from these and it is possible to confuse malignant tumours arising from this structure with teratomata where one sided development is marked. One of the cases described herein belongs to this group.

Tumours of the proctodeal membrane

Lahey mentions in his article the possibility of such a tumour. But he does not give its histological characteristics. Perhaps an ante sacral dermoid which arises from inside the anal canal may be styled as a tumour arising from the proctodeal membrane.

Tumours from the notochord

Much literature has accumulated about tumours arising from the notochord. These tumours (chordoma) are locally malignant. The most characteristic feature of the tumour are the 'physaliparous' cells.

Sacrococcygeal teratoma

It has been already stressed that teratomata are the commonest of tumours here.

These have been grouped and often unnecessarily confused with dermoids. Both are common. One should not arrive at a histological diagnosis of teratoma unless one can demonstrate derivatives from more than one layer. Teratoma can arise either posterior or anterior to the sacrum; in the latter case it can arise in the rectal wall itself. As in teratomata elsewhere the aetiological factors of these tumours are not known. There is no special age predilection for these tumours. They are more common in the female.

Pathological Nature

Many of these tumours are benign to start with, excepting a few like chordoma which are always malignant. But as far as teratomata are concerned it has been stated that one third of the subjects are born dead and 90% die within a few days (Bacon¹).

Teratomata may undergo malignant changes—usually affecting one of the germ layer derivatives. The type of malignant change most common is a denocarcinoma. But others like papillary adenocarcinoma, 'alveolar sarcoma', embryonal adenocarcinoma, and chondrosarcoma have been recorded (Bacon¹, Lisco³).

Signs and Symptoms

Tumours of the sacrococcygeal region do not have any special signs or symptoms. Frequently the patient comes mainly because of the physical handicap due to a large swelling in the gluteal region. Difficulty in defaecation and very occasionally bleeding per rectum have also been recorded. Even urinary retention due to a large mass is not uncommon. Table I gives an analysis of the cases under discussion. Some of these case records have been given in detail.

TABLE I

S. No.	Sex Age.	Duration.	Path. Report.	Remarks.
Case I	F. 7 years.	Since childhood.	Teratoma.	Operated.
Case II	M. 3 days.	do.	...	Not operated due to extensive anomaly of genitalia (Fig. 1).
Case III	F. 10 years.	do.	Teratoma.	Operated.
Case IV	M. 7 months.	2 months.	Dermoid.	Operated.
Case V	F. 2 years.	3 months.	Carcinoma.	Operated.
Case VI	F. 30 years.	6 months.	Teratoma.	Operated.
Case VII	M. 10 months.	Since birth.	Teratoma.	Operated.
Case VIII	M. 10 days.	do.	Teratoma.	Operated.

The diagnosis does not present any difficulty. Usually at the stage in which the patient comes it would be difficult to indicate the exact anatomic site of origin (due to the large size of the mass).

A plain skiagram of the sacrococcygeal region may show (a) the presence of radio opaque structures like bone or imperfectly formed teeth and (b) erosion of the sacrum as a proof of the malignant nature of the tumour.

A Ba. enema or I.V. pyelography may be useful, where gross pressure on the rectum or bladder is suspected.

Treatment

The only available treatment for sacrococcygeal tumour is surgery. No form of radiotherapy is useful due to the complex nature of these tumours. Surgery is usually possible only in a few cases. In others, some form of surgery will offer palliation.

The tumour can be excised from the perineum or per abdomen. In some cases Kraske's approach or its modification is useful. But even the benign tumours because of the large size and the situation are often difficult to excise in toto at one stage. Much more so are the malignant tumours.

Details of Some of the Cases

Case IV.—A male baby aged 7 months was brought with the complaint of a tumour that was coming out of the anus ever since the age of 5 months. On examination there was a small tensley cystic tumour entirely covered by skin attached by a thin pedicle of skin to the anal canal. The mass had just come out of the anus.



Fig. 1
Showing Case No. II note the extensive genital anomaly.



Fig. 2
Showing the structure of the dermoid
in Case IV.



Fig. 3
Showing the adeno-carcinomatous pattern
in Case V.



Fig. 4
Showing the massive size to which these tumours attain, Case VII.



Fig. 5
Showing the large size of the tumour in Case VIII, in a baby ten days old. There was not any difficulty during delivery—a creditable performance!

The mass was excised and it had the typical structure of a dermoid.

Because of its situation at the upper level of the anal canal this is most probably a dermoid arising from remnants of the proctodeal membrane.

Case V.—A female child aged 2 years was admitted in September, 1955, for a swelling in the sacro-coccygeal region—since three months. There was no other complaint. Examination revealed a cystic swelling situated practically over the tip of the coccyx. Rectal examination did not reveal any abnormality. A plain x-ray did not reveal any radio opaque shadows. At operation it was found to be quite superficial. A study of the tumour revealed it to be an unilocular cyst with a smooth wall except at the floor—where there were 'velvety' projections. The pathology report was 'adenocarcinoma'.

The child was kept under observation. Four months after the operation the child was brought in with enlarged inguinal glands. Surgery was advised and refused. A month later the child was admitted with more marked enlargement of glands in both groins. A 'bloc' dissection was done on both sides; histologic examination revealed a picture of an adeno-carcinoma identical with the original tumour.

We can consider the tumour to be a teratoma where the entodermal layer has undergone malignant change and resulted in an adenocarcinoma. But we should then be able to demonstrate tissue of epiblastic and mesoblastic origin. Unless this is definitely shown we cannot postulate a unilateral development of a teratoma. But from published reports of previous cases it is well known that when a teratoma undergone malignant changes the usual histological picture is that of an adenocarcinoma. Case Reports published by Lisco and others illustrate this.

The one other possibility is that the case could be one of an adenocarcinoma arising from the remnants of the postnatal gut. Since an examination of the original tumour did not reveal any other tissue it is not unreasonable to suppose that this was a case of an adenocarcinoma arising from remnants of the post anal gut. The actual anatomical location of the tumour also lends support to this supposition.

Case VI.—This patient, a female aged 30 years, was admitted for bleeding per rectum of six months' duration. There was nothing obvious externally. Rectal examination revealed a very hard mass situated on the left posterolateral wall of the rectum. A tuft of hair was felt projecting from the tumour.

A plain skiagram of the abdomen revealed radio opaque shadows in the pelvis just in front of the sacrum. A lateral view did not reveal any attachment to the sacrum. The tumour was approached by excising the coccyx and the lowest piece of the sacrum; on incising the posterior rectal wall the tumour was seen and dissected out. The wound was closed with a drain. Her post operative period was complicated by (a) inability to pass urine for nearly two weeks and (b) slight discharge of faecal matter through the wound. But these were only temporary.

Pathology Report.—The specimen revealed a partly cystic and partly solid tumour containing a few ill-formed teeth. Microscopic examination revealed 'squamous epithelium, connective tissue and bony trabeculae—structure is that of a teratoma'.

Summary

A brief description of sacrococcygeal tumours is given. A record of eight cases is presented with full details in some of the more interesting ones.

My thanks are due to Dr. C. P. Viswanatha Menon, M.S., F.R.C.S., and to the late Lt.-Col. C. R. Krishnaswami under whom all these cases were admitted. My thanks are also due to the Dean of the Government General Hospital, Madras for permission to publish these cases.

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PRIMARY MALIGNANT LYMPHOMA OF THE GASTRO-INTESTINAL TRACT*

BY

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Although malignant lymphoma is usually a generalized disease, it does have a localized form or stage¹. Localization has been reported in all types of lymphoma. Gall and Mallory¹⁰, reported that 11% of cases in their large series were confined to one structure.

It is possible that some of these tumours have a local origin and, from such a nidus, invade and destroy the organ in which they arise¹. They spread primarily by direct extension or along lymphatic channels to the regional lymphnodes. Distant metastases occur late⁹.

Various figures in the literature show that carcinoma is far more frequent than lymphoma in the gastro-intestinal tract, except in the small bowel, where the two have been reported with equal frequency¹.

Involvement of the stomach in a localized process is much more frequent than that of the rest of the gastro-intestinal tract¹. The first case was reported by Cruveilhier⁴ in 1871. Forni (1914), Taylor²⁶ (1937), Snoddy²³ (1952), Crile, Hazard, Allen⁵

(1952) have reported various series of such lesions of the stomach. The term applied to the neoplasm was lymphosarcoma^{10, 15, 16, 21}.

Singleton and Moore²² (1949), Marcuse and Stout¹⁴ (1950), and Sperling²⁴ (1954), reported this disease in the small bowel, in the comprehensive reviews of lymphomas of the entire gastrointestinal tract.

These tumours, though comparatively rare, are being reported with increasing frequency in the literature. They offer great diagnostic difficulties. They occur in comparatively younger age groups. Gastric lymphosarcoma produces an ulcer-like syndrome and many times it is difficult to exclude carcinoma. Ileo-caecal lymphomas may give a picture of abdominal tuberculosis or intestinal obstruction.

The terminology of these tumours has not been standardized¹². Descriptive cellular classifications of the lymphoblastomatous tumours have been suggested by different authors. These classifications are primarily based on the predominant cell in the tumour (Table I).

Table I—Classification

Mayo Clinic.	Gall and Mallory	Jackson and Parker.
Small round cell lymphosarcoma ...	Lymphocytic lymphoblastoma. Lymphoblastic lymphoblastoma.	Lymphocytoma. Lymphoblastoma.
Large round cell lymphosarcoma... (or reticulum cell lymphosarcoma).	Stem cell lymphosarcoma. Clasmatocytic lymphosarcoma.	Reticulum cell Sarcoma.
Hodgkin's disease ...	Hodgkin's lymphoma. Hodgkin's Sarcoma.	Hodgkin's paraganuloma. Hodgkin's granuloma. Hodgkin's Sarcoma.
Giant follicular lymphoblastoma ...	Giant follicular lymphoblastoma.	Giant follicular lymphoblastoma.

* (The paper was presented at the scientific session of the Annual Conference of the Association of Surgeons of India, held at Jaipur in 1959).

We encountered three such patients during the last one year.

Case No. 1.—K. S. 40 years, Hindu male was admitted on December 17, 1958 with pain in the epigastrium, which was being relieved after taking meals, for the last eleven months. This pain had become continuous and there had been loss of appetite, marked loss of weight and constipation for the last six months. During this pain he often felt nausea, but never vomited. There had been no episode of haematemesis or melena.

He had been diagnosed as a case of peptic ulcer and had received antacids, antispasmodics and milk diet. The symptoms had become progressively worse.

On physical examination, he was a fairly built individual and did not look anaemic. There were no palpable lymph nodes.

There was a firm, partly mobile, mass, 4" × 5", in the region of the left hypochondrium and epigastrium. The liver was just palpable below the costal margin and was firm in consistency. The spleen was not palpable. The heart and lungs were normal.



Fig. 1

Barium meal showing a constant filling defect, very suggestive of Carcinoma.

The blood picture was within normal limits. The E. S. R. was 13 mm. fall for the 1st hour (Wintrobe). The blood urea was 19 mgm%. Stool examination was positive for occult blood. Urine contained a few oxalate crystals. Fractional test meal showed a high total acidity with blood and mucus in all the specimens.

Barium meal showed a constant filling defect; very suggestive of carcinoma (Fig. 1).

With a preoperative diagnosis of carcinoma of the stomach, he was operated upon on 22nd December 1958. There was a large tumour mass in the region of the pyloric antrum. Distal, radical sub-total gastrectomy was performed.

Gross examination of the resected stomach, revealed a large infiltrative type of growth near the distal end of the stomach, with ulceration, measuring about 2 cms. in diameter. The wall of the stomach was diffusely thickened (Fig. 2).

On microscopic examination, there was a large tumour mass occupying the submucosa and in one portion completely replacing the muscle coat, made up of cells with rounded outlines, scanty cytoplasm and deeply staining round nuclei. Cells were arranged in sheets with scanty stroma. The mucosa was raised and ulcerated (Fig. 3).

In some places the deeper layers were partly infiltrated.

Histopathological diagnosis was malignant lymphoma of the stomach with ulceration (Fig. 4).

The post operative course was uneventful.

He attended the out-patient's section during the first week of December 1959. He is symptom free and feels much better.

He was not given any irradiation.

Case No. 2.—B. S., 30 years, Hindu male, was admitted on 5th November 1958, with low grade fever, weakness, cough and gradually increasing lump in the abdomen for the last two and a half months.

On examination, he was an anaemic young man of thin build. There were no palpable lymph nodes. There was shifting of the trachea to the left and there were crepitations in the left upper and middle pulmonary zones.

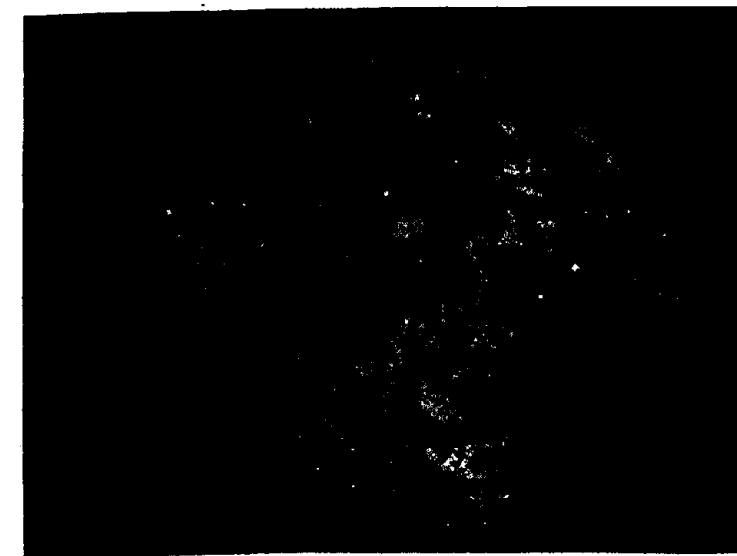


Fig. 2

Large infiltrative type of growth with ulceration.

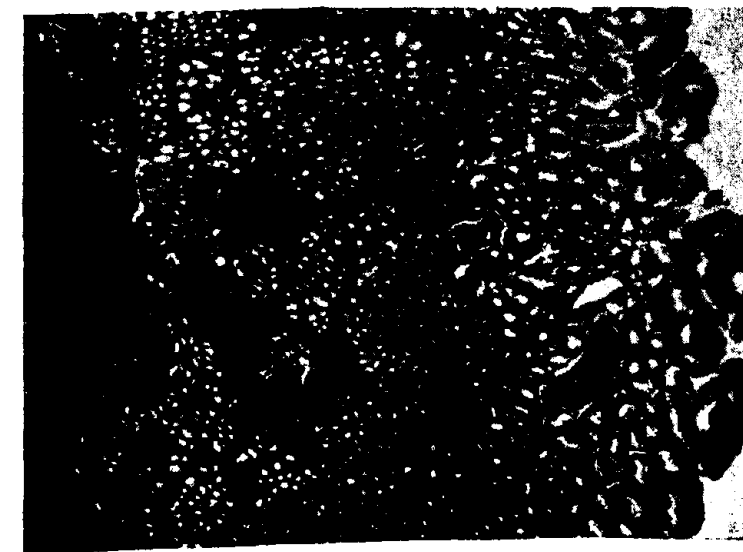


Fig. 3

Microphotograph showing large tumour mass occupying the submucosa and replacing the muscle coat.

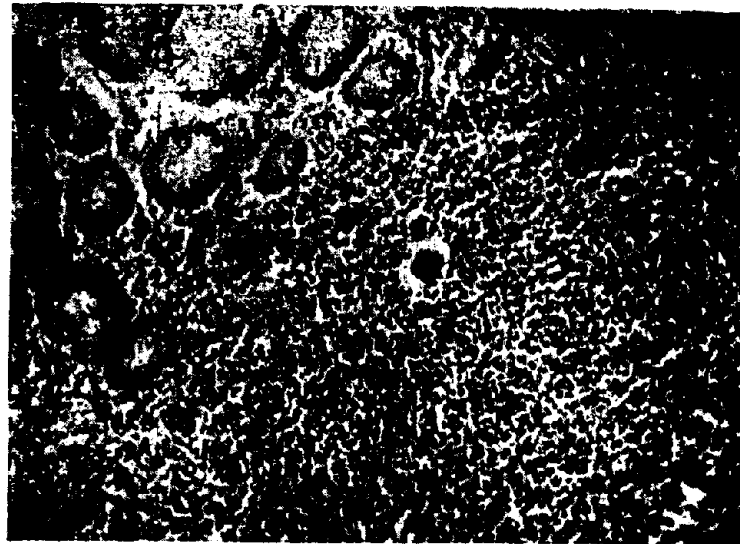


Fig. 4
Microphotograph showing the tumour, made up of cells with rounded outline, scanty cytoplasm and deeply staining round nucleus. Cells are arranged in sheets with scanty stroma.

The liver was tender and just palpable below the costal margin. The spleen was not palpable. There was a firm, tender, partly mobile mass in the right iliac fossa, measuring 4" x 4". Blood picture showed normal total and differential white cell counts and total R.B.C. 2.8 mil/cm. and 7.5 gm% haemoglobin. E. S. R. was 98 mm. fall in 1st hour (Wintrobe).



Fig. 5
Chest skiagram showing infiltration and cavitation in the left upper zone.

Sputum contained acid fast bacilli on smear examination. Skiagram of the chest revealed infiltration with probable cavitation in the left upper zone (Fig. 5).

Barium enema showed a deformity with incomplete filling of the caecum and ascending colon. Appearance was very suggestive of either malignancy or tuberculosis (Fig. 6).



Fig. 6
Barium enema showing incomplete filling of the caecum and ascending colon; very suggestive of malignancy or tuberculosis.

He was put on antitubercular treatment (Streptomycin 1 gm. O. D. and P. A. S. 3 gm. Hourly).

After two months of this treatment the patient's condition progressively deteriorated and he started having obstructive symptoms.

A laparotomy was performed with a preoperative diagnosis of ileocaecal tuberculosis. There was a firm mass in the ileocaecal region. There were no glands. As the patient could not stand a resection, an ileo-transverse colostomy was performed. The patient was continued on the antitubercular treatment.

He did not show any improvement. After an interval of 2 months, he was explored again on 9th March, as he showed signs of obstruction. Loops of bowel were adherent to the mass in the right iliac fossa. A piece from the involved bowel was removed for histopathological examination and the abdomen closed, as the patient's condition was too poor for any extensive resection. The ileocolostomy stoma was patent.

Histological examination revealed the entire tissue, to be wholly composed of tumour. The cells were arranged in sheets with scanty stroma. The cells were fairly uniform, with a vesicular nuclei, prominent nucleoli and scanty cytoplasm. Occasional mitotic figures were seen. Tumour cells were seen infiltrating the lymphatic channels. There were no giant cells. The diagnosis was malignant lymphoma, lymphosarcoma (Fig. 7).

The patient improved slightly in the post-operative period and was discharged on 31st March 1959. He has not been contacted since then.

Case No. 3.—B. D. 25 years old, Hindu, female was admitted on February 5, 1959 with pain in the abdomen, loss of weight and amenorrhoea for the last one year. The pain was colicky in nature and was accompanied by vomiting. She had lost a considerable amount of weight. She had been getting low grade fever for the last ten months. There were frequent episodes of alternate constipation and diarrhoea.

On examination, she was a very thin, emaciated and anaemic young lady. There were discrete, firm and tender lymph nodes on both sides of her neck. Heart and lungs appeared normal. Loops of intestine both visible peristalsis could be seen in her abdomen, and a firm tender mass (3" x 2") could be felt in the right iliac fossa. The spleen and liver were not palpable. Pelvic examination was negative.

The blood picture showed a moderate degree of anaemia and the white cell count was within normal limits. E. S. R. was 46 mm. fall for the 1st hour (Wintrobe). Bone marrow was normal. Skiagram of the chest did not show any active pulmonary lesion. Biopsy of one of the cervical lymph nodes showed a chronic inflammatory type of reaction. Barium enema showed an irregular filling defect in the caecum and ascending colon, very suggestive of tuberculosis (Fig. 8).

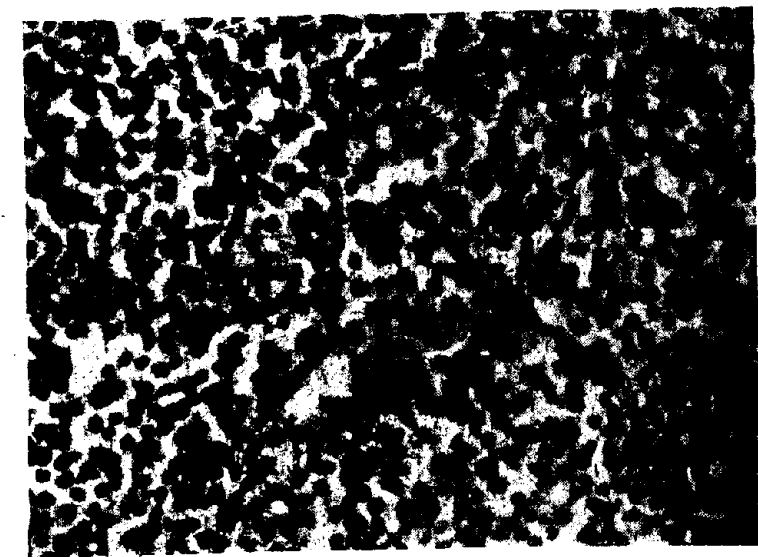


Fig. 7
Microphotograph showing fairly uniform cells, with vesicular nucleus and scanty cytoplasm. Cells arranged in sheets with scanty stroma.



Fig. 8
Barium enema showing irregular filling defect in the caecum and ascending colon.

She was put on antitubercular treatment (Streptomycin 1 gm. O.D. and I.N.H. 100 mgm. T.D.S.).

She had two episodes of subacute intestinal obstruction, which were managed by suction and intravenous alimentation.

She was operated upon on 12th February 1959. The lesion was confined to the terminal ileum and caecum. Right hemicolectomy was performed with end to end anastomosis.

On gross examination the mesentery contained numerous enlarged firm lymph nodes averaging

1 to 2 cms. in diameter. They were firm, non-matted and the cut surface was uniformly pinkish grey. The terminal ileum showed a thickened and partly stenosed segment approximately 12 cms. long. The gut proximal to this was thinned out and dilated. On opening the indurated portion, the wall was seen to be markedly thickened, measuring upto 3 cms., and completely replaced all round the circumference by a firm, grey, pinkish tumour. The lumen was markedly narrowed and the mucosa completely ulcerated (Fig. 9).



Fig. 9
Thickened and stenosed bowel segment with complete ulceration of mucosa.

Microscopically the mucosa was ulcerated in places. The entire thickness of the wall was infiltrated by tumour tissue made up of large mononuclear cells, lymphocytes and stray eosinophils. There were very many giant cells of the Reed-Sternberg type. Some of these were of bizarre type. Mitotic figures were present in abundance. Regional lymph nodes were completely replaced by the tumour. The diagnosis was Hodgkin's sarcoma (Fig. 10).

The post-operative period was uneventful. Two weeks after the operation she was given a course of deep X-Ray therapy. She was discharged in April free of all symptoms and markedly improved in her general condition. She had been contacted since then and is alive and well.

Comments

Lymphosarcoma of the stomach is said to occur more frequently in the younger age groups. The average age in Marshall and Meissner's¹⁴ cases has been 43 years. Farmer and Hertzog⁷, however, have reported a higher average age. Our patient was only 40 years old. Sex incidence is predominantly male in the literature.

The presenting symptoms are very much like those of an ulcer, as in this case.

Burning epigastric pains, nausea, vomiting and weight loss are common. Hematemesis and melena may occur. There was marked nausea but no vomiting, hematemesis, or melena in our patient. A mass is often palpable. Gastric analysis differs significantly from cancer, in that the large majority of these cases show free HCl, ranging from 70 to 90 units¹. Similar findings have been reported by McSwain and Beal¹⁷ and Warren and Lubenski¹⁸. In spite of a recent enthusiastic report¹², Papanicolaou smears have very limited value in diagnosis.

Roentgen studies are the best diagnostic aids.⁹ The majority of the authors conclude that the process cannot be differentiated from carcinoma. Certain findings, however, are strongly suggestive: giant rugal folds, extensive involvement with little peristaltic impairment, multiple gastric ulcers and a large gastric ulcer in a young patient^{3, 5, 6}.

Gastroscopy and biopsy may be of help in some cases¹. The gross appearance of

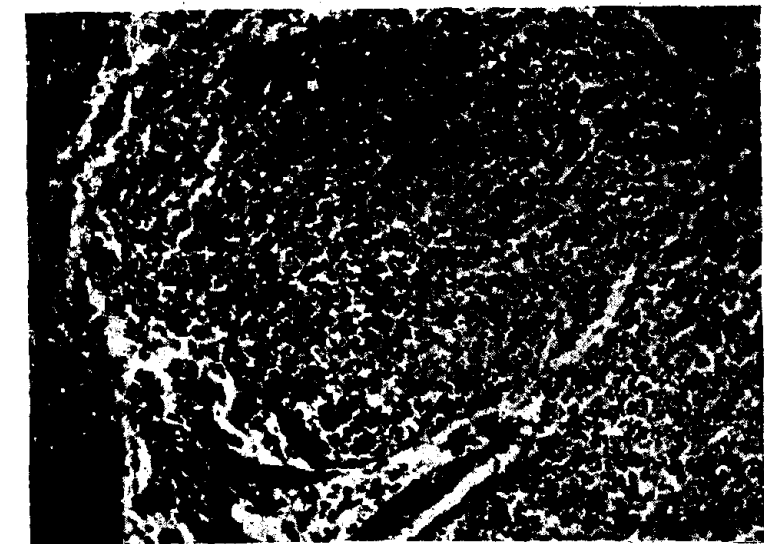


Fig. 10
Microphotograph showing large mononuclear cells, lymphocytes, and giant cells of Reed-Sternberg type. Abundant mitotic figures.

lymphoma of the stomach is often indistinguishable from that of carcinoma. The lesion may be localized ulceration with irregular heaped margins, a fungating or annular growth or diffuse infiltration with thickening. The cut surface is usually grey to light yellow in colour, homogeneous and glistening. There is no great propensity to undergo necrosis or haemorrhage. Involvement of the lymphnodes may be indistinguishable from that of a malignant process.

The published reports of others,^{4, 17, 18, 27, 28, 29, 30, 36} strongly suggest that isolated lymphoma of the stomach and the bowel does not have the pessimistic outlook indicated by Minot and Issacs¹⁸, 30 years ago. Wide surgical excision remains the primary form of therapy⁹. Survival figures range from 42%¹⁸ to 53%²⁷ in 5 year follow-ups. The prognosis is considerably better than that of carcinoma. Our patient, almost 1 year after resection is alive and well. However, it is known that untreated cases may run a slow course, and survival of over 10 years has been reported²⁶.

Ileocaecal lymphomas may invoke epigastric or mid abdominal pain and general malaise in early stages⁹. Later, signs of intestinal obstruction may predominate. A mass is often palpable most commonly in the right side of the abdomen. Weight loss may be a marked feature. Radiologic studies may demonstrate an ileocaecal filling defect. Ileocaecal tuberculosis, not being a rare disease, often may be the first diagnosis. Both of our cases were suspected as tuberculosis and treated as such. The picture was more confusing in the second case, as he had a lesion in the lung with positive sputum. It is difficult to differentiate the two lesions even on gross examination. Both may show ulceration with marked thickening

of the wall. Caseation, tubercles and calcification, if seen, will be in favour of a tubercular pathology. Right hemicolectomy with resection of adjacent lymph-nodes, is the accepted form of treatment.

The value of post-operative irradiation therapy is not entirely proven. At one extreme Yarnis and Colp²⁹ favour radiotherapy over total gastrectomy in gastric lymphoma, Allen and Donaldson¹ advocate its routine use in post-operative patients, Holmes¹¹; Dresser and Camp¹¹, however, warn us of the danger of haemorrhage and perforation in irradiation of these organs. Our third patient, received post-operative irradiation.

Attempts at chemotherapy with nitrogen mustard and TEM have not produced satisfactory results⁹.

Summary

A short review of the literature on the primary malignant lymphomas of the gastro-intestinal tract has been given and three cases have been reported. The lesion in the stomach could not be differentiated from malignancy. The patient, a 40 year old male has remained well for one year following surgery. The two cases in the ileocaecal region were treated as tuberculosis, prior to surgical exploration. One of them has been followed up and has remained well for 8 months. Resection is the treatment of choice in these cases.

Acknowledgements

We wish to express our thanks to Dr. E. J. Lazaro for permitting us to include one of his cases in this report and the Pathology Department of the All-India Institute of Medical Sciences, New Delhi for their help in the histopathological study of these tumours.

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RETROGRADE GASTRO-JEJUNAL INTUSSUSCEPTION*

BY

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Retrograde gastro-intestinal intussusception, following gastro-enterostomy, is a rare pathological phenomenon.¹¹ Since the first case report of such a condition in 1917¹², several additional reports have appeared in the literature^{3, 6, 10, 12, 14}. Till to date eighty cases of retrograde intussusception of the loop of jejunum into the stomach through the gastro-enterostomy stoma have been published^{4, 14}. The majority of these cases had occurred following a simple gastro-enterostomy but cases have also been reported following a subtotal gastrectomy^{7, 13, 14}.

The case of jejuno-gastric intussusception, which forms the basis of this report, was similar to the ones already reported in the literature, except that it occurred fifteen years after the gastro-enterostomy and is the first case of its kind reported in India.

Case Report

K. N., 50 years male cook was admitted on 19th November, 1958 with severe abdominal pain and vomiting of one day's duration. He had been operated upon at Stanley Hospital, Madras, for what appeared to be pyloric obstruction (vomiting, distension and pain after food). The immediate post-operative period had been uneventful. One year after the operation he was in Pondicherry Hospital, for forty days, with severe vomiting. He had six repeated hospitalizations then for varying intervals, for similar complaints, in different hospitals.

He always had mild pain and had taken Aldrox, two bottles a month, almost regularly.

The last episode, which brought him to the hospital this time, was marked by recurrent, upper abdominal, colicky pain and persistent vomiting. The vomit was greenish red to start with but later had become blood-stained.

On examination, he was a middle aged man of fair build. He looked anaemic and toxic. Pulse rate was 68/min. and B. P. was 120/80 mm. of mercury.

*Paper presented at the Annual Conference of the Association of Surgeons of India, held at Visakhapatnam in December, 1958.

Abdomen showed a well healed, right paramedian scar, with no masses or peristalsis. There was slight tenderness in the upper abdomen. Blood picture showed 8.5 gm.% Haemoglobin and Total leucocyte count of 10,500/cumm.

On 20th November, 1958, slight rigidity had appeared under the left rectus muscle. Conservative management by continuous gastric suction and intravenous alimentation was continued. A vague mass was palpable in the epigastrium and left hypochondrium. Roentgenogram of the abdomen showed, no free gas under the diaphragm and a convex shadow above the fluid level in the stomach suggestive of a bowel loop (Fig. 1). Attacks of pain continued and visible peristalsis appeared in the upper abdomen, moving from left to right. A pre-operative diagnosis of retrograde gastro-jejunal intussusception was made.

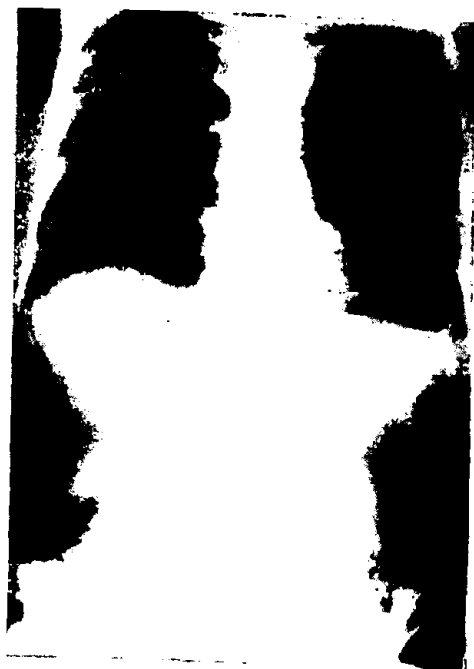


Fig. 1
Roentgenogram showing a convex shadow above the fluid level in the stomach, suggestive of bowel loop.

He was operated upon on 21st November, 1958, through the old scar. It was not obvious immediately what was wrong. There was no dilatation of the loops of small intestine. On everting the transverse colon, the efferent loop of the jejunum of the gastro-enterostomy was found invaginating into the stomach (Fig. 2). The stomach was palpated and found to contain loops of small bowel (Fig. 3). By a process of gentle squeezing and manipulation, the loops were reduced. The last loops appeared partly devitalized and got damaged during the manoeuvre; and so about eighteen inches of small bowel was resected and end to end anastomosis performed. 300 cc. of blood was given during the operation. The post-operative course was uneventful and he was discharged from the hospital almost symptom free.

Discussion

Retrograde jejuno-gastric intussusception of the efferent jejunal loop is a rare sequel of gastro-enterostomy. It seems to be still rarer following a sub-total gastrectomy¹⁵.

The etiology of this condition has not been determined satisfactorily⁶. Among the more accepted views, it has been suggested that the wide stoma may cause rapid emptying which may result in irritation of the jejunal mucous membrane as a result of its contact with food, and so jejunitis results. Radiological examination demonstrated the irritability of the jejunal wall, and it was suggested that these areas of jejunitis may set up waves of antiperistalsis resulting in

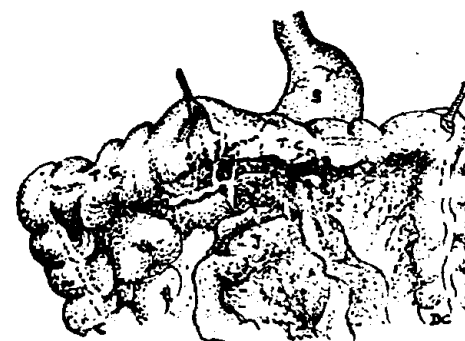


Fig. 2
Diagram showing invaginating efferent loop of jejunum.

the formation of intussusception^{5, 9}. The size and the type of gastroenterostomy has no relation to the condition^{8, 13}.

Shackman has classified the types of intussusception met with, into three¹⁴ :—

Type 1.—Intussusception of the afferent loop.

Type 2.—Intussusception of the efferent loop.

Type 3.—Intussusception of both loops.

Our case comes under the second and the most commonly met with type.

The condition has been described in two clinical types, acute and chronic^{1, 15}. Rarely recurrent intussusceptions have also been encountered^{2, 4, 8}. The condition may occur at any time, ranging from a few days, or a few weeks to several years after the original operation¹⁴. The chronic form, however, is intermittent in nature and in a number of



Fig. 3
Diagram showing jejunal loops in the opened stomach.
(Adapted from Thomson Shields.)

cases may pass unnoticed. The present case occurred fifteen years after the previous operation and fits into the chronic or recurrent variety. In the literature we could only come across one case occurring after such a long interval¹¹.

The onset may be classically sudden in acute forms⁶. The initial symptoms in the large majority of the cases are colicky epigastric pain, followed by vomiting. Early appearance of altered, rather than frank, blood in the vomit has been the characteristic in the published cases⁷. It is said that in half the cases a swelling is palpable in the epigastrium⁶. In spite of the absence of marked rigidity or distension in this case, only a vague swelling could be felt. Visible peristalsis may be seen in a varying number of cases. In the chronic forms the symptoms may be episodic, intermittent or mild.

Early diagnosis in acute forms may be extremely difficult. The usual pre-operative diagnosis has been high intestinal obstruction, a ruptured viscus or an acute surgical abdomen⁶. In this group, the prognosis is grave and surgical intervention should be immediate.

The other group of patients, to which this case belongs, is composed of those who maintain a state of chronic invalidism, following a gastro-enterostomy or sub-total gastrectomy for peptic ulcer. The symptoms starting any time after the operation, are epigastric pain, nausea and vomiting, which occur at irregular intervals and subside spontaneously⁶. Radiological investigations aid in establishing the diagnosis. Plain film of the abdomen may show intestinal gas shadows in the region of the stomach, but barium meal fluoroscopy establishes the

diagnosis. It may show a marked filling defect, a rounded shadow produced by the ectopic coils in the stomach, which may change its position during palpation. The condition should be considered in any patient who complains of abdominal pain and vomiting following a gastro-enterostomy¹⁴.

It is now generally realized that provided the condition is recognized early enough, manual reduction of the intussusception can be carried out at operation without any difficulty, and the results will be satisfactory in all cases. In our case although manual reduction was easy, the bowel segment was devitalized and got damaged during the procedure, hence resection had to be done.

Various measures have been suggested for preventing recurrence, namely:

1. Undoing the gastro-enterostomy and reforming it.
2. Entero-enterostomy between the afferent and efferent loops.
3. Partial gastrectomy.

Naturally, it is very difficult to judge the efficacy of these methods, as recurrence of retrograde gastro-jejunal intussusception is rare^{2, 4, 8}.

Summary

Retrograde intussusception of the efferent loop of a gastro-enterostomy is a well recognized, although infrequent condition. The literature on the subject has been reviewed. A case has been reported, which was successfully treated surgically.

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HORN IN AN EPITHELIAL CYST

BY

H. K. SARKAR, B. P. GHOSH and K. P. SEN GUPTA, Calcutta.

In the available literature on epithelial cysts (Epidermoid cysts) there is no mention of any horn like content. Finding such a thing in a recent case has prompted us to put the following case on record.

Case Report

Sri B. C. a hindu male aged 24 years came with a hard mass in the middle of his right thigh gradually increasing in size and giving rise to occasional pain. He noticed it accidentally about a year back. There was no history of injury or of acute inflammation. Clinical examination revealed slight fullness in the middle of the anterolateral aspect of the right thigh. The skin in the centre was dimpled and dark in colour. On palpation there was a mass measuring 3"×2", slightly irregular, hard in consistency, fixed to the skin over the dimple and freely movable on the deep fascia. Groin glands were not enlarged.

Operation notes.—The swelling was removed under local anaesthesia. It consisted of a lax fibrous bag in the subcutaneous tissues. On opening the sac whitish cheesy material poured out along with whitish flakes that are usually seen in epithelial cysts. The wall contained plenty of similar laminated keratinised material.

The whole of the cavity was occupied by a hard mass having the shape and size of a young deer's horn. (Fig. 1). It was fixed to the cyst wall over its rounded base and showed on its surface dark, yellow and whitish striations.

Microscopic examination.—Under the microscope the contents of the cyst showed granular debris,

degenerated keratinised disquamated epithelial cells and occasional cholesterol crystals.

The wall of the cyst was lined by granulation tissue in most of the places with plenty of giant cells. In isolated areas the lining was intact and it showed thickened stratified squamous epithelium with keratinisation (Fig. 2).

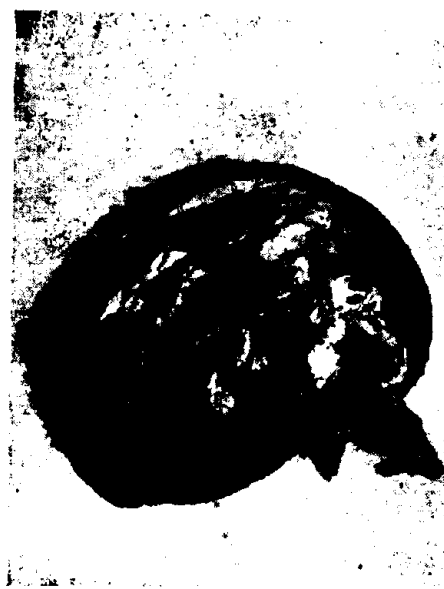


Fig. 1

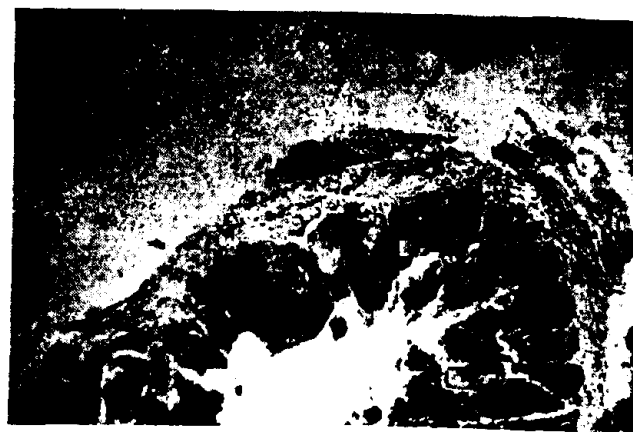


Fig. 2

Composition.

Cholesterol free	10 mgm. Gm.	Moisture - 14.2%.
Cholesterol trace	16 mgm. Gm.	Total Ash - 4%.
Protein	300 mgm. Gm.	Total
		Lipids - 90 mgm/Gm.

the only difference being the formation within the cyst instead of outside. But it is difficult to explain inspersion of the cyst content within a fluid cavity in an area of thigh exposed to movement and pressure.

Discussion

The origin of epithelial cysts has been reviewed by us on one of traumatic origin in a recent article. (Sarkar and Sengupta). In the absence of history of trauma it may be presumed that the patient has forgotten about it, but it is difficult to explain the exact mechanism of the formation of the horn like structure. However it can be assumed to have formed in the same way as a sebaceous horn by slow protrusion of the content through the punctum and its subsequent inspersion and keratinisation

Summary

An epithelial cyst in thigh containing a horn like structure is described Mechanism of its formation is suggested.

Acknowledgement

I am thankful to Maj. General A. K. Gupta, F.R.C.S., Director, Institute of Post Graduate Medical Education and Research for his kind permission to publish the case. My thanks are also due to Sri S. Dutta of the Department of Pathology for the excellent photograph of the specimen.

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RENAL CARCINOMA IN CHILDHOOD

BY

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Carcinoma of the kidney is very infrequent among children. The literature seems to be devoid of more than a few case reports of renal carcinoma in the very young. *In the British Isles, Riches et al (1951) analysing 2814 cases of malignant neoplasms of the kidney recorded during 1935 to 1950 found no authentic report of renal carcinoma below the age of ten years. *Gross (1953) failed to find any record of carcinoma of the kidney in childhood in the Boston Children's Hospital during a period of thirty years. *Sirsat had no case of renal carcinoma in a child when he reported cases of cancer of infancy and childhood attending Tata Memorial Hospital, Bombay, from 1941 to 1951. *Hempstead et al (1953) reported a case of Renal Carcinoma in a boy of eight years who was well for nine months after surgery. Hempstead's second patient, a boy of fourteen years died of metastases, one year following surgery. *Clinton Thomas (1956) mentions a ten year old girl who died of metastases from Renal Carcinoma six weeks after admission into Hospital. *Mathew White (1951) analysing fifty one renal tumours in children could find only one carcinoma. Case reports by Malcolm (1894), Rawls (1931), Campbell (1937), Nicholls (1936), Roche (1951), and Hellstrom are not authentic as definite histological evidence was lacking. It is evident from this brief review that renal carcinoma in childhood is very rare and hence needs reporting.

The rarity of carcinoma of the kidney in children seems to be an avenue for speculation. The development of carcinoma is related to renal adenoma. The renal adenoma

in itself is a sequel of arteriosclerosis which is a hall mark of advancing years. The change from adenoma to hypernephroma is supposed to be an insidious process. Thus, the observed infrequency of renal adenoma prior to the degeneration years, the low growth potential of adenomas and the silent slow-growing nature of hypernephromas explain the infrequency of hypernephromas during childhood.

61 malignant renal neoplasms were recorded during 1950 - 1959 in the Christian Medical College Hospital, Vellore, out of which 16 occurred in children. Among the latter only one was a carcinoma and the 15 others were embryomas. The single case of renal carcinoma is reported.

Case Report

VI., Hindu girl, 10 years old, from Bangalore, was admitted for investigation into the Christian Medical College Hospital, Vellore on 2-7-1959 with a history of a mass in the right side of the abdomen, headache and attacks of vomiting. The history of headache and vomiting dates back to the time when the child had jaundice at the age of two years. The mass in the abdomen was discovered accidentally during a detailed clinical examination by the family physician three months before admission and no importance was attached to it till a few days before admission. The child had vague abdominal pain for 8 months before the tumour was discovered. Episodes of headache and vomiting recurred at intervals of two to three weeks and were relieved by aspirin and other uncharted simple remedies. Bowel habits and micturition were normal. History of fever and chills, or hematuria was absent. Except for jaundice when two years of age the past history revealed no pertinent incidents. No points of significance were available in the family history.

Clinical Examination.—A healthy girl with normal respiration, pulse and temperature. General examination did not show any significant finding. The

blood pressure was 100/70 mm. of mercury. Blood pressures recorded periodically showed no evidence of hypertension. Respiratory, cardiovascular and nervous systems were normal.

Abdominal examination revealed fullness in the right lumbar region and an intra abdominal mass was discovered. The tumour was not tender, was firm and smooth, moving freely with respiration, bi-manually palpable, and separate from the liver border. Percussion note was dull and margins were well demarcated. Rectal examination showed no abnormality.

A clinical diagnosis of right renal tumour was made.

Investigations.—Blood: Hb. - 10 Gms.%, Blood Urea - 27 mg. W.B.C. Total: 9,400/cm.: Blood Group 'O'. Sedimentation rate, 20 and 40 mm. for the first and second hour respectively. Urine and stools were normal.

Intravenous pyelograph.—showed normal functioning left kidney. There was a space occupying lesion in the lower pole of the right kidney distorting the calyces and pushing the ureter medially (Fig. 1).



Fig. 1
Intravenous pyelogram showing tumour at the lower pole of right kidney.

X-rays.—Skull and Chest—No lesions were noticed.

Operation (6-7-59). The abdomen was explored through a right oblique incision extending from the renal angle to the umbilicus and a large smooth tumour arising from the middle of the right kidney was recognised. Large veins were seen coursing over the tumour. The other kidney was normal. A transperitoneal nephroureterectomy leaving the suprarenal gland behind was done, excising the ureter as low as possible. The liver and spleen were normal and no palpable evidence of metastasis was seen in the glands around. The abdomen was closed in layers. The child made an uncomplicated recovery.

Pathology.—The specimen weighed 603 G. and measured 14 × 11 × 5 cms. and consisted of an oval shaped soft, well encapsulated tumour involving the kidney. The surface was covered by large blood vessels and both poles of the kidney were seen. About 8 cms. of the ureter was attached to the specimen. Cut section revealed a pale yellow coloured soft and friable tumour with haemorrhagic areas. The tumour had destroyed the kidney except for the upper and lower poles (Fig. 2) showing dilated calyces. The tumour showed many spaces filled with blood.



Fig. 2
Tumour as seen during operation.



Fig. 3

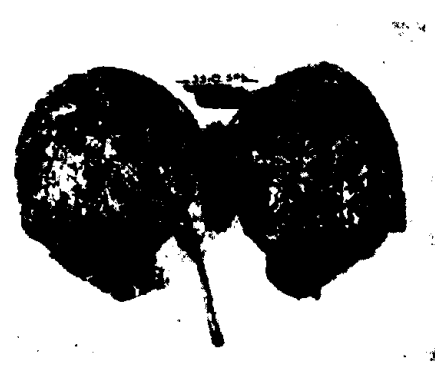


Fig. 4

Fig. 3 and 4—Operation specimen showing tumour of the right kidney.

Microscopic picture. Tumour-Section revealed a neoplasm of the kidney consisting mainly of two types of cells: 1. Uniform cells with large hyperchromatic nuclei and eosinophilic cytoplasm, arranged in tubular and papillary patterns (Fig. 6).

2. In some areas the papillary processes were lined by large pale foamy cells with small nuclei. These foamy cells were arranged in clusters in some areas (Fig. 5).

The remaining renal tissue was normal.

Impression. Papillary adeno-carcinoma or clear cell carcinoma of the kidney.

The child was discharged on 18-7-59 in a healthy state and was advised Radiation.

In Bangalore, post-operative radiation was given to the operated area.

Follow-up examination was done in January 1960 (6 months). The patient had no symptoms and there was no evidence of disease locally or otherwise. Urinary investigations and X-ray chest were normal.

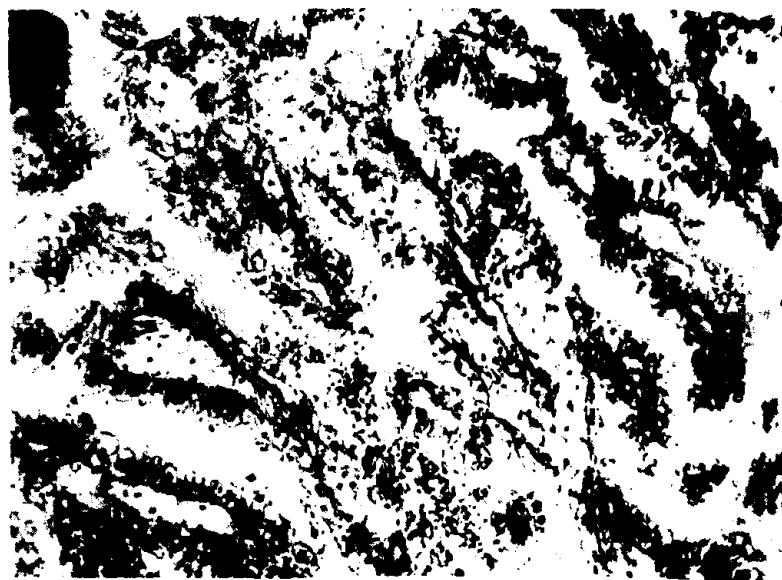


Fig. 5

Photomicrograph $\times 160$ showing papillary carcinoma with clear cells.

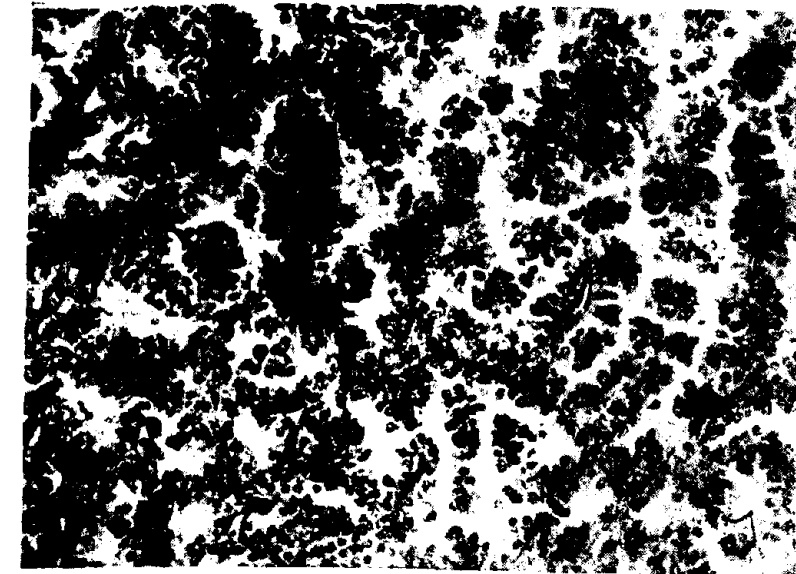


Fig. 6
Photomicrograph
 $\times 160$ showing
papillary carcinoma
with granular cells.

Comments

The rarity of renal carcinoma in childhood warrants this case report. In our case, the predominant symptoms were pain and swelling; haematuria was absent. Headache and vomiting preceded the discovery of the renal swelling by many years. No evidence was found to explain the headache and vomiting on the basis of hypertension or metastasis in the brain as repeated blood pressure records were normal and neurological investigation revealed no abnormal findings. The absence of metastasis in lymph nodes and abdominal viscera on exploration, the encapsulation of the tumour and the absence of blood vessel invasion on

microscopic study, normal roentgenograms of bones and lungs and adequate surgery followed by radiation are all in favour of a good prognosis. The short term follow-up however, does not necessarily justify the above statement.

Summary

A case of Renal Carcinoma in a 10 year old girl is reported. A brief review of the literature on Renal Carcinoma in childhood is presented. Views on rarity of Carcinoma of the kidney in childhood are enumerated.

Acknowledgements

We are grateful to Dr. E. W. Gault, Pathologist for his help.

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SELF RETAINING MALLEABLE ABDOMINAL RETRACTOR

BY

K. N. KASHYAP, New Delhi.

A need exists for a self retaining malleable retractor to overcome certain difficulties encountered during surgical operations. Sometimes a sustained retraction in a relatively fixed position is required, for example, the stomach and duodenum must be retracted from the operation field during gall bladder operations, the peritoneum and viscera retracted while performing lumbar-sympathectomy, or during prolonged operations on the kidney, et cetera. During these procedures one assistant is almost wholly engaged in holding a suitable retractor and is of no further help to the surgeon, and sometimes this retraction becomes fatiguing. Various self retaining retractors which fit into the operation wound are of a fixed shape and increased retraction at one end may produce difficulty at the opposite site.

To overcome some of these problems and to provide a retractor which can be adapted to individual conditions a self retaining malleable retractor has been designed.

It consists of two rods, a joint that allows fixation of these rods at any angle and in any position by the tightening of a single thumb screw, and a terminal malleable blade, one end of which, carrying a shoulder, can slide over one rod, and be fixed in position by another screw.

The joint consists of two pairs of cup-shaped pieces held together by a centrally passed bolt. Each pair is notched to hold one rod in its grip. Thus the two rods can be fixed in any desired position by tightening one thumb screw. The retractor blade is made of copper (chromium plated) and is

of suitable tensile strength to allow both bending into position manually and also effective retraction.

The components of the retractor can be sterilised by boiling or in an autoclave along with other instruments and assembled when required. When the patient is being draped on the operating table the vertical thicker rod is fixed in the leg-rest holder on the side of the table at the approximately required position. Later, when retraction is required, the joint and the thinner transverse rod is fixed on to the vertical rod. The blade is bent according to the shape required and its shoulder slipped over the transverse rod where it is fixed by the screw. Greater or lesser degree of retraction can be easily obtained by simply loosening the screw and tightening at the required position.

The viscera are thus effectively retracted out of the operation field and the assistant is spared for more definitive help to the surgeon. The retractor is fixed alongside the assistant and does not interfere with his movements.

The retractor blades are made in two sizes, a broad one 2½" and a narrow one 1½" wide.

A Kidney Hook

During operations on the kidney, especially plastic repair of the renal pelvis, the kidney has to be held for a long period. This usually involves either elevating the organ with the hand, which takes too much space, or the kidney is slung up by 2 tape

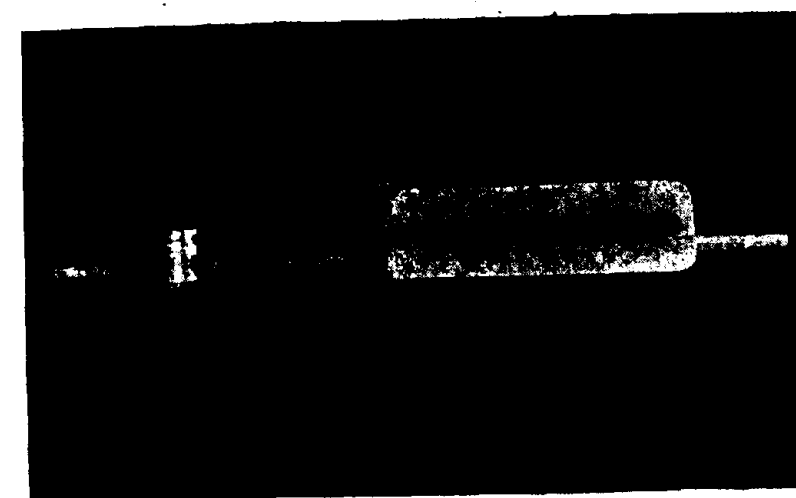


Fig. 1

Self-retaining malleable abdominal retractor (collapsed).

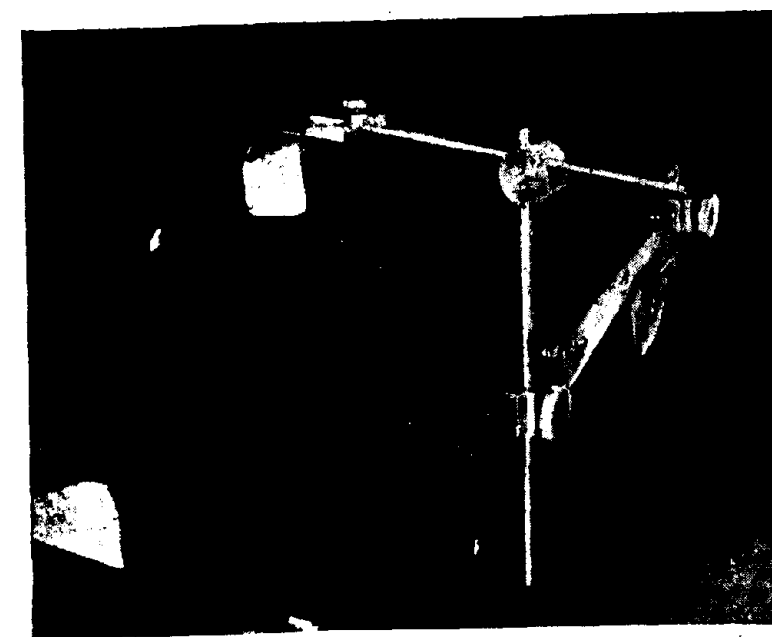


Fig. 2

Self-retaining malleable abdominal retractor fixed to the operating table, illustrating its use.

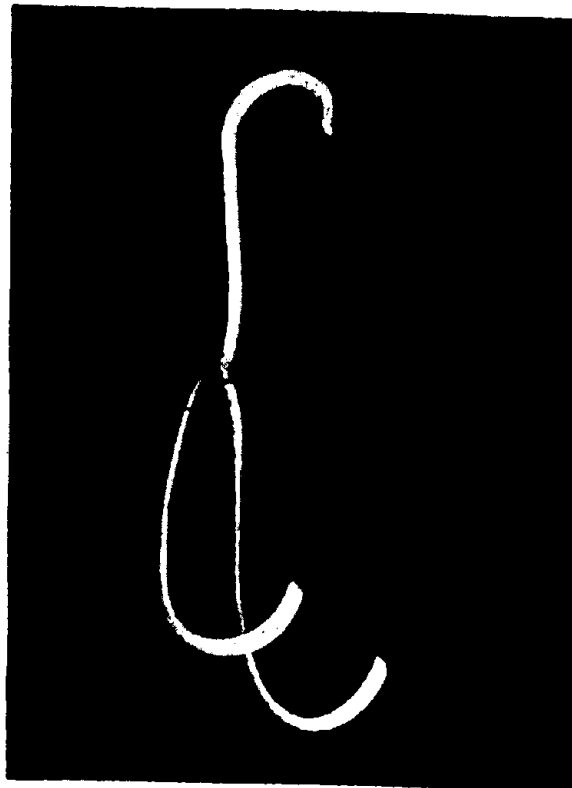


Fig. 3—Kidney hook.

slings passed above and below the kidney pelvis and crossed on the outer side. This involves extensive stripping of the kidney of its fatty capsule and further, these tapes tend to slip. The kidney clamp also, when applied, tends to interfere with the blood supply of the kidney.

A simple device is suggested to hold up the kidney by means of a two-pronged curved hook bent on the flat. The limbs are adjustable manually if any change is required. The prongs pass along the anterior surface of the kidney and hook up the kidney - one prong passing above and the other below the kidney pelvis. The hook is held comfortably by one finger and presents the whole pelvis for operative work. It does not damage the kidney in any way and is easy to apply.

A similar hook made of plastic can be used for slinging up the kidney for radiological examination during an operation. As plastic is radioluscent it will not interfere with the shadow of calculi. It can be sterilised in formaline vapour or in dettol or lysol.

The kidney hook can also be used to hook up the ureter during uretero-lithotomy, one prong passing above and the other below the site of the calculus.

Messrs. Himalaya Manufacturing & Sales Co., Faiz Bazar, Delhi-7, India, have very kindly agreed to manufacture and supply these instruments.

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“RHINOSPORIDIOSIS”

BY

G. LAKSHMIPATHI and K. V. SUBBA RAO, Kurnool.

The recent literature contains a number of case reports of Rhinosporidiosis from South India. Generally these are from the coastal areas, either from the east coast or from the west coast; but seldom from the interior areas such as Rayalaseema. This case report is of interest as it records a case of Rhinosporidiosis from Kurnool District (Rayalaseema).

Case Reports

K. N. A. male aged 20 years attended the Eye, Nose and Throat out patient department of the Kurnool General Hospital on 8-8-'58 with a history of obstruction to the nose and blood stained nasal discharge for the past two years. The onset was insidious with blocking of the right and left nasal chambers alternatively in the early days. The obstruction became constant, bilateral and progressive and he observed a mass growing in the left nostril. About an year ago, he was admitted in this hospital for this and the mass was removed from the nose with partial improvement in his breathing. The obstruction recurred again after some months. His general condition is normal and there is no history of Haematuria or Haemoptysis.

Family History.—He is a native of Maddikara, a village in Kurnool District about 70 miles from

Kurnool. His parents and grand parents belonged to the same village and he spent all his 20 years of life in the same village. He is a cultivator by profession. He has one elder sister and one elder brother. No one in his family has suffered from a similar complaint nor has he been aware of anybody in the village having a similar complaint.

Clinical Examination.—At the time of admission, a red vascular polypoid mass of the size of a small marble with a papillomatous surface attached to the lower margin of the septum was found in the left nostril. Another mass was seen in the left nasal cavity, partially hidden by an anterior septal deflection. The middle of the right nasal cavity also contained a similar polypoid mass protruding from under the inferior turbinate. Posterior Rhinoscopy showed both the Choanae free. But the roof and the left lateral wall of the nasopharynx near the Eustachian tubal orifice showed a number of small but discrete papillomatous masses of the size of a millet seed (See Fig. 1). No other similar lesions are seen any where else on the body. Clinically the picture was typical of Rhinosporidiosis.

Pathological Report.—Naked eye examination of the specimen, tissue shows papillomatous growth, the surface of which is covered by tiny round whitish nodules. These nodules, on close examination with a lens are found to be the mature sporangia.

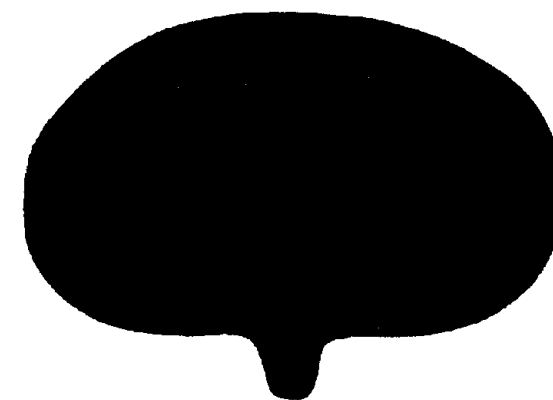


Fig. 1

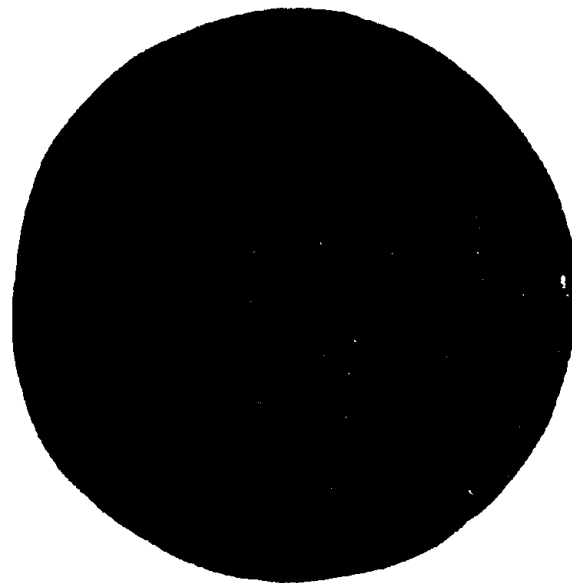


Fig. 2

Microscopic examination shows the sporangia of *Rhinosporidium seberi* in various stages of development. Some are on the surface while others are in the submucous layer. Around the latter, there are

inflammatory changes. Some of the ruptured sporangia are being surrounded by foreign body giant cells. The appearances are typical of *Rhinosporidium Seberi* (See Figs. 2 and 3).

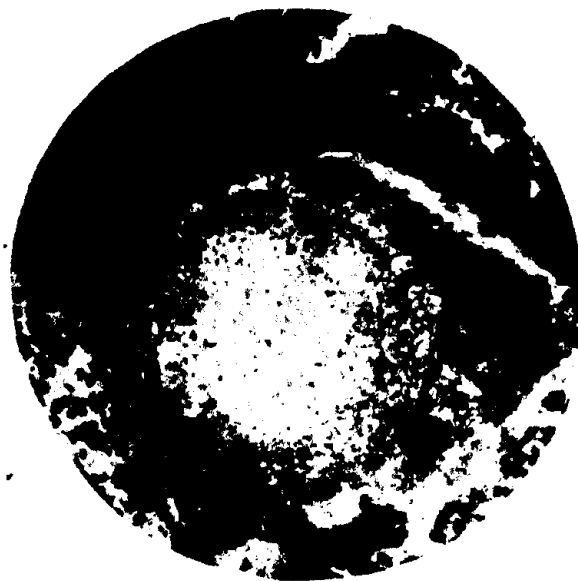


Fig. 3

Treatment

As the septum is markedly deflected to the left side and blocking the nose, a submucous resection of septum was performed under local anaesthesia by the usual technique from the left side. On correcting the septum, the polypoidal mass in the left nose was found to be hanging from the roof. This was removed with Luc's forceps. The mass on the anterior portion of the septum on the left side and the mass from the right nasal cavity were similarly removed. There was moderate bleeding which was controlled by vaseline ribbon gauze packing. When the packing was removed the next day there was again brisk bleeding which was controlled by repacking with ribbon gauze. The packing was finally discarded after 48 hours. One week later, the areas of attachment of the masses were treated with the Galvanocautery.

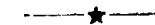
For the small discrete masses in the nasopharynx, no surgical treatment was undertaken as they are very small and far remote for access.

2% Antimony Tartarate Solution was prepared and given to the patient with instructions to use it as nose drops twice daily. He was instructed to report again whenever the trouble recurs.

Acknowledgement

Our grateful thanks to Dr. K. Ramesh Pai, M.S., F.R.C.S., Superintendent, Government General Hospital, Kurnool, for permitting us to use the Clinical materials. We are thankful to the Radiologist, Government General Hospital, Kurnool and the Clinical Photographer, Sri K. Haricharanapathi for the Photographs.

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RESTORATION OF GLUTEUS MAXIMUS POWER FOR POST POLIO PARALYSIS OF HIP BY DOUBLE BELLIED (DIGASTRIC) EXTENSOR RECONSTRUCTION WITH REPORT OF 3 CASES

BY

A. K. SAHA, Calcutta.

Problems of momentary balancing for a fraction of a second and stationary balancing on one limb are different. A person can balance (negative Trendelenberg) for a fraction of a second if the homolateral abductors and trunk muscles have some power. Stationary balancing on one limb requires, in addition, minimal power of extensors to convert the hip joint into a stable component through which the body weight is transmitted. The extensor power with the synergistic action mainly of abductors, flexors and trunk muscles helps to adjust the line of weight transmission through one foot, the reduced base on which the body stands (negative Trendelenberg). Obviously, standing on two limbs gives a wider base and, therefore, there is less exertion on the part of the extensors than while standing on one limb.

During slow forward locomotion there is momentary balancing on one limb when the other limb is swung forward for a step (negative Trendelenberg). Gradually developing power of hip extensor, adductors and internal rotators brings the hip into a state of controlled disequilibrium with the change of position of the body in space (positive Trendelenberg), so that the momentum of the body moving forward transfers the body weight to the other limb, swung and poised after taking a step and now ready to be the weight bearing pillar thus freeing the rear limb for its next swinging phase.

Therefore, characteristic awkwardness in gait from loss of power of the hip extensor is clinically manifested from the midstance phase of the paralysed limb till its termination and is due to the compensatory mechanism of the trunk pelvic muscles which with the aid of the momentum of the body moving forward transfer the weight to the sound limb.

During fast forward locomotion (running) the state of disequilibrium of the limb in stance for transfer of the body weight to the other (*vide supra*), full extensor power has to be reinforced by a strong backward thrust from equinus forefoot to maintain the required speed at a constant level. This spring action from the forefoot, as it were, acts in the same way as the periodic transmission of power by twin piston combustion engine to the rotating fly wheel to keep its speed at a steady level. Adequate and optimum power of almost all the muscles of the lower extremity and trunk and accurate coordination amongst them are the necessities for running. Speed is greatly reduced and unsteadiness appears during fast motion if there is diminution or lack of power in any of the key muscles of the lower extremity.

During backward locomotion, the extensor power is required from the beginning of the swinging phase till the middle of the stance phase of a particular limb.

Restoration of power of the paralysed extensors is therefore a necessity particularly during locomotion to prevent awkwardness in gait. Depending on the degree of residual power in other muscles and restoration of the quality of extensor power, running (fast locomotion) becomes a possibility.

In the paralysed limb (chronic poliomyelitis) affecting the hip extensors, various methods have been tried with varying degree of success. Dickson (1927) transferred the origin of fascia lata backwards. Ober (1929) and Groves (1927) used sacrospinalis separated from its origin and prolonging it to greater trochanter using a wide strip of fascia lata. Ober's operation was a modification of an earlier operation of Kreuscher (1925) who used strands of silk instead of fascia lata. Saha & Chatterjee (1957) used much neglected quadratus lumborum to the homolateral greater trochanter using a wide strip of fascia lata singly or with the whole of rectus abdominis (for abductor power) in completely flail hips in children. In none of these procedures, however the extensor power reached the desired minimum i.e. elevation of the limb against gravity (3). Barr in 1950 in his follow up of fifty cases of sacrospinalis transfer (Ober's operation) found only 25% showed some objective improvement in extension. He is non-committal about the quantity of the power restored. Almost identical results were obtained with quadratus lumborum transfer: the power in most of the cases just fell short of 3'. Delayed exposure has proved that the diminished power was due to the waste from (a) probable slack of fascial strip from the repeated stretch (b) long strands of adhesions in the new course of the muscle particularly with its fascial strip portion. The adhesions elongated with the excursion of the muscle in its course and look like the rootlets of a tree: lacy silky fibres going to the fibrous septa of the fat lobules. Methodical

and painstaking experiments in animals by Chatterjee and Ghosh (1960) using 'Nylon' strip showed definite improvement of power (limb weight and power ratio). Though not yet tried in man, the method is expected to eliminate the difficulties of long strip fascial transfer.

Thus failing to reach the objective to get adequate extensor power, other alternative transfers including double transfer were considered to improve upon the older procedures. Adductor longus was considered a good reinforcement in those cases where it is available. Its power could be harnessed after detachment from its origin to either tensor fascia femoris, sacrospinalis, iliopsoas or quadratus lumborum after severance from their lower attachments with the intermediation of a wide strip of fascia lata and thus converting it into a double bellied extensor (digastric). The rotation was also expected to improve and the nature would depend on the direction of pull in different flexion-extension phases of the limb, whether lying on the inner or the outer side of mechanical axis of the femur (c.f. action of psoas magnus). These were verified in cadaver. Training an adductor to contract in unison with the contraction of the outer belly was not formidable particularly in children.

Materials

Three cases with almost complete paralysis of extensor and abductors were selected for operation. All had good power of adductors, specially adductor longus. They were children between the age of 5 and 9 years suffering from the effects of poliomyelitis for 3 to 4½ years. The 2nd case had an earlier operation for restoration of internal rotator power of the right hip. This enabled him to lock the knee on his own. The other two cases had flexion-abduction deformity due to tensor fascia femoris contracture.

In these, preliminary correction of the flexion contractures by Soutter's operation was done at the same sitting before harnessing the distal and of the tensor fascia femoris to the homolateral adductor longus. The 2nd case had digastric reconstruction with the help of sacrospinalis and adductor longus.

Methods

Except for the reconstruction of extensor digastric with the help of tensor fascia femoris, the procedure of exposure and detachment of the sacrospinalis, iliopsoas and quadratus lumborum are as described by Ober (1927), Mustard (1952) and Saha & Chatterjee (1957) respectively. In each of these latter procedures 1½-2" wide and 6"-7" long strip of fascia lata has to be taken from the healthy thigh to be used for joining the ends of either of the above muscles to the adductor longus detached from its origin from pubis. Both the cases where tensor fascia femoris was used, had abduction-flexion deformity. This deformity was corrected by Soutter's muscle slide operation. The incision in these cases was prolonged to the lateral aspect of the thigh for 7"-8" to expose the fascia lata. 1½"-2" wide strip was dissected free from the lower end of the skin incision keeping its upper attachment in the tensor fascia femoris in tact. After correction of the deformity of the hip and reconstruction of the common aponeurotic origin over the iliac crest the distal tongue shaped dissected prolongation was now free to be harnessed to the adductor longus.

Detachment of the origin of the adductor longus

With the affected limb held by an assistant in abducted, flexed and externally rotated position a 6" hockey stick incision is made over the taut adductor longus. The curve is at the upper end and circles the upper taut tendinous origin of adductor longus.

The muscle is dissected free from the femoral vessel and their sheath anteriorly and laterally, medially from the fascia covering this and posteriorly from adductor brevis taking special care to keep the nerve and vascular supplies. The origin of the muscle is detached with the help of a sharp scalpel from the body of the pubis.

Half way down the vertical limb of the incision, a subcutaneous tunnel is made on the medial and back of the thigh directed towards the greater trochanter. The subcutaneous tunnel is carried with the help of a small incision behind the greater trochanter (not always a necessity) to the bottom of the incision for quadratus lumborum or sacrospinalis detachment. In case of tensor fascia femoris, oritropsoas the tunneling is carried towards the anterior superior iliac spine.

Suture of fascia lata to the detached end of the sacrospinalis, iliopsoas or quadratus lumborum is done by constructing a Y at one end of the strip, sandwiching the muscle end between the limb of the Y and fixing it by interrupted "0" silk sutures.

Tensor fascia femoris in the new orientation with a long strip of fascia lata or one of the muscles sacrospinalis, iliopsoas and quadratus lumborum by artificial prolongation of the insertions by fascia lata can now be drawn through the subcutaneous tunnel to the intermediate incision on the buttock to which the upper end of the adductor longus has been drawn subcutaneously.

The limb is now held in full extension, 45° abduction and internal rotation with the patient in 60° prone position. The free end of fascia lata is drawn over the adductor longus and fixed by 2" silk suture to the tendinous part of the muscle and interrupted "00" silk to the surface of the muscle belly. While the limb is held in this position the

skin wounds are sutured and a plaster of Paris spica applied. During these extensive exposures transfusion is necessary.

Post-operative

The plaster of Paris spica is kept for 6 weeks and after removal, the limb is rehabilitated. Restoration of movements by assisted exercises, resisted exercises and lastly training and co-ordination in standing and locomotion are carried. If the limb below the hip is flail, the patient is encouraged to walk with the help of a bucket weight bearing light caliper if necessary.

Case Reports

Case No. 1.- 3802/60 S. D. female child aged 7 years with residual almost flail limb; paralysis of right lower limb with flexion abduction contracture

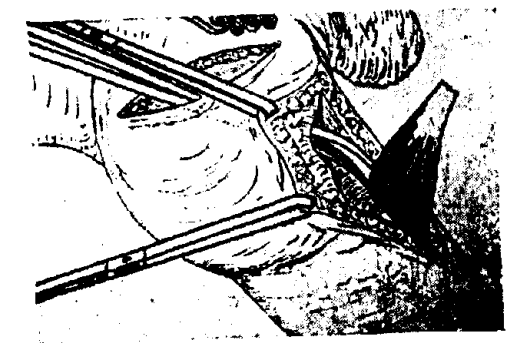


Fig. 2

The diagram showing adductor longus severed from its origin and ready to be drawn through a subcutaneous tunnel to the intermediate incision on the buttock.

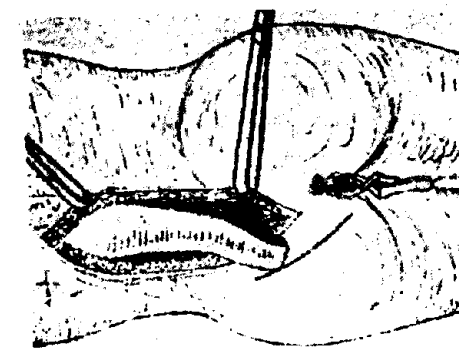


Fig. 1

Sketch showing the detachment of sacrospinalis from its lower attachment to the sacrum.

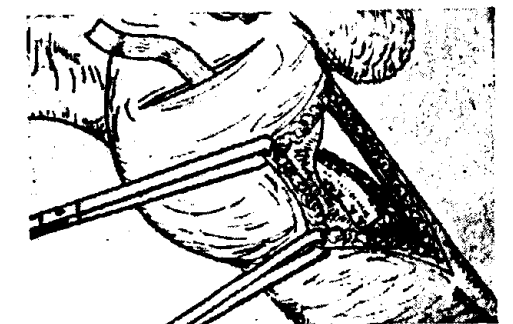


Fig. 3

The strip of fascia sutured to adductor longus after drawing through the subcutaneous tunnel to the intermediate incision.

Residual Power :

Rt. Hip.		Rt. Knee.	Rt. Ankle and Foot.
Tensor fascia femoris	2++	Quadriceps	1
Sartorius	1++	Flexors:	All "Zero"
Flexors	4+	Outer	
Extensors	0	Inner	
Abductor	0		
Adductor	3		
Ext. rotator	4		
Int. rotator	3		

Paravertebral group and abdominal - normal power.

Operated under general anaesthesia on 12-4-60. After Soutter's muscle slide for correction of flexion-abduction deformity, extensor digastric reconstruction was done with the help of adductor longus and tensor fascia femoris. Blood transfusion of 250 c.c. was required. Post-operative period was uneventful. Plaster of Paris spica was removed on 18-5-60. After rehabilitation she was given bucket-top caliper owing to her failure to lock the knee during the stance phase.

Extensor and abductor power has developed to 3. Gait is near normal with the caliper (weight bearing and bucket top).

Case No. 2.—4504/60 A. K. D. male child aged 9 years with residual paralysis of left lower limb. He had an attack of poliomyelitis at the age of 4½ years. He was admitted in early 1959 with 2½" shortening of the left lower limb. He could walk with shuffle while bearing weight on the externally rotated affected limb; the body bent forwards by 80° at the hip and hand above the knee to keep it extended. He had facile locomotion with this awkward gait and developed callosity of the skin above the knee from friction of hand.



Fig. 4

Suture of the proximal end of the fascia with sacrospinalis with the limb in optimum position is complete. Incision to expose adductor longus is seen closed.

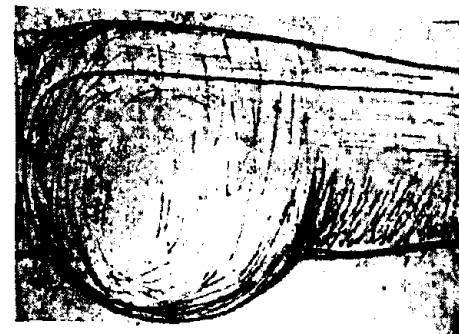


Fig. 5

Soutter's incision over iliac crest for muscle slide operation for correction of flexion-abduction deformity is shown prolonged over the lateral aspect of the thigh.

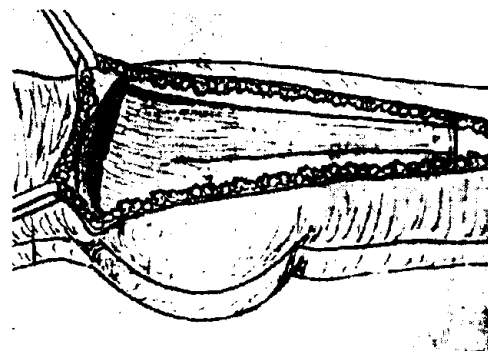


Fig. 6

Muscle slide done and the deformity corrected, the iliac crest is now visible. A tongue shaped rectangular strip in continuity with tensor fascia femoris is separated from the underlying muscles.

Residual Power : (May 1959)

Rt. Hip.	Rt. Knee.	Rt. Ankle and Foot.
Tensor fascia femoris 4	Quadriceps 0	Ext. dig. longus 1
Sartorius 4	Flexors :	Intrinsics 2
Flexors 4	Outer 1	Others Nil
Extensors 1	Inner 3	
Abductors 1		
Adductors 3		
Ext. rotators 4		
Int. rotators 0		

Paravertebral and abdominals - normal.

He was operated on 12-5-59 for restoration of internal rotation power of the left hip by contralateral external oblique transfer to the homolateral greater trochanter. After this operation he could walk straight with corrected shoe for height though the shuffle persisted owing to the lack of abductor and extensor power.

On 12-5-60 digastric reconstruction for extensor power was done with the help of sacrospinalis and adductor longus. Plaster of Paris was removed on 25-6-60. Recent check up shows definite improvement in locomotion with the corrected shoe. The power is 3. It is curious to note that with development of power in the extensor he lost temporarily spontaneous locking of knee. However after walking in bucket caliper for some weeks he can lock the knee on his own.

Case No. 3.—9215/60 B. D. female child aged 5 years with residual paralysis of Rt. lower limb following attack of poliomyelitis at the age of 2 years.

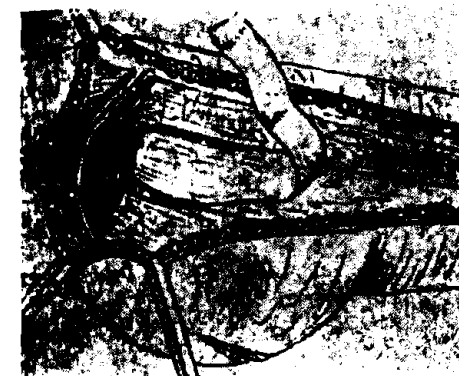


Fig. 7

The tensor fascia femoris is seen separated from its anterior border in continuity with fascia lata prolongation.

She had flexion-abduction contracture of the hip to 50° and shuffled with gross forward stoop and hand support above knee. She had shortening of ½".

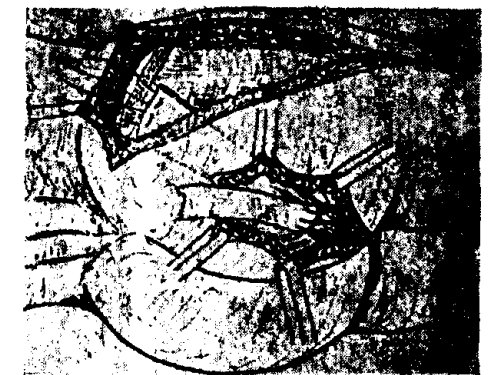


Fig. 8

Intermediate incision behind the greater trochanter showing the adductor longus drawn to it and sutured to the fascia lata in continuity with tensor fascia femoris.



Figs. 9

Case No. 1 showing extensor digastric reconstruction with tensor fascia femoris and adductor longus and ability to extend at the hip. Intermediate incision was not used.

Residual Power :

Rt. Hip.	Rt. Knee.	Ankle and Foot.
Tensor fascia femoris 4	Quadriceps 2	Gastroc 4
Sartorius 4	Flexors :	Flex. dig. longus 4 +
Flexors 4	Outer 3 +	Flex. hall. longus 4 + +
Extensors 1	Inner 3 +	Ext. dig. longus 4 + +
Abductors 1		T. Ant. 4 +
Adductors 5		E. H. longus 4 +
Ext. rotators 3		T. post. 5
Int. rotators 2 +		P. longus 4 + +
		P. brevis 4 + +
		Intrinsics 5

Paravertebral and abdominals - normal.



Fig. 10

Case No. 1 showing extensor digastric reconstruction with tensor fascia femoris and adductor longus and ability to extend at the hip. Intermediate incision was not used.



Figs. 11

Case No. 3 had similar reconstruction as in Case No. 1 show the intermediate incision and patient's ability to extend at the hip.

She was operated on 8-9-60 under general anaesthesia. She required saline-glucose transfusion 250 c.c. After correction of flexion-abduction contracture by Soutter's muscle slide operation, extensor digastric reconstruction was done with the help of tensor fascia



Fig. 12

Case No. 3 had similar reconstruction as in Case No. 1 show the intermediate incision and patient's ability to extend at the hip.

femoris and adductor longus. Plaster spica was retained for 6 weeks. She was rehabilitated in the routine way and at the end of 3 months had extensor power valued at 3.

Discussion

Problem of restoration of extensor power for paralysis of the hip has yet to be solved. All known single transfers do rarely give enough power to lift the limb against gravity. Absence of sufficient power cripples the patient as he cannot join outdoor games without caliper and is unable to run. Hip fusion possibly has been found by many in this country and abroad to be the answer.

But this procedure can only be applied to patients above 18 - 20 years. For children we had to find some other alternative method for improvement of the extensor power. With a view for further improvement, digastric extensor reconstruction with the help of adductor longus (when its power is available) and another known muscle transfer was attempted in 3 children. In all, though the power shows some improvement over other single muscle transfer in similar situations, yet there is much to be desired to improve the power further. The power was seen to be enough to give more graceful locomotion but still insufficient for faster movement. Possible causes of loss of power have been discussed. Whether the long strip of fascia needed for these reconstruction operations will be made to traverse through tunnels to prevent adhesions or will be replaced by plastics in man is yet a speculation dependent on long term follow-ups of experimented animals.

These procedures though short of expectation yet have been found to give hope to the hopeless children who are amenable to easy rehabilitation. They with this restoration are able to go to school and mix with other children as one of them.

Summary

Requirement of extensor power of hip in various stages of balancing on one limb, two limbs in standing, walking and running has been discussed. Good hip extensor have

been shown to be a sportsman's companion in combination with triceps surae (gastro-soleus).

Restoration of power in post-polio paralysis by various known methods have been discussed and the power is found to be short of the expected maximum.

Method of digastric reconstruction with the help of one of the known muscle (transfers) and adductor longus has been advocated as a new procedure for children. The method has been shown in all the three illustrated cases to be superior to single muscle transfer. Problem of certain loss of power still looms large, though in experimental stages, the use of plastic material or long strips of fascia (autogenous) traversing non-adhesive preformed channels will probably solve the problem.

Acknowledgements

My thanks are due to Prof. M. Pan, F.R.C.S. (Edin.), for his help in carrying out the operations in the cadaver, to the Superintendent, Nilratan Sircar Hospital, Calcutta, for his permission to publish the cases operated in my wards. I convey my gratitude to Dr. S. Datta for the sketches and my anaesthetist Dr. A. Banerjee, D.A., F.F.A.R.C.S., my house staff, nursing staff for their ungrudging assistance to carry out the work.

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STUDY OF ORTHOPAEDIC PROBLEMS IN LEPROSY AND VALUE OF SPLIT-SUBLIMUS TENDON TRANSPLANT IN POST-LEPRA CLAW HANDS*

BY

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PART I

With the advent of sulphone therapy in the treatment of Leprosy we are to-day able to control the disease to a great extent; in fact by early and prolonged treatment it can be cured. The residual deformities, mostly of the hands and feet, remain as the main orthopaedic problem. To the physician it is the presence or absence of bacilli that seems important, but the patients and the public are very much more disturbed by the deformities and the ulcerations. Once facilities for the prevention and cure of these disabilities are provided at great many centres, our National Leprosy Scheme and the medical treatment can be made more popular and successful enabling the patients to be treated in the same way as any other sick person and resume his normal place in the society, when cured.

Leprosy is highly endemic in the Eastern Coastal Areas of South India. From a recent survey conducted by Dr. K. R. Chatterjee (July, 1958) in Pondicherry State, it has been revealed that there is an average incidence of 7.1%. In the Pondicherry State alone with a population of little over three lakhs, the total number of leprosy patients works out to be 21,500. In India, it has been estimated that there are over fifteen lakhs leprosy cases and about two million in the whole world. However, all of these are not Orthopaedic problems.

With a view to getting some idea about the exact magnitude of the problem in leprosy in this part of India from the orthopaedic point of view, a clinical study of 1000 consecutive cases which attended the leprosy out-patient department during the year 1960, was undertaken along with detailed recording of the deformities in the 150 cases which were admitted to the local leprosarium.

Type Distribution and Incidences of Polyneuritic Forms (Table I)

26.1% of the cases were seen to have associated polyneuritic signs in the form of either palpably thickened nerves or with additional paralytic signs, like claw hands, foot-drop or trophic ulcers. These are the cases which either require active orthopaedic care for the potential ones, which are later likely to go in for these complications. Cases with polyneuritic signs in the lepromatous type of lesions constituted a large percentage of the total, which is not often realised and the lepromatous leprosy is not thought to be associated with polyneuritic signs in so many cases. However, these were the cases which were mainly having only thickened nerves and anaesthesia and less often the clinical deformities.

*Paper read at the Orthopaedic Section of the Conference of the Association of Surgeons of India—30th December 1960.

TABLE I
Incidence of Polyneuritic forms in Different Types of Leprosy
Total Cases—1000

Type of Lesions	Total Cases	Pure Forms	With Polyneuritic signs	Percentage
Lepromatous	317	196	121	12.1%
Tuberculoid	283	243	40	4.0%
Maculo-Anaesthetic	245	211	34	3.4%
Indeterminate	103	85	18	1.8%
Polyneuritic	48	—	48	4.8%
Border Line	4	4	—	—
Total	1000	739	261	26.1%

Sex Distributor of Polyneuritic Lesions (Table II)

The sex incidence of leprosy in the pure forms of various types comes to be almost three males to one female, while in cases showing polyneuritic signs, there is still lesser incidence in females being only 1 in 4. The problem of lesser incidence of leprosy in the females and still lesser incidence of the mutilating deformities of the hands and feet is worth investigation. The females seem to get more of maculo-anaesthetic form of leprosy (42.2%) and less of lepromatous form (26.0%) than the over-all figures of 32.5% would suggest. In case of neural involvement no sexual variance in type has been observed, practically in all groups the incidence has been 1 to 4.

Distribution of Polyneuritic Lesions in Various Age Groups in the Male and Females (Table III)

In the males below the age of 10 years no case with polyneuritic sign was detected. The maximum number of cases presented between the ages of 20 to 50 years—the

most active period of ones life; in females (Table IV) maximum incidence has been a decade earlier between the ages of 11 to 40 years.

Various Physical Disabilities in Leprosy (Table V)

On closer and detailed study of the 150 cases admitted to the local Leprosorium, it was found that more than 75% of the cases had one or the other type of deformity. Hand deformities were the most frequent, closely followed by feet disabilities with trophic ulceration or its secondary effects. In most of these cases, however, both the hands and feet were simultaneously involved. These figures are high as compared to those of other workers because practically no orthopaedic treatment is being carried out in this institution since its inception and all the deformed cases stay on and clog the already meagre facilities for the isolation of the infectious cases, for which these leprosaria should be primarily meant. If proper physio-therapy and operative facilities are provided most of these cases can be made useful and rehabilitated.

TABLE II
Sex Distribution of Leprosy Cases with and without Polyneuritic Signs
Total Cases—1000

Type of Lesion	Pure Form				With Polyneuritic signs			
	Total	M/F	Total	%	Total	M/F	Total	%
Lepromatous	196	M F	145 51	74.0 26.0	121	M F	101 20	83.5 16.5
Tuberculoid	243	M F	169 74	69.5 30.5	40	M F	32 8	80.0 20.0
Maculo-Anaesthetic	211	M F	121 90	57.8 42.2	34	M F	26 8	76.5 23.5
Indeterminate	85	M F	61 24	71.8 28.2	18	M F	14 4	77.8 22.2
Polyneuritic	—	M F	— —	— —	48	M F	37 11	77.1 22.9
Border Line	4	M F	3 1	75.0 25.0	—	M F	— —	— —
Total	739	M F	499 240	67.5 32.5	261	M F	210 51	80.5 19.5

TABLE III
Age Distribution of Polyneuritic Lesions in Males
Total Cases Males—210

Age	L. P.	T. P.	M. A. P.	I. P.	P.	Total
Below 10 years	—	—	—	—	—	—
11 to 20 years	15	8	2	6	5	36
21 to 30 years	27	13	7	7	12	66
31 to 40 years	21	6	10	—	9	46
41 to 50 years	23	4	3	—	8	38
Over 50 years	15	1	4	1	3	24
Total	101	32	26	14	37	210

TABLE IV
Age Distribution of Polyneuritic Lesions in Females
Total Cases Females—51

Age	L. P.	T. P.	M. A. P.	I. P.	P.	Total
Below 10 years	—	1	—	1	—	2
11 to 20 years	2	—	4	1	3	10
21 to 30 years	7	5	1	2	3	18
31 to 40 years	6	2	1	—	3	12
41 to 50 years	3	—	2	—	1	6
Over 50 years	2	—	—	—	1	3
Total	20	8	8	4	11	51

TABLE V
Incidence of various Physical Disabilities Resulting from Leprosy
(In the Leprosorium Patients)
Total Cases—150

Type of Deformity	Bilateral	Unilateral	Total	%
Hand involvement	51	63	114	76.0%
Feet involvement	32	64	106	70.7%
Lag Ophthalmia or Paralysis Eye-lids	5	3	8	5.3%
Total Blindness	5	4	9	6.0%
Collapse Nasal Bridge	—	—	12	8.0%
Gynaecomastia	17	3	20	13.3%
Healed ulceration cornea with partial blindness	1	2	3	2.0%

Hand Disabilities (Table 6)

Over 50% of the hands had intrinsic paralysis and are the ones amenable to reconstructive surgery and form the major active orthopaedic problem in leprosy patients.

It is interesting to note that partial or gross absorption of all the fingers and

thumb (grade IV and V) were commoner in the females out of a total of 7 cases, 6 were females and only one male. More than half of these cases were bilateral, while in the rest, only right hand was involved—left hand having completely escaped atrophy. Perhaps, trauma has definite part to play in the causation of this bone atrophy in leprosy.

TABLE VI
Classification of Hand Disabilities in Leprosy
(After the Leprosy unit of W.H.O.)

Total Cases—150					Total Hands—300				
Grade	Description	Total Cases	Sex		Hands involved			Total hands	%
			M	F	Both	Rt.	Lt.		
I	Only Anaesthesia	25	16	9	15	6	4	40	13.3
II	Mobile Claw Hand Useful Thumb	52	36	16	25	16	11	77	25.7
III	Intrinsic Paralysis Fingers and Thumb or Fingers with contracture	55	38	17	22	15	18	77	25.7
IV	Partial absorption fingers with useful length remaining	3	—	3	1	2	—	4	1.3
V	Gross absorption with stumps only left	4	1	3	3	1	—	7	2.3
	Total	139	91	48	66	40	33	205	68.3
	Percentage	—	65.4	34.6	64.4	19.5	16.1	100	—

Table VII shows that of the deformed hands 6% of the cases showed an intrinsic plus deformity of all or few fingers, which may be severe enough in some cases to need treatment.

TABLE VII
Types of Deformities Hands in Leprosy according to Nerve involved
Total No. of Hands—200

Type of Lesion	No. of Cases	Sex		Hands involved			Total	%
		M	F	Both	Rt.	Lt.		
Ulnar Nerve alone	71	43	28	30	23	18	101	50.5
Median Nerve alone	2	1	1	1	1	—	3	1.5
Ulnar and Median	31	14	17	16	6	9	47	23.5
Ulnar with Median and Radial Nerve	3	1	2	—	1	2	3	1.5
Total	—	—	—	47	31	29	154	77.0
Percentage	—	—	—	61.0	20.2	18.8	—	—

Table VIII shows that of the deformed hands 50% of the cases had only ulnar nerve involvement with paralysed fingers, while another about 25% had combined nerve paralysis with the whole hand paralysed. Involvement of the median nerve alone in the form of paralysed thumb muscles was seen only in two cases while another three cases showed paralysis of all the three nerves supplying the hand muscles. In these cases only the long flexors were spared, and patients could use the hand as a hook (Fig. 2). In 61% of the cases, the involvement was bilateral and mostly symmetrical.

Table IX shows that out of 104 hands showing single nerve paralysis of ulnar or median nerve, 24 hands (about one-fourth of the total) had fixed deformity or partially atrophied fingers and were difficult to treat (Fig. 1).

Table X shows that out of 50 hands with complete paralysis of the intrinsics 36 (72%) had either marked stiffness of the

fingers and thumb or atrophy and partial amputation presenting a challenge for the orthopaedic surgeon, since these cases would need lot of ingenuity and experience of hand surgery to salvage some of these hands. If physiotherapy facilities were available, these cases would not have reached such a hopeless stage.



Fig. 1

Case with ulnar nerve paralysis with little and ring fingers clawed. The clawing is fixed in Left hand.

TABLE VIII

Various Types of Deformities Hands in Leprosy

Total Cases—100

Total Hands—200

Types of Deformities	Total Cases	Sex		Hands Involved				Percentage
		M	F	Both	Rt.	La.	Total	
Paralytic with Claw hands ...	—	—	—	47	31	29	154	77.0
Reverse or Intrinsic plus deformity of fingers ...	7	5	2	5	1	1	12	6.0
Partial or gross absorption of all fingers ...	7	1	6	4	3	0	11	5.5
Terminal tip atrophy of all or few fingers ...	13	—	—	4	5	4	17	8.5
Very supple fingers ...	9	—	—	9	—	—	18	4.5
Horny Thumb Nails ...	2	—	—	2	—	—	4	2.0

TABLE IX

Paralytic Deformities of the Hands

Single Nerve Paralysis (Ulnar or Median)

Total Cases—100

Total Hands—200

	Type of Deformity	No. of Cases	Sex		Hands Involved				% Total hands
			M	F	Both	Rt.	La.	Total	
ULNAR NERVE ALONE	Clawing Little Finger Supple ...	12	8	4	6	3	3	18	9.0
	Clawing Little Finger Fixed ...	4	—	4	1	2	1	5	2.5
	Clawing Ring and Little Finger-Supple...	21	16	5	12	9	—	33	16.5
	Clawing Ring and Little Fin. fixed.	2	1	1	—	1	1	2	1.0
	Clawing all four finger supple ...	19	12	7	7	4	8	26	13.0
	Clawing all four finger fixed ...	5	2	3	2	1	2	7	3.5
	Clawing all fingers with partial amputation ...	8	4	4	2	3	3	10	5.0
Median	Paralysis Thumb alone ...	2	1	1	1	1	—	3	1.5
Total ...		—	—	—	31	24	18	104	—

TABLE X

Paralytic Deformities of the Hands

Combined Nerve Involvements

Total Cases—100

Total Hands—200

Nerve Involved	Type of Deformity	No. of Cases	Sex		Hand Involved				Percentage
			M	F	Both	Rt.	La.	Total	
ULNAR + MEDIAN	Clawing all fingers and thumb Supple ...	9	6	3	5	—	4	14	7.0%
	Clawing all fingers and thumb Fixed ...	5	3	2	1	—	4	6	3.0%
	Clawing all fingers and thumb with partial amputation and atrophy of some ...	17	5	12	10	6	1	27	13.5%
Ulnar + Median + Radial	Fixed flexion fingers with wrist drop (Ulnar and median with radial nerve involvement) ...	3	1	2	—	1	2	3	1.5%
Total ...		—	—	—	16	7	11	50	—



Fig. 2

Right Hand showing paralysis of all the 3 nerves, while in left hand there is ulcer and median nerve involvement.

Feet Disabilities (Table XI)

In about half the cases (46.7%) trophic ulcers either active or healed were seen. This high incidence can probably be explained by the fact that almost all the patients walk about bare-footed, mainly by habit and partly because they cannot afford a shoe.

In 12% cases paralysis, mainly in the form of foot-drop was seen and another 10% showed partial or gross absorption of the feet. In three cases below knee amputation had already been performed due to extensive deformation and ulceration of feet.

Table XII. On closer study of the 70 cases with trophic ulceration, only 15 cases (21.4%) showed healed ulcers, while in the rest, the ulcers were all active

TABLE XI

Classification of Feet Disabilities in Leprosy

(After the Leprosy Unit of W. H. O.)

Total No. of Patients—150

Grade	DESCRIPTION	No. of Cases	%
Grade I	Only Anaesthetic feet	24	16.0%
Grade II	Trophic Ulcers—Present or Past	70	46.7%
Grade III	Paralysis—dropped foot or claw Toes	18	12.0%
Grade IV	Partial atrophy of foot upto 1/3 of surface area of the sole	6	4.0%
Grade V	Gross absorption—more than 1/3 of the foot lost	9	6.0%
	Amputated lower limb due to foot ulceration, deformity, etc.	3	2.0%
	Total	130	86.7%

TABLE XII

Trophic Ulcers Feet in Leprosy

Total Cases with Trophic Ulcers—70

Description	No. of Cases	Sex		Feet Involved			Total Feet
		M	F	Both	Rt.	Lt.	
Active Ulcers with toe deformities ...	26	20	6	8	12	6	34
Active Ulcers without toe deformities.	14	9	5	4	5	5	18
Healed trophic Ulcers ...	15	10	5	3	5	7	18
Extensive ulceration with deformed feet with amputation ...	6	3	3	—	3	3	6
Ulcers associated with foot drop (Lat. popliteal N. paralysis) ...	9	4	5	5	2	2	14
Total ...	70	46	24	20	27	23	90
Percentage ...	—	—	44.4	30.0	25.6	—	—

needing necessary orthopaedic measures and education regarding the protection of anaesthetic feet from trauma. 20 out of these 70 cases (28.6%) had involvement of both feet which is quite disabling and some of these cases get permanently bed-ridden due to ulcers alone. Six out of these cases had such extensive ulceration with secondary osteomyelitis and deformed feet, that

only treatment advisable was amputation below the knee.

Table XIII. Out of the paralytic deformities of the feet, lateral popliteal paralysis was the commonest and was met with in 13 cases out of a total of 18 (72.2%). Of these thirteen cases bilateral involvement was met with in 6; and it may be of interest to know that all these

TABLE XIII

Various Types of Paralytic Foot Deformities in Leprosy

Total Cases—18

Serial No.	Type of Deformity	No. of Cases	%	Sex		Feet Involved			Total
				M	F	Both	Rt.	Lt.	
1	Only "Foot-Drop"	4	22.2	2	2	1	2	1	5
2	"Foot-Drop" with Ulceration...	9	50.0	4	5	5	2	2	14
3	Cavus feet with claw toes	5	27.8	3	2	1	2	2	6
	Total	18	—	9	9	7	6	5	25
	Percentage	—	—	50.0	50.0	56.0	24.0	20.0	—

cases happened to be female patients. Lateral popliteal paralysis is a major orthopaedic problem in these leprosy patients since extensive ulceration starts very soon and some of these cases go on to small stumpy feet or need amputation on account of extensive ulceration. Out of these 9 cases with "drop-foot" and ulceration 3 cases showed extensive ulceration requiring amputation and 5 had secondary atrophy of the distal parts of feet.

Table XIV. Out of 15 cases showing distal absorption of the feet, 5 cases (33.3%) showed almost bilaterally symmetrical findings which was associated with similar atrophy in both hands (Fig. 3, 4, 5). Two-thirds of these patients were females; again



Fig. 3

Bilaterally symmetrical bone atrophy of both hands and feet.

indicating similar greater incidence of severe mutilating deformities with paralysis and atrophy of the hands and feet in the females patients. Right foot was more often involved than the left. Only three cases with the stumpy feet were free of ulceration or lateral popliteal paralysis. The mechanism of these changes would form an interesting study. It seems to be chiefly neurotrophic but vascular disturbances, trauma and infection would form an important step in avoiding this mutilation of the hands and feet.



Fig. 4

X-rays of hand showing bone absorption.

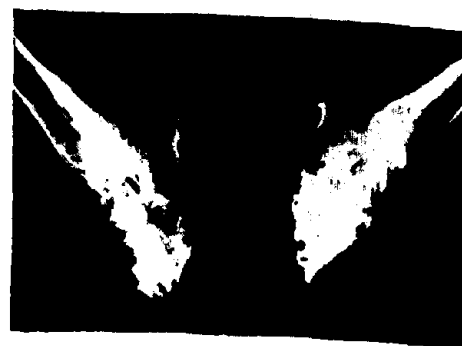


Fig. 5

X-rays of feet showing bone absorption.

TABLE XIV
Bone Absorption and Foot Atrophy in Leprosy
Total Cases—15

Type	No. of Cases	%	Sex		Feet Involved			
			M	F	Both	Rt.	Lt.	Total
Associated with ulceration active or healed	8	53.3	3	5	2	4	2	10
Associated with Lateral Popliteal Paralysis	4	26.7	—	4	2	2	—	6
Without Ulceration or Lat. Popliteal paralysis	3	20.0	2	1	1	2	—	4
Total	15	100.0	5	10	5	8	2	20
Percentage	—	—	33.3	66.7	50.0	40.0	10.0	—

PART II

Split Sublimus Tendon Transplant

Work on the reconstructions of these post-lepra claw hands is comparatively in its infancy in the orthopaedic department at Pondicherry—being just about one year old. As it happens in any other place, my first patients to volunteer have been mainly those who have had these deformities for a long period, even over 10 to 12 years, with secondary stiffness, and contractures. Of course, due to the pioneering work of Dr. Paul Brand at Vellore there was very much more confidence in the minds of the patients regarding the value of operative interference in these hands. Now more and more cases are flocking to the clinic for treatment.

Transplantation of the flexor sublimus to take the place of the paralysed intrinsic to restore the digital muscle balance is one of the oldest operation. It was first described by Stiles in 1922 and later modified by Bunnell. Since most of these cases had pre-operative contracture and stiffness, which had to be overcome by intensive physiotherapy, in all these cases only split sublimus transplant has been done. There

has been no occasion to use Brand's "Many-tailed" transfer or Fowler's extensor proprius transplant.

A review of a total of 31 cases with the last follow up of three months after operation is presented. A total of 33 cases were operated during this period but two were lost to the follow up.

Table XV. 26 were males and 5 female patients and more than 50% of these cases were young adults between the ages of 20 and 30 years.

Table XVI. In about 50% of these cases all the four fingers needed transplantation to restore the balance while in one-third of the cases only little and ring fingers had to be transplanted. In 24 out of these 33 cases, left hand was operated.

Now, as a routine, for the claw deformity of ring and little fingers, sublimus tendon of the ring finger is detached and split into three tails (Fig. 6) one for the ring finger and the other two to be passed on to the two sides of the little finger. The results of this

TABLE XV

Age Distribution of the Operated Cases

Males—26		Total Cases—31		Females—5
AGE		Number of Cases	%	
Below 10 years		—	—	
11 to 20 years		6	19.3%	
21 to 30 years		16	51.6%	
31 to 40 years		4	12.9%	
41 to 50 years		5	16.1%	
Over 50 years		—	—	
Total		31	100.0%	

TABLE XVI

Distribution According to No. of Fingers in each Operated Hand

Total Hands Operated—33

No. of Fingers	Rt. Hand	Lt. Hand	Total	%
All the 4 Fingers	2	14	16	48.5%
Little, Ring and Middle Fingers	2	3	5	15.2%
Little and Ring Fingers	4	7	11	33.3%
Ring Finger only	1	—	1	3.0%
Total	9	24	33	

modification of attaching the transplant to both the sides of the little finger were found to be definitely superior as revealed by the comparison of our earlier results, when only one tail was attached to either side of the little finger. The residual flexion or abduction deformity of the little finger used to be common after single sided transplant, which is very much less common now—patients can even get back some active adduction and abduction power. In cases with all the four fingers involved, in addition the sublimus of the index finger is detached and

split into two tails and attached after passing on to the radial side of the respective metacarpophalangeal joint (Fig. 10). The tendon tails were attached to the oblique bands of the extensor expansion using finest black silk and usually three stitches are put. The last stitch is passed through the extensor expansion in region of the dorsum of the p.i.p. joint to ensure that maximum straightening effect can be exerted on the inter-phalangeal joints especially in cases of flexion contracture of a long duration.



Fig. 6

The flexor sublimis of the ring finger split into 3 tails and two of these tails attached to either side of little finger.



Fig. 8

Post operative. Fingers in possible adduction.



Fig. 7

Preparative. All the 3 fingers (little, middle and ring) were operated.



Fig. 9

Post Operative Fingers in possible abduction

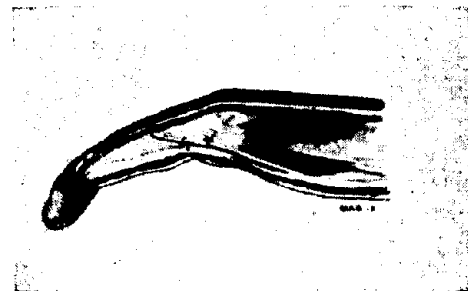


Fig. 10
The distal end of the transplant anchored to the extensor expansion in region of the dorsum of P. I. P. joint.



Fig. 11
Pre-operative.



Fig. 12
The little finger of right hand showing slight persistent abduction and flexion deformities because single sided transplant done. Left Hand showing "Excellent" result.



Fig. 13
Preparative (fingers nails digging into palm).



Fig. 14
Post operative.



Fig. 15
(Preparative) Patient holding bottle with the fingers flexed.

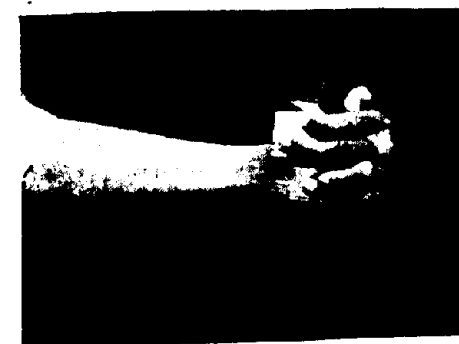


Fig. 16
(Post operative) Patient able to open out fingers and hold the bottle better.

Results

(Table XVII). In 24 out of 31 cases (77.4%) the results could be rated as *Excellent* or *Good* with no residual clawing of the fingers and with full movements of all

the joints. The patients have as good a hand as normal both in function and to look at. In reconstruction of the lepra hands, no doubt, function is of great importance, but appearance is equally important since, once the disease has been cured by Chemotherapy the stigma of clawing may be the only one left to single out the patients.

In 7 cases the results could be rated only as *Fair* or *Poor*; of course, even in these cases there was definite improvement in function and appearance. In two of these cases, the clawing had been present for 8 and 12 years though the fingers were very soft and could be opened out fully before the operation. In these cases the fingers still go into some degree of clawing on trying to open out the hands and also the transplant is functioning weakly. Perhaps in these cases, due to a long duration, the dorsal expansion stretches and the oblique hands come to occupy a volar position in respect to the axis of the p.i.p. joint. Even in these cases the operation has been worth-while very definitely because the patients can hold the objects in the hands instead of the fingers just getting flexed and digging into the palm when trying to catch anything. Also, both the patients are keen to get the other hand operated which is similarly affected.

In rest of the four cases with fair results some stiffness of the M.P. or I.P. joints is persisting which though mobilised before the operation has re-appeared, partly due to the non-cooperation of the patients in the physiotherapy regime. In one of these cases,

TABLE XVII

Results of Operation

Total Hands Operated—33

Lost to Follow up—2

Total Hands Reviewed—31

Results	DESCRIPTION	No. of hands	%
Excellent	No clawing with transplant working well. Full movements Fingers No Secondary Deformity Finger.	4	12.9%
Good	No clawing with transplant working well. Full movements Fingers. Slight flexion deformity (usually of little Finger).	20	64.5%
Fair	Some residual clawing with weak functioning transplant Movements fingers restricted in extremes Persistant-flexion contracture deformity fingers	6	19.3%
Poor	Clawing persisting or Further decrease in function due to paralysis etc.	1	3.2%

there was paralysis of the wrist extensors with weakness of the finger extensors, after an orthrodesis of the wrist, split sublimus transplant was done, which however, is weak due to the stiffness of the M. P. joints as well as the inherent weakness of the extensor mechanism.

The solitary poor result has been due to tourniquet paralysis which has not yet sufficiently recorded to give him a good grip. This is one of the recent cases and still the improvement is maintained. Even in this case there is no residual clawing.

In no case did we meet with secondary deformity and hyper-extension of the p.i.p. joint subsequent on the removal of flexor digitorum sublimus, in fact our main difficulty has been to get over the marked flexion with which most of these cases presented.

In conclusion, I would like to remark that more than 25% of the patients affected by leprosy need orthopaedic care. Till the time we can find ways and means of preventing or reversing the neural involvement in leprosy, surgery should be given a larger place in all the institutions caring for the leprosy patients. Since the disfigurement and deformities which were once regarded as inevitable can to-day be prevented by physiotherapy and in most cases corrected by surgery.

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FRACTURES OF PATELLA*

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This is a study of some aspects of fractures of patella and their treatment by patellectomy with a review of literature.

Fractures of patella have held a fascination all their own and the last word in their treatment is not yet said. Because of the role of patella as a part of the extensor mechanism of the knee, the fractures are important. A study has been made of 35 cases of fractured patella met with in King George Hospital, Visakhapatnam during the last five years. Twenty-five of these were treated by total excision of the bone and their results analysed.

Morphology and comparative anatomy

In a study of function after its total excision the morphology of the bone can be expected to throw some light. The point in dispute is whether it is a sesamoid bone or whether it is phylogenetically inherited. *Brook* on the evidence put forward by *Berney* and *Kazzender* came to the conclusion that the bone is phylogenetically inherited and the tendon takes a secondary attachment. If the bone has developed to meet the functional needs, its size must increase *pari passu* with the increasing function of the quadriceps in the adult. On the contrary the size of the patella is relatively bigger in the child than in the adult. It is said that the fast moving animals have a small patella and the bone is big in slow moving animals. In the Kangaroo in which the quadriceps is best developed the bone is extinct. From all the evidence *Brooke* came to the conclusion that the bone is in a process of

biological extinction and not one that has developed out of necessity.

Surgical Anatomy

The patella is a triangular piece of bone situated in front of the lower end of femur with its apex pointing downwards. The posterior surface articulates with the corresponding surface on the femur. Above and below there are roughened areas which in normal situation are covered by fat. The anterior surface is convex and rough and is pitted for the entry of nutrient vessels. The superior pole receives part of the insertion of Rectus-femoris and Vastus intermedius, some fibres of which go across its anterior surface to become part of the ligamentum patella. The medial and lateral borders give attachment to the Vastus Medialis and Vastus Lateralis, which also are inserted into the upper end of Tibia through the retinaculae. To the lower pole is attached the ligamentum patellae.

The blood supply of the bone is through the small vessels that enter the anterior surface. The poor blood supply is responsible for the avascular necrosis met with after fractures of this bone. The bone is ossified from a single centre which usually appears during the 2nd or 3rd year, but may be delayed upto 6th year. Ossification is usually complete by puberty. Occasionally a second centre may also appear. Failure of fusion of the two centres gives rise to the condition called congenital bipartite patella, a condition which assumes importance in the radiological diagnosis of a fracture. We had no such case.

Function

The functional utility of the bone is a matter subjudice and many theories have been advanced to explain the function. *Smillie* thinks that the bone carries the extensor tendon away from the axis of the joint in all positions and thus increases the power of the quadriceps. According to *Lickey* the bone is a pulley for movement round the condyles of the femur and the upper end of it is kept in front of the axis of flexion and extension. This provides for better function during extension. He suggests that the presence of the bone makes the mechanism that of a lever of 1st order with the fulcrum in between the two fixed points, the site of the fulcrum depends on the resultant of forces acting and their direction. Such a mobile fulcrum, he says, provides a maximal utilisation of force in all angles of the range of motion. It has also been claimed that the bone gives a 'zip' effect in the last 10 to 15 degrees of extension.

Brooke from a study of comparative anatomy shows that such advantage is minimal in animals and that any advantage gained in leverage and alteration of fulcrum is lost by the interference in rate and loss of smoothness of motion. In man active range of motion at knee is just short of extension both in running and walking and in this position the force is least efficient as a weight bearing mechanism. Such being the range the 'zip' effect of terminal extension also falls into insignificance.

The point in dispute is whether it is designed for this purpose or whether it has adopted itself to this function because of its situation. *Brookes* concludes that though, theoretically there is an advantage, in practice it is doubtful whether its mechanical value is of any assistance in the movement of the knee and it appears to be an imperfect

adaptation for a function for which it was never meant and thus has a deterrant action.

Based on this view is the operation of patellectomy and the results of earlier workers and of ours too are in accordance in regard to the full maintenance of function after the operation.

Nature of injury and types of fractures

Classically two types of injuries are said to produce correspondingly two different types of fractures. (1) A direct injury to the bone due to a blow over the patella or direct hit against a hard object during a fall causes a stellate or a comminuted type of fracture. (2) Indirect injury which is more common is often due to slipping while walking, running and while going up or down steps. The individual tries to regain stability by suddenly contracting the quadriceps. This results in avulsion of either of the poles (Fig. 2) or a transverse fracture of patella (Fig. 1) and tear of the retinacula. (3) A combination of both types occurs quite commonly and it forms roughly about 50% of our cases. This is due to the accident during which, following the nature of damage described in 2, the patient falls on the ground and rests on the fragment, which then becomes comminuted. Most often it is the lower fragment that thus becomes comminuted (Fig. 3 & 4). In our total of 16 cases of transverse comminuted fractures, we had only one with comminution of the upper pole. This comminution is usually greater than what is evident in radiographs and is best noted at operation. Their importance is that they are obviously unsuitable for treatment by the method of screw fixation, by suture etc.

Table I shows various types of fractures and their incidence in relation to the nature of injuries.

*Paper read at the Annual Conference of Association of Surgeons at Jaipur, December 1959.

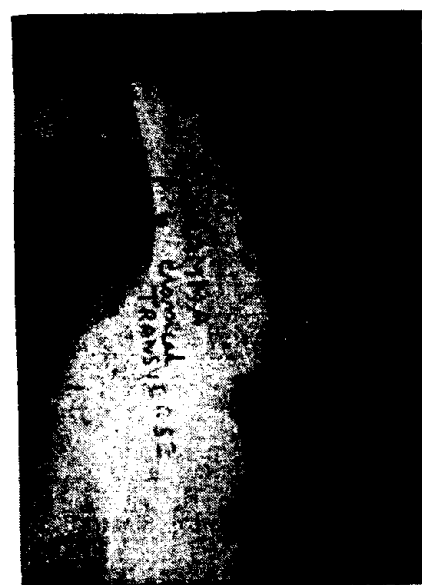


Fig. 1
Showing transverse fracture.



Fig. 3
Showing lower pole comminuted fracture.



Fig. 2
Showing upper pole fracture.



Fig. 4
Showing lower pole fracture without separation. Can be treated conservatively without excision.

TABLE I
Showing Nature and Types of Fractures

Nature of Injury	Stellate	Simple Transverse	Transverse comminution of one pole	Polar		Marginal Chip
				Superior	Inferior	
Indirect (a) While Walking ...	—	4	8	2	3	—
Violence (b) While Running ...	—	1	—	—	—	—
Slipping (c) Going up a Stair Case ...	—	—	1	11	—	—
Total 22 (d) Getting Down A Stair Case ...	—	1	1	—	—	—
Direct Violence (e) Fall on Ground ...	2	2	5	—	—	—
Total 13 (f) Blow on Patella ...	1	1	1	—	—	—

Right side 19—Left side 16.

The distribution between the two sexes at various age groups is shown in Table II. The proportion of M : F is 3 : 1 in our series and in the series of *Reich* and *Rosenberg* 2 : 1. Age and sex have no relation to the method of treatment or the end results. The relationship of the end result to the duration from the time of injury to the time of operation is shown in Table III. Our conclusion is that operation should never be delayed as retraction and fibroses will interfere with good result.

TABLE II
Distribution of Age and Sex

Age Group	Males	Females
20 — 30 ...	6	1
30 — 40 ...	8	3
40 — 50 ...	3	4
50 — 60 ...	4	1
60 — 70 ...	5	0
Total ...	26	9

TABLE III

Results in Relation to pre-operative period

Group	Duration before operation	Grades			
		A.	B.	C.	D.
1	1 to 7 days average 5 ...	7	3	1	0
2	7 to 15 days average 13...	0	3	1	1
3	2 to 6 months average 4...	1	—	—	—

Treatment

(1) Chip fractures and polar fractures not involving the articular surface and without separation of the fragment and hence without tear of ligament and aponeuroses can be satisfactorily treated on conservative lines. Compression bandage after aspiration along with rest for a week relieves pain and swelling. A week of non-weight bearing exercises will make the patient fit to bear weight.

(2) Stellate fractures must be treated by patellectomy and many people agree on this point. This is to prevent osteo-arthritis.

(3) With regards to the transverse fractures much difference of opinion exists. These fractures are associated with wide tear of quadriceps expansion and it should be repaired without fail for efficient function of quadriceps.

The different methods of treatment are (1) when it is a pure transverse fracture, open reduction and internal fixation by nails, screws, circumferential wiring stitching by chromic cat-gut, silk, linen, Kangaroo tendon, or fascia lata, or bone grafting. (2) When the fragment is small or comminuted, excision of the fragment with repair of the tendon. (3) Total excision of the patella.

Method one is advocated by those that believe that the patella has an important function. But the disadvantages of this method are, (1) failure to obtain accurate reduction leading to irregularity of articular surfaces will predispose to early osteo-arthritis which will necessitate patellectomy. (2) comminution of fragments will not allow proper reduction and fixation. (3) The use of metal screws and nails for fixation near joint is not good as there is a likelihood of reaction. (4) Separation of fragments will occur inspite of fixation due to a continuous distraction force of the muscle. (5) Dissolution of breaking of the fixation material and the danger of the same getting into the joint. (6) The necessity to remove foreign metal material after the fracture has united. (7) Fibrous union due to distraction is unsatisfactory as it produces lengthening of tendon, which causes instability and weakness. (8) The possibility of refracture: *Blodgett* and *Fairchild* quoted *Kellog Speed* and *Corner* as mentioning that the patella was liable to refracture. *Schmeir* gave the frequency of rate of refracture as 10%. (9) The fracture requires prolonged period of immobilisation due to poor osteogenic

powers of the bone. (10) Avascular necrosis of the bone is fairly common. (11) If infection occurs, fixation of the bone to the femur results which impairs the function.

In Method two repair of the tendon retaining the large fragment is advocated on the grounds that (1) it restores the functional integrity of the bone (2) it retains the protection to the joint, (3) the symmetry of the knees is maintained, and (4) it leads to minimal residual deformity and disability. The fragment is said to be retained to act as a fulcrum during the knee movements. But how far it is a fulcrum, and whether a fulcrum is needed at all is doubtful. *O'Donoghue* pointed out that the patella loses its stability when more than one third of it is removed. *Reich* and *Rosenberg* mention that many cases show unstable or rocking patellas even if two thirds of bone is left behind. It is important to note also that the tilting of the fragment occurs and leads to dragging of the rough edge on femoral surface causing osteo-arthritis.

Advocates of the above two methods try to preserve the normal anatomy but as *Smillie* says that "Restoration of normal anatomy should be ideal of treatment, but impossible should not be attempted. It would not be out of place to mention that they maintain the best functional results depend on accurate quadriceps repair".

Method three depends on the repair of quadriceps for best results. Total excision of patella was done for various purposes but till late in 19th century was considered a failure. In 1898 *Scudder* did it for a fracture and reported good result. In 1908 *O. Rogers* did it for a second recurrence of fracture and obtained a perfect result. The first paper on the subject was by *Heinech* in 1909. He did 21 total excisions of which 7 were fractures. However he discouraged the method. Later on *Dudley, Willis, Rouvillier*

all reported good results. Interest on the subject was greatly revived by the study of *R. Brooke* in 1937. He obtained very good results and when *Hey-Grooves* was satisfied with the results he also advocated this method. Later many like *Freiberg, Dolsbie, Ryerson, Horwitz and Lambert* published their results.

The advantages of this method are (1) removal of all fragments of bone and thus avert osteo-arthritis. (2) Rapid, progressive, uneventful recovery in all cases. (3) Early return to function. (4) Excision will not adversely affect motion, strength, or stability of the knee joint.

The disadvantages are (1) Extensor lag due to residual lengthening of tendon resulting

in instability, but can be prevented by adequate over-lapping. (2) Loss of leverage, if any, is reported. But this does not occur as is shown by the good results obtained by many. (3) Asymmetry and loss of protection to the front of the joint. Asymmetry is not a complaint in any of our cases (Table IV). The men of our country do not bother about it and women will never worry about it either as long as there is a cloth to cover. Loss of protection is a hypothetical fear. In a fall invariably we land on the tibial tubercle, but even if it is the front of the femur it appears to be better to have a elastic band of tendon rather than this brittle bone. Many other disadvantages like presence of pain, aches etc., are only minor and are less in frequency (Table IV).

TABLE IV
Incidence of Complications and Disabilities

Serial No.	PARTICULARS			No. of Cases
1	Power of Quadriceps.	A. Normal and Equal on Both	...	12
	Do.	B. Slight Weakness	...	4
	Do.	C. Poor Power	...	1
2	Range of Movements	A. Full Range as Normal	...	3
	Do.	B. Flexion Beyond 90	...	3
	Do.	C. Flexion upto 90	...	1
3	Pain	...	...	3
4	Aching	...	...	3
5	Effusion	...	...	1
6	Complaint about Asymmetry	...	...	0
7	Rupture of Ligaments after Repair	...	...	0
8	Division of Infra Patellar Branch of S. Nerve	...	...	1
9	Laxity of Ligaments	...	...	1
10	Instability	...	...	0
11	Extensor Lag	...	...	0

Technique of Operation

Spinal anaesthesia was used in all cases, and was satisfactory. Under tourniquet the fragments were exposed through a curved incision extending from one condyle to other with its convexity pointing downwards and lying above the tibial tubercle. Skin and fascia were reflected in single layer. The fragments were removed by scalpel dissection. An important step is to pass the finger along the cut margins to feel for the spicules and remove them, the blood clots were washed off with saline. The tear in most cases was about 1". The ends were over-lapped and stitched with interrupted chromic catgut. All stitches were placed before they were tied. Wound was closed in layers and posterior plaster slab and bandage was applied. Antibiotics and sulfadiazine were given as usual. The sutures were removed on the 10th day and knee was immobilized in plaster from groin ankle which was kept for a month. Later active exercises to regain movements were started. Patients came back with full normal function in an average period of 2 months, from the time of removal of plaster. The exercises are very important and bad results are often due to the patient disregarding the advice.

Some surgeons do not immobilise the knee after operation but start exercises immediately after suture removal. We feel that immobilisation for a month is necessary to ensure good fibrous union at the site of suture. The resulting stiffness is never difficult to overcome.

Length of Quadriceps Tendon

A lot has been written about the need to shorten the tendon after excision of fragments to prevent extensor lag and instability. The truth of this is never in dispute but the disadvantage of over doing it is considerable. *Reich* and *Rosenberg* advocate

even over shortening. All this may be satisfactory in the western countries, but if we remember how important is complete flexion of knee to our people in our daily life we should not overlap the tendon too much as it prevents the flexion. The optimum shortening to be done, in our opinion, is not more than 1½ CM. (Figs. 5 & 6).

Our series consists of 25 cases of patellectomy and 10 cases which were not subjected to surgery. Follow up studies were made of the operated group from 6 months to 5 years. 17 cases came up for study and the results are shown in tables IV and V.

The success or failure was determined by the criteria laid down in Table V. The cases falling into the good and excellent groups amount to 82%, which is in accordance with the figures of *Reich* and *Rosenberg* 80% and those of *Freiberg* 85%. The



Fig. 5

Clinical photograph showing power of extension after excision; photograph showing complete flexion after excision which is very important in our patients.



Fig. 5-a
In Extension.



Fig. 6
Clinical photograph demonstrating the power of quadriceps muscle, after excision of patella.

TABLE V
Results in Comparison with Other Series

Grade	CRITERIA	Our Series Total Cases 17		Reich & Rosenberg Total Cases 16		Freiberg Total Cases 32	
		No.	%	No.	%	No.	%
A. Excellent	Equal length of quadriceps; full range of motion; No pain; Can do all work; Knee Normal	8	47%	14	68.75%	—	85%
B. Good	Slight weakness of quadriceps. Limitation of last 10-20 flexion; Pain on prolonged use; can do all work	6	35%	2	12.75%	—	—
C. Fair	Flexion upto 90. Power unequal; pain cannot run fast	2	11.7%	2	12.5%	—	—
D. Poor	Flexion upto 90. Pain, aching, walking with difficulty	1	5.9%	1	6.25%	—	—

N.B.—The criteria in our series and Reich and Rosenberg series differ. The recovery of complete flexion is insisted on as it is very important for our conditions; but complete flexion is not necessary in Western Countries and cases with limitation in flexion comes under excellent result; we have grouped such cases under Group B. As such the % in A. looks smaller. But the total of A and B is almost equal to our figures.

operation gives very good results in most of the cases. The incidence of various disabilities said to occur following operation are also tabulated in Table IV which are very insignificant.

Regeneration of Patella

Blodgett and Fairchild advocate excision with periosteum intact to obviate this. Experimentally it has been found that radiographic evidence of regeneration of patella in dogs appears in 17 to 20 days. There is no record of total and complete regeneration in man. Many cases might have developed cartilage or fibro-cartilage not seen in x-ray. Clinically we found locally hypertrophy and thickening in most cases but not bone.

The non operated cases

Of the 10 non-operated cases 6 were polar and marginal fractures without displacement. These were treated conservatively and we did not get any complaints from them. One transverse comminuted fracture case was not operated because the patient refused operation. One stellate fracture was not operated as the patient was a poor surgical risk and we had

considerable anxiety over him during a prior S. P. nailing for fracture neck of femur. One case of transverse fracture of 10 years duration came to us because of instability of knee resulting in a fall producing a basal fracture of neck of femur. In this case the fragments were about 3" apart, the quadriceps was weak and fibrosed and the knee showed signs of osteo-arthritis.

Conclusions

(1) Patellectomy appears to be a very satisfactory method of treatment of fractures of patella with distraction. (2) The advantages of this method are (a) early return to function. (b) Short period of disability (c) regaining stable and sound knee. (d) Excision of the bone does not impair efficiency of function.

Summary

(1) The function of patella in relation to morphology is discussed and various views mentioned. (2) The various methods of treating fractured patella are reviewed and their advantages and disadvantages discussed. (3) The good results obtained in a series of 25 cases treated by patellectomy are analysed.

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PLASTIC SURGERY SECTION

SINGLE PEDICLE OPEN FLAP IN THE TREATMENT OF UPPER LIMB CONTRACTURES*

BY

RASAMAY GANGULY, Poona.

Introduction

Indications of pedicle grafts decrease as soon as the Surgeon gets into the habit of thinking of free grafts first and becomes adept in handling them (Brown & McDowell). Though this is generally true in the treatment of most contractures, a pedicle graft also has its useful field of application in selected cases. When there are binding dense scars, excisions of which exposes muscles or tendons, bones or joints, vessels or nerves, and there is no subcutaneous fat to cover them, the transfer of a pedicle flap of skin becomes imperative.

The use of open pedicle flaps have fallen into disrepute in recent times. When a pedicle graft is indicated, a tube pedicle is usually preferred. Direct transfer of single pedicle flaps is considered only as an expeditious but relatively septic form of Surgery which is to be avoided if possible (Pick).

Seven Cases of contractures affecting the upper limb are reported here. In all these cases, excision of dense scars, followed by immediate transfer of a single pedicle open flap gave satisfactory cosmetic and functional results.

Case Reports

Case I.—P. R. male, aged 40 years, while giving demonstration in grenade throwing, sustained phosphorus burns involving both hands and scattered

areas of the whole body. He was referred for plastic reconstruction of contracted hands six months after the initial injury.

On admission, patient had flexion contractures involving the thumb, index, and little finger of right hand and the thumb and index finger of left hand. The scars were dense and hypertrophied (Fig. 1). In addition there were keloid scars scattered over both arms and chest wall.

Operation.—Right hand—Scars over the thenar eminence and volar aspect of right thumb were excised, exposing thenar group of muscles and part of the tendon of flexor pollicis longus, to release the thumb. The raw area was mapped out over the left lower quadrant of the abdominal wall, and a broad based, single pedicle, flap was raised, based inferiorly, for immediate transfer to the hand. The donor area was covered by split skin graft. The recipient and donor areas were closely approximated by flexion of elbow and full pronation of the forearm. The flap was made thin by removal of subcutaneous

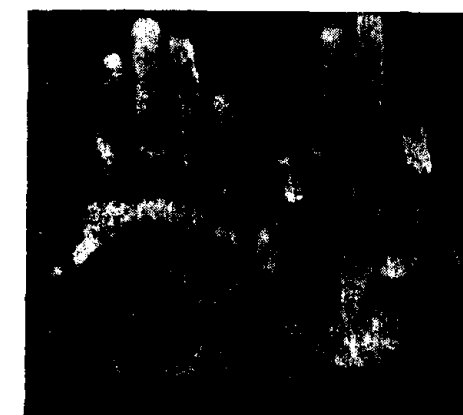


Fig. 1

*Paper read at the All-India Surgeons' Conference held at Poona on December, 1960.



Fig. 2

fat and accurately stitched to the defect on three sides (Fig. 2). The limb was anchored to the body by P. O. P. bandages.

The pedicle was severed at the end of three weeks and after necessary trimming and thinning, it was sutured in place. The pedicle base was returned to the original site and adjusted in place. During the same operation, scars on the volar aspect of contracted little finger (right) was excised and the raw area covered by a full thickness free graft. The index finger (Rt.) was straightened by multiple Z-plastics.

Operation.—Left hand - scars over the thenar eminence and part of the base of the thumb were excised and the thumb straightened out. Raw surface, left after excision, was covered by a small single pedicle, open flap from the right lower quadrant of the abdominal wall on the same lines as used in the right hand. The pedicle was severed after three weeks and finally adjusted into place.

Patient regained full function of the hands, and returned to full duty (Fig. 3 & 4).

Case 2.—G. R. male, aged 30 years, sustained deep burns involving the palm of left hand. He was



Fig. 3

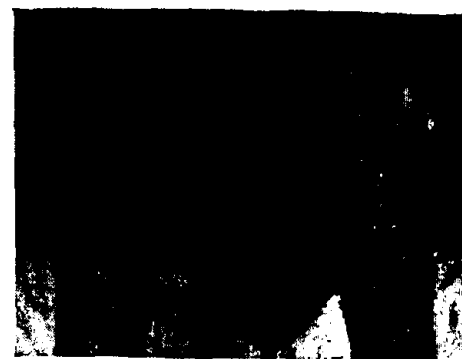


Fig. 4

referred for treatment of contractures 4 months after the initial injury.

On admission, patient had a hypertrophied scar in the palm with flexion contracture of the left index finger. In addition there were healed scars over the volar aspect of middle and ring finger but no contractures.

Operation.—Scars over the palm and volar aspect of the index finger were carefully excised and the affected finger straightened out. This resulted in partial exposure of the flexor tendons for the index and middle fingers. The raw area was mapped out on the left lower quadrant of the abdominal wall and a broad based, single pedicle, thin flap was raised, based inferiorly for immediate transfer to the hand. The donor area was covered by split skin graft, the recipient and donor areas closely approximated and the flap accurately sutured to the defect on three sides.

At the end of 4 weeks, the pedicle was severed and after necessary trimming and thinning, the unattached margin was sutured in place. Patient made a good functional recovery (Fig. 5 & 6).

Case 3.—N. N. male aged 30 years, sustained deep burns involving both hands. He was referred for treatment of scars, 6 months after the initial injury.

On admission, patient had dense hypertrophied scars over the dorsum of right hand, involving the web space between the thumb and the index and greatly limiting thumb abduction. Dorsum of left hand also had healed scars but no limitation of finger movements (Fig. 7).

Operation.—Hypertrophied scars were excised from the dorsum of hand (Rt.) and the affected web space, to release the thumb. The raw area was mapped out



Fig. 5

and a broad based, single pedicle, open flap was raised from the left upper quadrant of the abdominal wall, based superiorly. The donor area was closed by skin sliding. After close approximation of the hand to the donor area, the flap was accurately sutured on three sides, to the defect. The upper limb was immobilised to the trunk by adhesive strapping.

The pedicle was severed at the end of three weeks, the cut margin thinned and finally adjusted to the



Fig. 6



Fig. 7

defect. Patient made good functional recovery (Fig. 8).

Case 4.—M. S. male aged 26 years, sustained severe petrol burns affecting both upper extremities. He was referred for treatment of contractures involving right hand, 6 months after the initial injury.

On admission patient had dense scars over a wide area of the dorsum of hand (Rt.), clawing of the ring and little finger with partial webbing (Fig. 9).

Operation.—Dense scars were excised from the dorsum of hand (Rt.) to release the affected fingers. This left the extensor tendons to middle and ring fingers bare. The raw area was mapped out and a single pedicle flap was raised from the right lower quadrant of the abdomen, based inferiorly. The donor area was covered by split skin graft, the hand approximated to the abdomen and the flap sutured to the defect on three sides (Fig. 10).

The pedicle was severed at the end of 4 weeks and after careful trimming and thinning, sutured into place (Fig. 11). Patient returned to duty though some contracture of the little finger persisted.

Case 5.—G. K. male, aged 38 years, sustained a lacerated wound over the dorsum of right hand which



Fig. 8



Fig. 9

was infected and healed by granulation. Patient was referred for treatment of contracture 6 months after the initial injury.

On admission there was a dense scar over the dorsum of hand (Rt.), extending into the web space between thumb and index finger and limiting thumb abduction.

Operation.—Scar tissue were excised to release the thumb leaving the extensor tendons partially bare. The raw area was mapped out and a single pedicle flap was raised from the upper left quadrant of the abdominal wall. The donor area was closed by skin sliding, the hand approximated to the abdomen and the flap sutured to the margins of the defect on three sides (Fig. 12).



Fig. 10

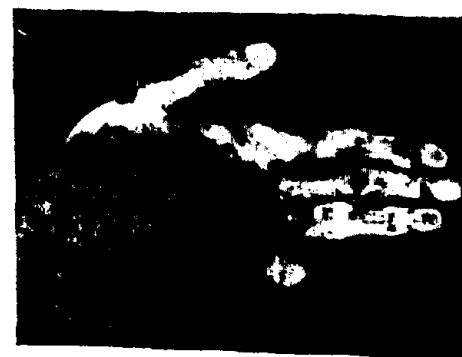


Fig. 11

The pedicle was severed after three weeks and finally adjusted to the defect with good cosmetic and functional results (Fig. 13).

Case 6.—L. N. male child, aged 6 years, sustained deep burns affecting the left upper limb, left side of abdomen and upper part of left thigh. He was referred for treatment of contractures 1½ years after the initial injury.

On admission there were dense scars all round the elbow and arm. Left forearm was almost fused to the arm by thick scar tissues. In addition there were hypertrophied scars on the thigh, abdomen and left hand (Fig. 14).



Fig. 12



Fig. 13



Fig. 14

Operation.—Dense scars were excised from the front of left elbow and arm. This allowed extension of the elbow a little more than a right angle. Scar excision left the muscle bellies exposed. The raw area was mapped out and single pedicle skin flap was raised from the chest wall based anteriorly. The donor area was covered by split skin graft, the arm held in close opposition to the chest wall and the skin flap sutured to the margin of the defect on three sides.

The pedicle was severed at the end of 4 weeks and after necessary trimming, the flap was sutured into

place. The range of elbow movement improved considerably allowing it to be extended beyond right angle (Fig. 15). Patient left hospital before any further treatment.



Fig. 15

Case 7.—C. M. female child, aged 7 years, sustained burns affecting left upper limb and part of the chest wall. She was referred for treatment of contractures 2 years after the initial injury.

On admission, patient had hypertrophied scars with flexion contracture of left elbow with a binding web across the joint (Fig. 16).



Fig. 16

Operation.—Dense scars over the elbow were excised and the joint fully extended with multiple Z-plasties in addition to scar excision. A raw area was left over the cubital fossa with the biceps tendon exposed. The area was mapped out and a single pedicle flap was raised from the abdominal wall (Lt.). The donor area was closed by skin sliding and the pedicle flap sutured accurately to the margins of the defect on three sides. The limb was immobilised to the trunk by adhesive strappings.



Fig. 17



Fig. 18

After 4 weeks the pedicle was severed, trimmed and sutured into place. Patient left hospital after a total stay of 6 weeks with good functional and cosmetic result (Fig. 18).

Discussion

Technique of free skin grafting has been perfected to such a degree that it has become the method of choice in a majority of contractures where a flap formerly was indicated. In all the cases reported here,

there were, however, enough justification to take recourse to pedicle grafts.

In cases 1 and 2, defects were in the palm and excision of scars left the thenar muscles and flexor tendons partly exposed. In cases 3 and 5 the scars were on the dorsum of hand going on to the web space between the thumb and the index. Scar excision exposed the interossei muscle and thumb extensors. In case 4 the extensor tendon to the fingers were exposed at operation. A pedicle graft was needed in all cases to provide a supple and movable cover.

The main disadvantages of a pedicle flap lies in the number of operations and the time involved. In all the cases reported here the defects were in the upper limb and the recipient area could be easily approximated to the donor area in the trunk, to receive the flap directly. There was no need to delay the flaps as the pedicles were broad based and the flaps not longer than twice the width of its pedicle. Immediate transfer of single pedicle, open flaps allowed the operative corrections to be completed in two sittings whereas the minimum number of operations needed, when a tube pedicle is used, is three.

Another accusation laid against a open flap is that there is a raw surface at the base of the flap, open to infection, fibrosis and puckering (Pick). After split grafting of the donor area or its closure by skin sliding, only a small surface is left provided the space between the defect and the base of the flap is minimum. The second operation was invariably carried out in three to four weeks, when the severed pedicle was freed of any granulations formed during the interval. There was no bobbiness in the repaired surface as special care was taken to adjudge the thickness of the graft to suit individual defects.

Summary

(1) Seven cases of contractures affecting the upper limb are reported.

(2) Single pedicle open flaps were used to cover defects after scar excisions in all cases.

(3) Flaps were directly transferred without any delay, saving in time and number of operations.

(4) The rationale of using pedicle flaps in preference to full thickness free skin grafts, has been discussed.

(5) It is felt that inspite of its inherent defects, a single pedicle open flap has some place in the treatment of contractures of the upper limb.

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RECONSTRUCTION OF THE ALA OF THE NOSE

(Case Report)

BY

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Loss of the ala of the nose is not a common condition from the files of nasal reconstructive problems. The loss may be due to a congenital absence or acquired during life. Traumatic loss of the ala alone

is rare as the accident very often involves the tip of the nose also. (I have not had the opportunity of seeing an injury due to a dogbite). A shrunken ala following burns is quite common.



Fig. 1
Defect of the nostril.



Fig. 2
Forehead flap with temporal artery pedicle.



Fig. 3
After second operation. Colour match is good.



Fig. 4
Side view.

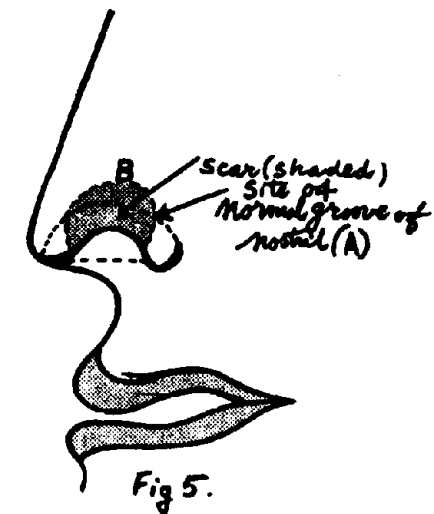
Amongst the infective group lesions due to tropical sores and gangrenous lesions in childhood present some cases.

Malignant skin lesions involving the ala require drastic surgical excisions with either simultaneous or late reconstructions.

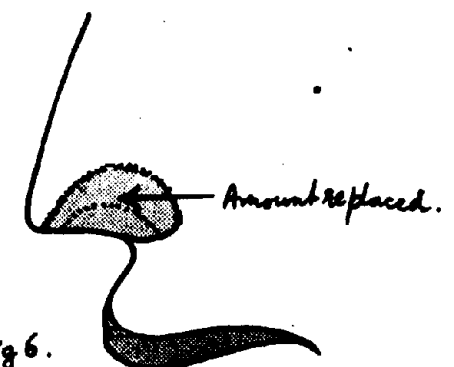
Case History.—Mr. M. H. a young Muslim from Cawnpore presented himself with a deformity of the left nostril (Fig. 1). He gave an history of burns due to acid. Four attempts had been made elsewhere to reconstruct the alar margin. His right forearm has scarred from attempted flap repair. Patient was very desperate due to these failures and showed suicidal tendency. A forehead temporal artery flap was suggested and operation carried out under general anaesthesia. The raw area was covered by a split graft from the innerside of the right arm. Second operation was done after one month. Forehead flap was replaced and split graft was excised in toto hence no graft was left on the forehead. The newly formed ala was kept slightly bulky to allow for post-operative shrinkage. Photographs one month after operation shows the result, the colour is slightly darker but the condition is very satisfactory.

Discussion

The forehead skin is an ideal donor area for nasal skin losses. The temporal flap avoids scarring of the centre of the forehead. To give the shape of the nostril some part of the normal skin had to be sacrificed. (Fig. 5) or else the result would not be so good. Notice in Fig. 5 the site of the normal groove on the nostril, (A) and the



upward extent of the scar beyond that groove (B). In Fig. No. 6 the curved margin of the replaced flap goes beyond that groove by a few millimeters—the difference is so small on the two sides that this



is unnoticeable. When this patient now sits amongst a group of men he passes without being noticed—that is exactly what he wanted. Repair with a composite graft from the ear, flap rotation from the cheek would have not solved this problem.

—Received for publication on 1-7-1960.

OSSIFYING FIBROMA OF THE CHEEK

(Case Report)

BY

R. J. MANEKSHA, Bombay.

This case is recorded for some of its interesting features. Mr. V. M. a young man of 25 years was referred from outside Bombay for correction of the tumour defect from the left cheek. History revealed a slowly growing mass which was painless. Below the lower eyelid was a scar and this was due to an attempt made at removal when the operation had to be terminated due to profuse bleeding. The most prominent outer part of the mass showed an area of telangiectasis and the skin was adherent at this spot. The tumour was firm except for the adherent area which was soft. Clinical diagnosis was difficult. There was no other tumour on the body. No evidence of facial nerve involvement.

Patient was operated under endotracheal anaesthesia. The area surrounding the tumour was infiltrated with saline-adrenaline

solution. The tumour mass had no capsule, was very friable and the skin had to be excised with it. Diagnosis on the operation table was suggestive of a malignant tumour. Frozen section facilities were not available. After excision a large raw area exposing the underlying maxilla had to be covered. It was decided to use a transposed flap from the forehead and skin graft the donor area on the forehead. This was done and the flap took well (Fig. No. 2).

After three weeks the second operation was done and the remaining part of the flap was detached and restitched to its original position (Fig. No. 3).

Biopsy report.—Ossifying Fibroma, no malignancy.



Fig. 1
Before Operation.



Fig. 2
After the First Operation. Split graft to forehead.



Fig. 3
After the Second Operation.

Discussion

The history of an unsuccessful previous attempt at removal due to profuse bleeding suggested that the tumour could be a haemangiomatous one. The hyperpigmented area at one spot also lead to the same conclusion. The infiltration of saline-adrenalin solution made the dissection a very simple operation. The decision regarding the closure of a wide defect exposing the

maxillary bone had to be made immediately. The graft would have succeeded but the result would not have been acceptable hence a flap from the forehead was shifted down and free graft applied to the forehead.

The late result of this case has been very satisfactory due to this method of skin cover. There has been no recurrence since six months.

—Received for publication on 1-7-1960.

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THE XXIII ANNUAL CONFERENCE

The 23rd Annual Conference of the Association of Surgeons of India will be held at the Medical College, Baroda, from the 27th to the 30th of December 1961.

The Main subjects for the scientific discussion at the Annual Conference are as follows :—

1. (a) **Injuries of the Hand.**
by Dr. Subir K. Chatterjee, Calcutta.
- (b) **Early repairs of Hand Injuries.**
by Dr. C. Balakrishnan, Nagpur.
2. **Spinal Cord Tumours.**
by Dr. R. Chatterjee, Calcutta.

Besides this, a few "Short Papers" will be presented at the Conference.

Dr. A. B. Kothari, M.B., F.R.F.P. & S., M.S., F.I.C.S., Lecturer in Surgery, Medical College, Baroda, is the Local Secretary, who is making arrangements for the Conference.

Further details about the Conference will be announced later.

*

*

*

SUBJECTS FOR DISCUSSION AT FUTURE MEETINGS

24th Meeting (1962)

1. **Tumours of Urinary Bladder.**
by Drs. K. K. Ghosh and H. K. Sarkar, Calcutta.
2. **Management of Burns.**
by Dr. Anjali Mukherji, Calcutta.
3. **Experiences in the Use of Extracorporeal circulation for Cardiac Surgery.**
by Dr. A. K. Basu, Calcutta, P. K. Sen, Bombay and Dr. S. N. B. Roy, Calcutta.
4. **Septic and Suppurative Arthritis of the Hip.**
by Dr. B. Mukopadhaya, Patna,
and
5. **A Paper on Anaesthesia (to be decided in due course).**

25th Meeting (1963)

1. **Hypothermia.**
2. **Experiences in Surgery for Chronic Pancreatitis.**
by Dr. R. S. Gupta, Calcutta.

—★—

NOTICES

ORTHOPAEDIC SECTION

The Summer Conference of the Orthopaedic Section of the Association of Surgeons of India, will be held on 4—5 and 6th August 1961, at Ahmedabad.

The long paper to be discussed is "Partial Synovectomy of knee joint".

Those members desirous of attending the conference and/or present short papers, please contact the local Secretaries:

1. Dr. M. D. Desai, M.S., F.R.C.S., M.Ch., orth., Director, K. M. School of Post-Graduate Medicine and Research, Ellisbridge, Ahmedabad-6.
2. Dr. M. T. Mehta, M.S., M.S. (ortho.), K. M. School of Post-Graduate Medicine and Research.

* * *

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The Fellowship will enable a candidate to visit all the leading Orthopaedic Centres in India and a very lively programme will be arranged for them. The candidates if selected must be willing to proceed on the tour of visits by the 1st week of January 1962. There are four fellowships for this year but the Orthopaedic Section reserves the right to select as many as they consider suitable.

The last date for receiving applications is 30th June 1961.

—★—

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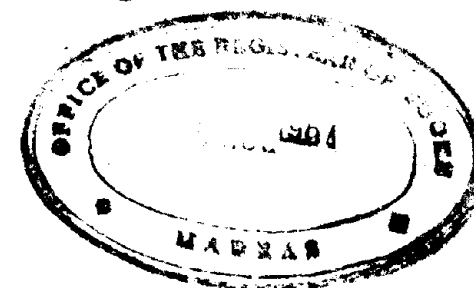
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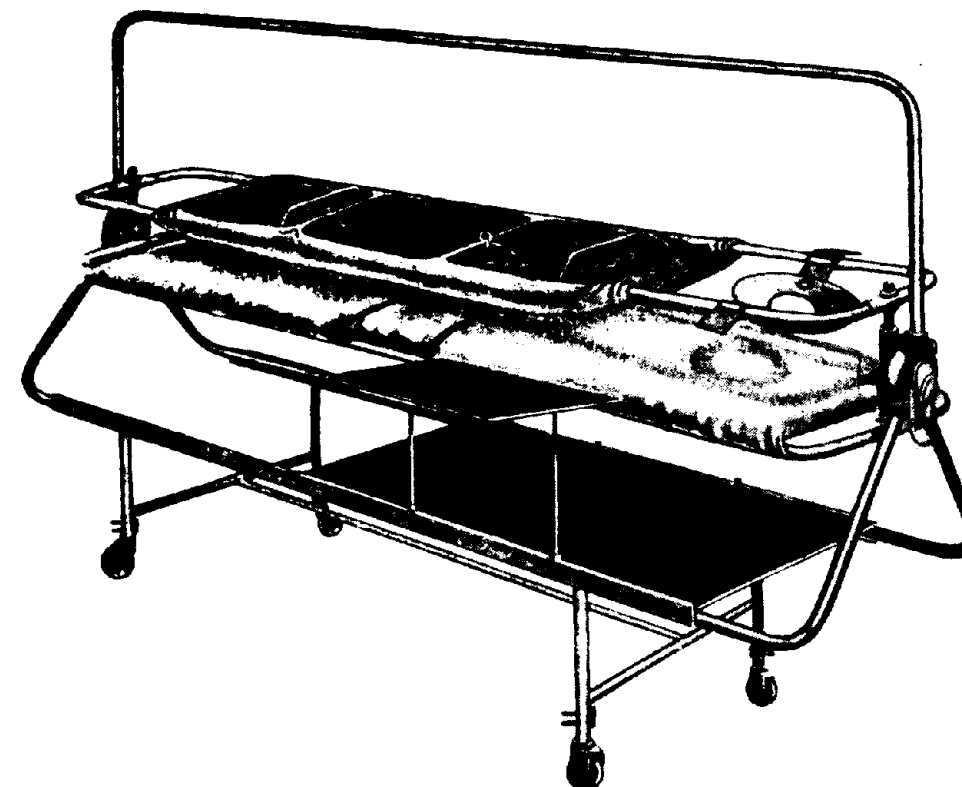
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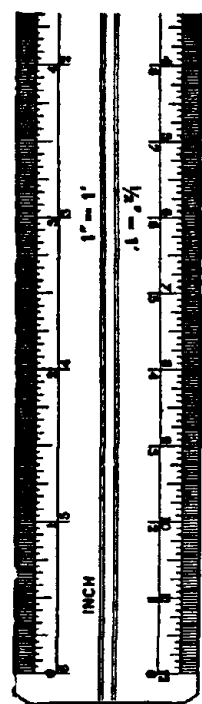
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Fowler, R. H.: Cysts of the Spleen, Ann. Surg., 57: 638, 1930.

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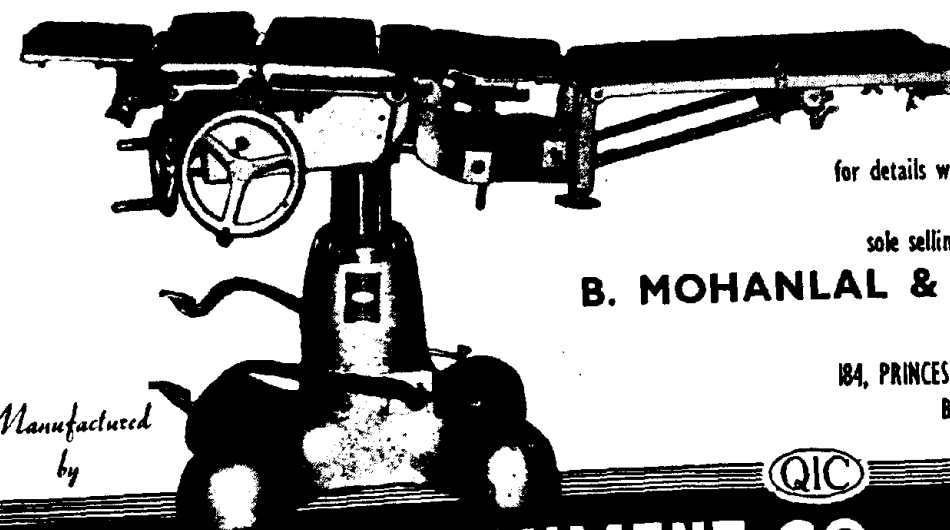


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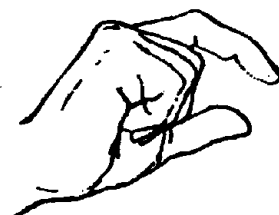
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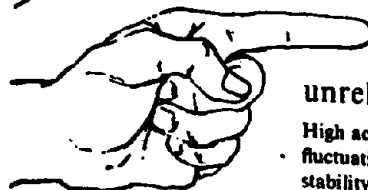
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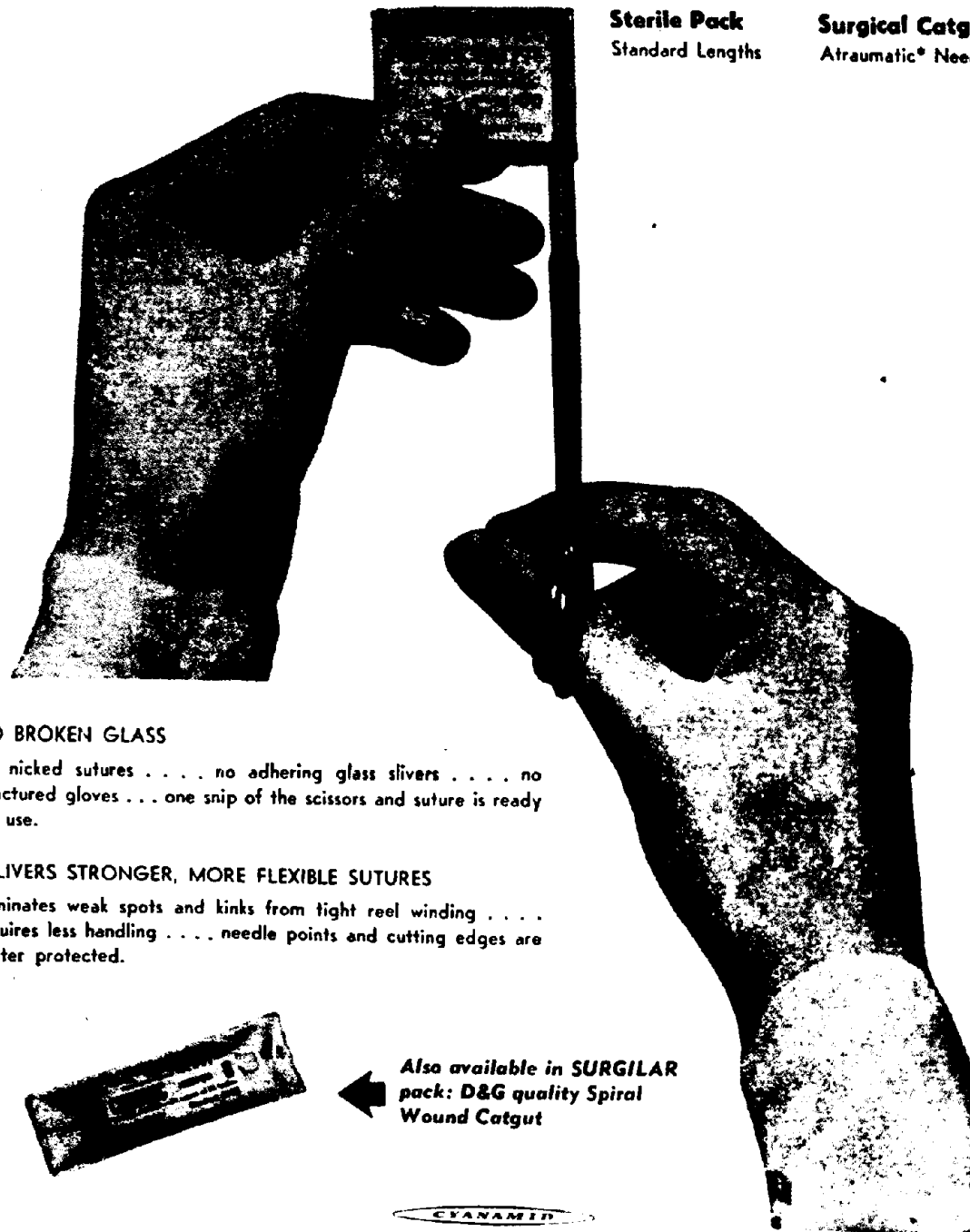
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RECONSTRUCTION FOLLOWING RESECTION OF THE HYPOPHARYNX, LARYNX AND CERVICAL ESOPHAGUS

*With Special Reference to the use of a Retrosternal Transplant of
Jejunum, Stomach or Colon*

BY

A. G. FLETCHER, Jr., TIMOTHY TAKARO and A. N. GAIKWAD, Miraj.

During recent years there has developed an increasing preference for the use of radical surgery in the treatment of cancer of the extrinsic larynx, hypopharynx and cervical esophagus. In many instances it is possible to resect such a lesion, together with an adequate margin of normal tissue, while preserving sufficient pharyngeal and esophageal mucosa for immediate reconstruction of the alimentary canal. This is obviously the procedure of choice when it can be accomplished without compromising the adequacy of the resection.

However, one occasionally encounters more extensive cancers in this area, involving the larynx and most of the circumference of the hypopharynx or cervical esophagus. For these lesions the only adequate surgical treatment is *en bloc* resection of the hypopharynx, larynx and cervical esophagus. The resection may also include the base of the tongue, part or all of the thyroid gland and unilateral or bilateral radical neck dissection.

Such a resection presents the surgeon with a difficult problem of reconstruction. The stump of the trachea must be brought out above the sternal notch as a permanent tracheostomy, and some method of bridging the gap between the hypopharynx and the distal cervical esophagus must be devised if swallowing function is to be restored. Some of the possible solutions to this problem are indicated in Table I. In general, they fall

TABLE I

Methods of Reconstruction after Laryngo-Esophagectomy

I. Local Plastic Reconstruction

- A. Two-Stage Pedicle Flap Skin Tube (Wookey)
- B. Free Split Thickness Skin Tube (Edgerton)

II. Reconstruction by Means of Abdominal Viscera

- A. Jejunum
- B. Stomach
- C. Colon

into two groups: (1) Local plastic reconstruction of the defect by means of pedicle flaps or split thickness skin grafts; (2) more extensive procedures involving the use of various abdominal viscera (jejunum, stomach or colon) which are brought up for anastomosis with the hypopharynx by any one of several routes (subcutaneous, transpleural or retrosternal).

It is the purpose of this paper to review and evaluate each of these methods in turn and to present our own experience with the application of various methods in a group of ten patients operated upon at the Miraj Medical Centre and the Wanless Tuberculosis Sanatorium. In six of these patients, reconstruction was successfully accomplished by the use of an abdominal viscus (jejunum, stomach or colon) brought up through the anterior mediastinum for anastomosis with the hypopharynx. We have not seen a previous description of the use of this technique in the solution of this problem.

I. LOCAL PLASTIC RECONSTRUCTION

A. Two-stage pedicle flap skin tube (Wookey)

Repair of the defect in the cervical esophagus in two stages by means of a rectangular, pedicled skin flap was described by Wookey in 1942.⁶⁴ Watson independently reported a similar method of reconstruction in the same year.⁶⁵ This procedure often referred to as the "Wookey Operation", may be considered, as much as any other, as the standard method of dealing with this situation, since it has been quite widely adopted, especially by British surgeons^{11, 32, 37, 41, 65}, but also in the United States^{4, 16, 57, 62}.

When this method is to be used, the neck is opened by reflecting a large, rectangular skin flap, including the platysma muscle if

desired, based on the sternocleidomastoid muscle on one side. After the resection is complete, this flap is used to form a tube, open along one side, which is sutured to the margins of the hypopharynx above and the esophagus below. The lateral pharyngostome thus formed remains open at least a month while the tubed flap is picking up sufficient blood supply from its new bed, after which it is closed by means of a relatively simple second stage procedure (Fig. 1).

The principal *advantage* of this operation is its safety. The surgery, though locally extensive, is limited to the neck region, with a resulting low mortality rate under modern conditions (0-15 per cent)^{16, 41, 62, 65}. In successful cases, an excellent functional result is obtained, with practically normal swallowing and digestion.

However, there are several distinct *disadvantages* to the procedure. (1) It may be necessary to limit the extent of the lymph node dissection in order to preserve adequate blood supply to the large skin flap. Wookey's original operation did not include the removal of lymphatic drainage areas. The result was a high incidence of persistent disease in the cervical nodes.⁷² More

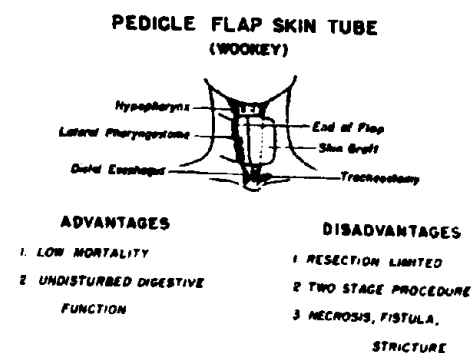


Fig. 1

Reconstruction by means of a pedicle flap skin tube (Wookey) following resection of the hypopharynx, larynx and cervical esophagus.

recently, several surgeons have combined radical neck dissection with a Wookey type of reconstruction. Grimes and Stephens¹⁶ base their flap on the side of the lesion and perform a radical neck dissection on the same side, if indicated. However, this seems to result in an increased mortality rate (12 per cent) and an increased incidence of fistula formation (three of twelve surviving patients had persistent fistulae). Raven⁴¹ emphasizes that the sternocleidomastoid muscle on which the flap is based must not be removed. He does a radical neck dissection, if indicated, on the side opposite the base of the flap and a limited removal of lymphatics on the side of the flap. Mustard³², who learned the technique of this operation from Wookey himself, points out that a satisfactory reconstruction is jeopardized if more than a limited lymphatic dissection, with preservation of the sternomastoid muscle, is performed on the other side. Thus, it would appear that the Wookey operation is not well suited to those cases in which a radical neck dissection, unilateral or bilateral is indicated. (2) This method of reconstruction is not practicable in cases in which it is necessary to transect the esophagus below the level of the sternal notch. (3) A period of one to two months must elapse between the first and second stages of the procedure. During this period the patient must put up with the discomforts of an open pharyngostome and must take all feedings by tube. In most cases, the patient will have to remain in the hospital, much nursing care is required, and the patient's nutritional status is likely to deteriorate¹². In some instances, recurrence of the tumour is evident before the final stage has been completed. Under such conditions no real palliative relief has been provided for the patient. (4) Partial necrosis of the skin flap, infection, fistula formation and stricture formation may be troublesome complications. (5) In male patients, the growth of hair within the skin

tube presents a problem for which no completely satisfactory solution has yet been devised³².

Case No. 1

Reconstruction with Cervical Skin Flap (Wookey).—A.N.D., MMC No. 134363, a 55 year old Hindu male shepherd, was admitted to the Wanless Hospital on August 10, 1953, with a history of increasing difficulty in swallowing and hoarseness of voice for four months. Examination of the neck revealed some thickening in the region of the larynx, but the larynx was not fixed. No enlargement of cervical lymph nodes was palpable.

Esophagoscopy revealed an ulcerated lesion of the cervical esophagus involving the posterior aspect of the larynx. The left vocal cord was paralyzed. The biopsy report was "Epidermoid carcinoma of the esophagus".

Operation was performed on September 24, 1953, by the method of Wookey. The skin flap was based on the right. Along with the larynx and the cervical esophagus it was necessary to resect the entire left thyroid lobe and most of the right lobe, both of which were adherent to the tumor. The skin flap was used to reconstruct the esophagus, leaving an open edge on the right. The trachea was brought out just above the sternal notch as a permanent tracheostomy. Post-operatively the patient developed quite a severe and persistent wound infection, which delayed the second stage. Finally, on January 16, 1954, nearly four months after the first operation, the second stage of the Wookey procedure was performed, completing the closure of the skin tube. This healed well, with the exception of a small fistula, which closed spontaneously in three weeks. After this, the patient was able to swallow quite well for

several weeks, until a stricture developed at the distal suture line. This was dilated with bougies on several occasions but yielded very little. On March 13, 1954, six months after the original resection of the tumor, the patient died, apparently from mediastinitis due to perforation of the esophagus at the site of the stricture.

Comment.—The case illustrates some of the difficulties in the Wookey procedure. The patient was hospitalized for six months and required an enormous amount of medical and nursing care. Infection and stricture formation were the principal complications. Although the tumour was resected, the patient received very little palliation during the six month period of survival.

B. Free split thickness skin tube

Due to some of the undesirable features of the two-stage Wookey type of reconstruction, a number of surgeons have developed techniques of immediate, one-stage, plastic repair, utilizing free grafts of fascia or skin to form tubes bridging the esophageal defect. The first of these were Bob and Bateman⁴⁶, who used a tube of tantalum mesh gauze surrounded by a free graft of fascia lata, with good immediate results in three cases of resection of the cervical esophagus. They pointed out that, "The fascia lata does not survive: it merely provides a temporary seal until the tissue planes of the neck have become closed around the tantalum gauze". Baronofsky and Hilger¹ later reported the successful use of this method in one case, but their patient required frequent post-operative dilation because of stenosis of the reconstructed segment. Other British surgeons^{39, 43} have used free split thickness skin grafts instead of fascia lata and have supported these with a temporary rigid polythene prosthesis instead of tantalum gauze. Results

were apparently encouraging, but detailed reports of the number of patients operated upon and the out-come in each case are not given. Reidy⁴⁷ mentions the complications of necrosis, fistula and stricture formation, stating that in some cases contraction of the whole grafted esophagus may occur in six weeks and may require resection and later reconstruction by means of pedicle flaps.

In the United States, Edgerton¹², Conley^{7, 8} and Grimes and Stephens¹⁶ have reported encouraging clinical results in the reconstruction of the cervical esophagus by means of free split thickness skin grafts applied around a tubed stent of tantalum or stainless steel mesh gauze. The skin graft is applied around the stent in such a way that the epidermal surface faces the lumen and the subcuticular surface faces the surrounding tissues of the neck and the raw surface of the skin flap, which form a nourishing bed. For success, the method depends upon a complete, or nearly complete, "take" of the graft. The wire mesh stent is removed transorally after a period of a month or more.

Edgerton¹² reports in detail three cases in which this method was used for complete reconstruction of the cervical esophagus. In one there was partial necrosis of the graft, resulting in a fistula, which was later closed by means of a chest flap. Two of the patients, who were followed for longer periods (eight months and seven months, respectively) showed no apparent tendency to stricture of the graft. Three additional patients are mentioned in a footnote as treated with "satisfying results" but not reported in detail. Conley^{7, 8} describes the technique and states that by this method "immediate reconstruction (of the esophagus) has been successfully carried out on six patients in the past two years". Results are

not stated in detail, but among complications are listed: infection, fistula and stenosis. In spite of antibiotics, loss of all or part of the graft may occur due to infection. "Stenosis is the most unpleasant complication, appearing gradually over weeks or months after an apparently successful operation". Grimes and Stephens¹⁶ used this method of primary reconstruction in two cases. Both developed fistulae. The first was a small one, which closed spontaneously in five weeks. The second was a large fistula, which probably would require closure by means of a pedicle flap.

This operation offers several important *advantages*. (Fig. 2).

(1) Like the Wookey operation, it has a low mortality, because the procedure is limited to the neck. No operative deaths were reported by the surgeons cited above.

(2) It has the great advantage over the Wookey operation of affording the patient an immediate, one-stage reconstruction of the esophagus and restoration of swallowing function at the time of the original resection.

(3) It is well suited to the requirements of adequate cancer surgery, since an unilateral, or even a bilateral, radical neck dissection may be performed without jeopardizing the success of the reconstruction.

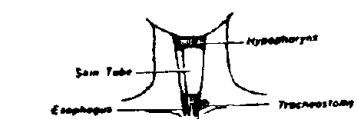
(4) In successful cases, the functional result is good, without disturbance of digestive physiology.

However, the procedure also presents very real *disadvantages*, as indicated above in the discussion of reported results. (1) Infection, necrosis of the graft and resulting fistula formation are complications which are bound to occur in an unpredictable, but significant, proportion of cases, in spite of careful technique and antibiotic protection. Massive necrosis of the graft results in a very difficult problem of secondary reconstruction and may easily endanger the life of the patient. (2) Late stricture of the grafted area is prone to occur, in spite of the use of stents for prolonged periods. This has been described even in cases in which immediate results seemed excellent.

Case No. 2

Reconstruction with Split-thickness Skin Graft.—A.V.P., MMC No. 142310, a 35 year old Hindu housewife, was admitted to the Wanless Hospital on April 6, 1955, with a history of pain in the throat and difficulty in swallowing for two months. Even liquids could be swallowed only with great difficulty. She was emaciated and dehydrated, weighing only fifty pounds. Examination revealed no palpable mass in the neck and no enlarged lymph glands. There were signs of pneumonitis at the base of the right lung. A chest x-ray showed patchy increased density in this area, apparently an aspiration pneumonia.

FREE SPLIT THICKNESS SKIN TUBE (EDGERTON)



ADVANTAGES	DISADVANTAGES
1. LOW MORTALITY	1. INFECTION, FISTULA, NECROSIS
2. UNDISTURBED DIGESTION	2. LATE STRICTURE
3. PRIMARY RECONSTRUCTION	
4. ADEQUATE RESECTION	

Fig. 2

Reconstruction by means of a free split thickness skin tube (Edgerton) following resection of the hypopharynx, larynx and cervical esophagus.

Esophagoscopy revealed an ulcerating tumour of the cervical esophagus at the level of the larynx, causing almost complete obstruction. The biopsy report was "Squamous Cell Carcinoma of the Esophagus." *Gastrostomy* was done soon after admission, and every effort was made to improve the general condition of the patient. The pneumonitis cleared, but in spite of nearly ten weeks of preparation, she weighed only fifty-six pounds at the time of operation.

Operation was performed on June 24, 1955, with reconstruction by the method of Edgerton. The skin flap was based on the right, undermining it as far as the sternocleidomastoid muscle on either side. The thyroid was divided at the isthmus and reflected laterally. The larynx, upper cervical esophagus, hypopharynx and sternothyroid and thyro-hyoid muscles were resected *en bloc*. A split-thickness skin graft, raw surface outward, was wrapped around a stainless steel wire mesh stent 8 cm. in length, fitted to the defect between the pharynx and distal cervical esophagus. Then the skin-wrapped prosthesis was interposed between these two structures and joined to them with two layers of interrupted sutures of fine cotton. The lobes of the thyroid were sutured together over the graft, the sterno-hyoid muscles were reapproximated, and the stump of the trachea was sutured to the skin in the midline to form a permanent tracheostomy. The cervical skin flap was sutured into place. The operation took six hours and 2000 cc. of whole blood was given.

Postoperatively, the patient's general condition was excellent. However, necrosis of the distal half of the cervical skin flap soon became apparent and this was followed by massive necrosis of the split-thickness skin graft and wide breakdown of the neck wound. The patient became despondent,

refused further reconstructive procedures, and left the hospital in very poor condition one month after operation.

Comment.—Several factors contributed to the unfortunate outcome of this case. (1) The patient was extremely debilitated and responded poorly to pre-operative preparation. (2) Insufficient care was exercised in preserving adequate blood supply to the cervical skin flap. (3) The sterno-hyoid muscles and lobes of the thyroid gland were interposed between the skin flap and the tubed skin graft—a procedure which we now consider definitely contraindicated. Nevertheless, the case illustrates some of the hazards and pitfalls of an operation which has many other features to recommend it.

II. USE OF ABDOMINAL VISCERA IN THE RECONSTRUCTION OF THE CERVICAL ESOPHAGUS

Because of the limitations of the local plastic procedures which have just been described, other methods of reconstructing the cervical esophagus by the use of various abdominal viscera have been employed in an effort to secure more consistently satisfactory results. Fundamentally, this involves the extension to the hypopharyngeal level of methods of reconstruction which were developed to replace the esophagus resected at lower levels for cancer or to circumvent benign strictures of the esophagus. These various techniques are the subject of detailed reviews by Ochsner and Owens²², Rienhoff²⁴, Mustard²⁵, and Takara²⁶. Jejunum, stomach and colon have been employed for esophageal replacement, and these organs have been brought up to the neck by one of three routes—through an antethoracic, subcutaneous tunnel, through the right or left hemithorax, or *via* a retrosternal tunnel through the anterior mediastinum.

In general, the use of an abdominal viscus for reconstruction of the cervical esophagus has the following *advantages*: (Table II).

TABLE II
Reconstruction by Means of
Abdominal Viscera

Advantages:

1. Immediate, One-Stage Reconstruction = Good Palliation
2. Uninhibited Cervical Dissection = Improved Chance of Cure
3. Reduced Incidence of Fistula and Stricture = Low Morbidity

Disadvantages:

1. Probable increased Surgical Mortality
2. Variable Functional Derangement of Abdominal Viscera

(1) Immediate, one-stage reconstruction of the esophagus and restoration of swallowing function are accomplished, thus affording the patient prompt relief and excellent palliation, regardless of whether or not long-term cure is obtained.

(2) There is no need to limit the extent of the cervical dissection in order to preserve the blood supply of skin flaps used in reconstruction. If required by the nature of the lesion, bilateral radical neck dissection and dissection of the superior mediastinum may be done without jeopardizing the reconstruction. This provides an opportunity for really adequate cancer surgery, which may result in a distinct improvement in the present discouragingly low cure rates. This point is of particular importance in dealing with patients who have had previous irradiation, resulting in reduced vascularity of the cervical skin and subcutaneous tissue.

(3) If a mucosa-lined viscus with adequate blood supply can be brought up into the neck, it is usually possible to make a very satisfactory anastomosis with the pharynx. Small, temporary, post-operative fistulae may occur, but there is minimal danger of persistent fistula or stricture formation. This is in marked contrast to either of the two methods of local plastic reconstruction.

The only important *disadvantage* of these methods is the greater extent of the operation, and therefore presumably the greater morbidity and mortality, in comparison with the methods of local reconstruction. However, as we shall explain later, these risks can be greatly reduced in two ways: (a) by the use of Robertson and Sarjeant's²⁷ retrosternal tunnel for elevating the viscus to the neck; (b) by the use of two surgical teams working simultaneously in the neck and in the abdomen—one team doing the cervical dissection, while the other team prepares the abdominal viscus. If this is done, the duration of the operation is not greatly prolonged and with the use of antibiotics, whole blood and good anaesthesia, mortality need not be increased and morbidity will be markedly reduced.

The use of each of the three organs in reconstruction of the cervical esophagus will now be reviewed in some detail, comparing the relative merits of each.

A. Jejunum

The jejunum was first employed in reconstruction of the esophagus in 1907 by Roux¹⁸, whose method was subsequently modified and improved by Herzen¹⁹. A long limb of jejunum was prepared by dividing several of the primary mesenteric branches and was brought up through an antethoracic, subcutaneous tunnel for anastomosis with the esophagus in the neck.

The method was fraught with various difficulties and was little used until Yudin published his spectacular report on "Surgical Construction of 80 cases of Artificial Esophagus" in 1944.⁶⁸ Yudin attempted a total jejuno-esophagoplasty in 16 cases, among which there were one death and four failures. In 58 cases, due to the difficulty of obtaining an adequate length of jejunum, he employed a combined type of re-construction using jejunum and a skin tube. There were only two deaths among these 58 cases. It is interesting to note that Petrov⁶⁹, Yudin's successor, recently stated that a total of 313 corrosive strictures of the esophagus were treated surgically by Yudin, and that during the last five years, since the death of Yudin, he (Petrov) had treated 321 more cases, or a total of 634, with an operative mortality of 4.3 per cent. Practically all of these reconstructions involved the use of a subcutaneous jejunal segment, with or without the addition of a short skin tube. Ingenious modifications of this technique in an effort to ensure a more adequate blood supply, have been described by Longmire and Ravitch^{24, 25}.

Rienhoff⁴⁴ and Harrison¹⁷ have demonstrated the feasibility of bringing the jejunal segment up *trans thoracically* for an anastomosis high in the chest or in the neck. The chief advantage was that the route was more direct, hence a shorter jejunal segment would suffice, the cosmetic result was also better, and this was of importance in treating benign strictures in young persons. The disadvantage was the greater extent of the surgery with a higher mortality rate to be anticipated, although there were no operative deaths in the five cases originally reported.

A very ingenious compromise, combining many of the advantages of the intrathoracic and subcutaneous routes for the jejunum,

was described in an outstanding contribution by Robertson and Sargeant⁴⁷ in 1950. An isoperistaltic limb of jejunum, prepared according to the technique of Roux-Herzen and Yudin, is brought up through a retrosternal, anterior mediastinal tunnel for anastomosis with the esophagus in the neck. Only abdominal and cervical incisions are required, the substernal tunnel being formed by blind, blunt dissection from above and from below. Since the pleural cavities are not opened, the magnitude of the operation is considerably less than that of a trans-thoracic, abdomino-thoracico-cervical procedure. Yet it combines the advantages of a good cosmetic result and a more direct and functional route for the jejunum. The authors reported good results in three patients, two with benign strictures and one with inoperable cancer. Recently Betts and associates² in India have reported eight cases in which this method was used for esophageal reconstruction in the treatment of benign stricture of the esophagus, with no deaths. In one case, however, there was loss of the jejunal segment due to gangrene. These authors quote Petrov as reporting 25 recent cases of esophagoplasty by the method of Robertson and Sargeant with three deaths. The method is obviously not without complications, even in the hands of experienced surgeons.

The reports quoted above do not include the use of a jejunal segment for reconstruction of the esophagus following total resection of the cervical esophagus and larynx. However, there seemed to us to be no reason why these procedures could not be extended to include pharyngo-jejunostomy, and two such cases are reported here. Of the three routes available, that through the anterior mediastinum would appear most suitable for this procedure (Tables III & IV).

TABLE III
Routes for bringing Abdominal Viscera into Neck

A. Subcutaneous: Jejunum	(Yudin)
	Stomach (Kirschner)
	Colon (Goligher & Robin)
B. Transpleural: Jejunum	(Rienhoff, Harrison)
	Stomach (Sweet, Garlock)
	Colon (Montenegro)
C. Retrosternal: Jejunum	(Robertson & Sargeant)
	Colon (Sherman, Watson)

The subcutaneous route is undoubtedly the safest, but it requires the greatest length of jejunum and therefore, may be impracticable in many cases, as shown by the experience of Yudin⁶⁸. Furthermore, some difficulty may be encountered in placing the jejunum sufficiently to one side to avoid interference with the tracheostomy in the lower cervical region. The transthoracic route involves a major abdominothoracic

TABLE IV
Advantages of the Retrosternal Route

- A. As Compared to Subcutaneous Route : Better Result
1. Better Appearance and Function
 2. Shorter Route to Neck
 3. No Interference with Tracheostomy
- B. As Compared to Transpleural Route : Lower Mortality
1. No Thoracotomy, Incision of Diaphragm or Dissection of Mediastinal Structures
 2. Less Time, Trauma & Transfusion
 3. Ideal for Two-Team Technique

procedure in addition to the cervical resection and anastomosis, and is undesirable on this account.

In summary, the particular *advantage* of retrosternal jejunal esophagoplasty, in addition to the general advantages of using an abdominal viscus, is the excellent swallowing function, with relative freedom from regurgitation, which is obtained because of the active jejunal peristalsis (Fig. 3).

However, there are two important *disadvantages* to the use of jejunum in this situation.

(1) The most serious disadvantage lies in the relatively precarious blood supply of such long segments of jejunum. Even with meticulous dissection and precise division of the appropriate primary branches of the superior mesenteric artery, it is occasionally impossible to obtain a viable jejunal segment of sufficient length^{68, 52}. In this connection, the two-stage division of the mesenteric vessels suggested by Shumacker and Battersby⁵² may be helpful in some cases, but even after an apparently satisfactory segment has been prepared, slight tension upon, or

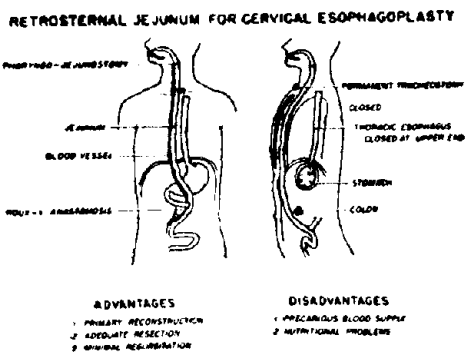


Fig. 3

Reconstruction by means of jejunum brought up through a retrosternal tunnel for anastomosis with the pharynx following resection of hypopharynx, larynx and cervical esophagus.

twisting of, the delicate marginal vessels, may result in interruption of the circulation, thrombosis and gangrene, as in cases reported by Betts² and Swenson¹⁸. This situation is aggravated by the fact that the vessels themselves are the limiting factor in the point to which the jejunum may be extended. The bowel itself is markedly redundant, and by its very weight and redundancy may, by a shift of its position, cause tension upon the "life-line" vessels, jeopardizing its own circulation. It is this tenuous circulation of the jejunum which may lead to an increased failure rate and an increased mortality rate when the procedure is extended to the pharyngeal level.

(2) A second possible disadvantage of jejunal esophagoplasty, though a less serious one in this type of case, is the physiological problem presented by the Roux-Y type of arrangement, which by-passes the stomach and duodenum. Some of the potential difficulties with nutrition and digestion which may be encountered are suggested by Carswell and associates⁶, Sweet¹⁶ and Sherman and associates¹¹. However, Yudin¹⁹, Swenson¹⁸, Robertson and Sargeant¹⁷ and Betts² observed a rapid post-operative gain in weight and no evidence of nutritional deficiency in their patients. To avoid the possibility of such difficulty Harrison¹² and Carswell and associates⁶ performed an anastomosis between the distal end of the jejunal segment and the stomach, instead of using the Roux-Y arrangement. However, this would seem to invite peptic ulceration of the jejunum, at least in younger individuals²⁰, and might also further imperil the blood supply of the jejunum, unless it were done as a second-stage procedure.

Case No. 3

Reconstruction with Retrosternal Jejunum.—T. N. K. MMC No. 137196, a 45 year old Hindu male, a weaver by trade, was admitted

to the Wanless Hospital on January 26, 1954, with a history of increasing difficulty in swallowing and pain in the throat for four months. At the time of admission even fluids were swallowed with some difficulty and he had lost considerable weight. Physical examination revealed only signs of moderate weight loss. No tumour or enlarged lymph nodes were palpable in the neck. The larynx was freely movable.

Esophagoscopy revealed an ulcerated tumour of the cervical esophagus in the post-cricoid area, involving the posterior aspect of the larynx. The epiglottis and the endo-larynx were normal. The report of the biopsy was "Epidermoid Carcinoma, Grade II".

Operation was performed on March 7, 1954, under endotracheal ether-oxygen anaesthesia. The neck was opened through an incision along the anterior border of the left sternocleidomastoid muscle, extending transversely across to the right at its upper and lower ends. The skin flap was reflected to the right and the larynx and esophagus mobilized. The tumour in the esophagus extended from the level of the larynx to a point just above the clavicle and had invaded the left thyroid lobe. The trachea and esophagus were transected distal to the lesion, the pharynx was transected proximally and the specimen, including the left thyroid lobe, was removed. The distal esophagus was closed with inverting sutures and the endotracheal tube was placed in the tracheal stump for continued anaesthesia. Through a midline upper abdominal incision a free jejunal segment of the Roux-Y type was prepared and brought up through a tunnel in the anterior mediastinum by the method of Robertson. Due to the pattern of the vascular arcades, much time was lost in an effort to prepare a segment of suitable length with adequate blood supply. The end of the jejunal segment was closed and an end-to-side anastomosis of the hypopharynx

and the jejunum was performed. As the anastomosis was completed, it was noted that the patient had become quite cyanotic and cardiac arrest suddenly occurred. The left chest was opened at once and cardiac massage was instituted and maintained for over an hour, when it was found that rupture of the heart had occurred, apparently due to over-vigorous massage. Examination revealed a tear in the right pleura which had apparently produced a tension pneumothorax, thus leading to inadequate respiratory exchange in spite of positive pressure anaesthesia.

Comment.—This case illustrates two of the difficulties of the Robertson method: (1) The occasional difficulty in securing a jejunal segment of adequate length with adequate blood supply; and (2) the risk of injury to the pleura, which may have troublesome sequelae if unrecognized. Also, in this case the two-team technique was not used and the operating time was therefore excessive—ten hours. This undoubtedly contributed to the fatal outcome in a none-too-robust patient.

Case No. 4

Reconstruction with Retrosternal Jejunum.—G. D. M., MMC No. 140839, a 41 year old Hindu housewife, was admitted to the Wanless Hospital on December 23, 1954, with a history of increasing difficulty in swallowing and pain in the throat during the act of deglutition. Even fluids were swallowed with difficulty. On examination of the neck there was a palpable swelling to the left of the trachea just below the larynx. One enlarged, firm lymph node was palpable on the right. On direct laryngoscopy and esophagoscopy an ulcerated tumour was identified, involving primarily the posterior wall of the esophagus at the level of the larynx. The biopsy report was "Squamous cell carcinoma".

Operation.—A gastrostomy was done at once for feeding purposes and on January 28, 1954, resection of the cervical esophagus and larynx and pharyngo-jejunostomy were carried out. On opening the neck an abscess was encountered due to perforation of the tumour. This was evacuated and the dissection was continued. The left thyroid lobe and the internal jugular chains of nodes on both sides were included with the larynx and cervical esophagus in the resection. The reconstruction was performed as in the previous case, using a retrosternal limb of the jejunum. The operation required 5½ hours, using the two-team technique, and 1500 cc. of whole blood was given.

The post operative course was surprisingly smooth, with the exception of a period of cough and fever, apparently due to bronchitis and bronchopneumonia. She was soon able to swallow without difficulty and the gastrostomy tube was removed. She was discharged on March 8, 1955, in good condition. We have had no further contact with the patient since discharge (Fig. 4).

Comment.—This case illustrates the favourable features of reconstruction by the Robertson method. With the two-team technique and a favourable vascular pattern of the jejunum, the operation was performed fairly quickly and without undue trauma. Excellent swallowing function was obtained and the patient was afforded very real palliative relief.

B. Stomach

The stomach was first used for total, or near-total replacement of the esophagus in 1920 by Kirschner²¹, who performed a successful cervical esophago-gastrostomy, bringing the stomach up through an antethoracic subcutaneous tunnel. Later came the development of the standard transthoracic resection of the esophagus and esophago-gastrostomy,

which was eventually extended to the cervical region by Sweet⁵⁶, Garlock¹⁴, Wylie⁵⁷, Nissen⁵⁸, Brewer⁵, and others.

This procedure is readily adapted to the reconstruction of the esophagus following cervical esophago-laryngectomy and has several obvious advantages. (1) The stomach is an organ with an excellent vascular supply and it has been repeatedly demonstrated that with careful division of all but the right gastroepiploic artery, and mobilization of the duodenum, the fundus of the stomach will readily extend to the upper cervical region. In this connection, it is important to note that the limiting factor in this extension is *not* the vascular supply but the organ itself. Hence, moderate tension will not

threaten the viability of the organ, as it does in the case of the jejunum, and a satisfactory anastomosis is readily attained. (2) The stomach is not bypassed and can contribute its share to the normal digestive processes⁵.

The principal disadvantages are: (1) the magnitude of the operation, which requires an extensive abdominothoracic procedure in addition to the cervical dissection and anastomosis; (2) the tendency to regurgitation from the stomach into the pharynx; (3) pylorospasm and dilatation of the stomach, which may follow division of the vagus nerve and extensive mobilization of the stomach. The following case report illustrates the magnitude of the procedure, even when divided into two stages and the difficulties which may be encountered in these debilitated patients.

Case No. 5

Reconstruction with Transthoracic Stomach.—N. D. G., MMC No. 139035, a 29 year old Hindu fruit merchant, was admitted on August 16, 1954, with a history of increasing dysphagia, hoarseness of voice and pain in the throat beginning five months previously. Examination revealed a mass in the lower left neck, which seemed to be behind the left lobe of the thyroid. No enlarged lymph nodes were palpable. On laryngoscopy, paralysis of the left vocal cord and left arytenoid was observed. X-ray of the chest showed no evidence of metastasis. *Esophagoscopy* revealed a tumor mass obstructing the lumen just beyond the cricopharyngeus muscle. On *Bronchoscopy* it was observed that the trachea just below the larynx was markedly narrowed by an extrinsic mass which was compressing its posterior wall. Respiratory obstruction seemed imminent. The biopsy report was "Squamous cell carcinoma of the esophagus".



Fig. 4 (Case 4)

Barium swallow shows the limb of jejunum in the retrosternal position with anastomosis to the hypopharynx at the upper end. Note the coiling of the loops of the jejunum although the blood vessels are stretched tight. The tracheostomy tube is still in place.

Tracheostomy was done on August 18th, and *gastrostomy* on the following day. Following these procedures, the condition of the patient improved considerably over a period of two weeks. On September 3rd, *resection of the cervical esophagus and larynx* was carried out under endotracheal ether and oxygen anaesthesia. A skin incision along the anterior border of the left sternomastoid muscle was extended transversely across the neck at the level of the hyoid bone and the flaps widely reflected. The tumor involved the esophagus from a point just below the cricoid cartilage to the level of the suprasternal notch. It had involved the trachea and the left lobe of the thyroid and there was an extensive inflammatory reaction surrounding the mass. The entire mass was mobilized and resected, dividing the trachea and esophagus distal to the tumor at the level of the suprasternal notch and transecting the hypopharynx just proximal to the larynx. To gain additional exposure and room for placement of a very low tracheostomy, the medial ends of the left clavicle and first rib and the left half of the manubrium of the sternum were resected extra-pleurally. The distal end of the esophagus was then closed in the superior mediastinum and the stump of the trachea was brought out under moderate tension to form a permanent tracheostomy in the lower neck left of the midline. The pharynx was partially closed and the margin sutured to the skin to form a temporary pharyngostomy. The operation required 7½ hours and 2000 cc of blood was given. It was not considered advisable to attempt primary reconstruction of the esophagus at this stage.

On October 4, 1954, one month after the first operation, *reconstruction of the esophagus* was performed. This consisted of a combined abdominal, right anterior thoracic and cervical approach. The stomach was

fully mobilized and the esophagus divided at the cardia, closing both the distal end of the esophagus and the cardia. The stomach was brought through the enlarged hiatus into the right chest and up into the neck, where the previous pharyngostomy was mobilized and pharyngogastrostomy was performed. The operation required 8 hours and 3,500 cc of whole blood and 500 cc of gelatin were given.

The patient had a fairly stormy post-operative course for a few days, but then settled down. However it soon became apparent that the stomach would not empty properly, apparently due to obstruction at the pylorus, which was just at the level of the diaphragmatic hiatus. Eventually, on the 14th day after operation, the abdomen was re-opened and the hiatus explored. No mechanical obstruction was found, but the opening was further enlarged by dividing the right crus of the diaphragm. The duodenum was opened and the pylorus, which was actually above the diaphragm, was dilated from within. Following this procedure the stomach began to empty, but an increasing elevation of the temperature was noted, and on November 5, 1954, a localized empyema on the right was drained by means of a small thoracotomy and rib resection under local anaesthesia. After this the patient's condition improved for some time. He remained afebrile and a small fistula at the site of the cervical anastomosis practically closed. He was taking his food by mouth, but he had a very poor appetite and was troubled by frequent regurgitation after eating. He had a troublesome cough and there was a copious discharge of purulent secretions from the tracheostomy. Bronchoscopy and bronchography revealed nothing except the secretions, which were negative for tubercle bacilli on smear. There was no evidence of bronchiectasis or lung abscess.

The condition of the patient slowly deteriorated in spite of all attempts at supportive therapy, including several blood transfusions. Finally, on January 29, 1955, five months after the original resection and four months after reconstruction by pharyngogastrostomy, the patient was discharged at his own request, in poor condition. He died at home several days later.

Comment.—The reconstruction achieved in this case was in many ways very satisfactory. The stomach was easily mobilized with excellent blood supply and a satisfactory anastomosis with the pharynx was accomplished. However, this is a very much more major undertaking than the Robertson procedure. Two prolonged operations and about 5,000 cc. of whole blood and plasma expander were required. The patient did quite well at first, but succumbed eventually to complications of the operation plus the general debilitating effect of so much surgery upon a weakened malnourished individual. Under similar circumstances we would now do a pyloroplasty at the time of the original mobilization of the stomach.

A possible alternative to the very extensive transthoracic procedure discussed above, would be to bring up the stomach subcutaneously in the manner first proposed by Kirschner²². This has been done more recently by Rienhoff⁴³ and Potts⁴⁴, each of whom operated upon two infants for reconstruction of the esophagus because of extensive atresia, in which primary anastomosis was impossible. The results were technically satisfactory, but functionally and cosmetically left a good deal to be desired. Three of the four infants died within a year. In the fourth case⁴⁰, the antethoracic stomach was transplanted into the pleural cavity at a second operation. It would seem particularly difficult and unsatisfactory to bring up the stomach

subcutaneously for reconstruction after esophago-laryngectomy because of the necessity for tracheostomy in the lower cervical region.

In an attempt to preserve some of the advantages of using the stomach for esophageal substitution, while at the same time avoiding the disadvantages of either intrathoracic or subcutaneous transplantation, it occurred to us that the stomach might be brought up into the neck through the anterior mediastinum in the manner described by Robertson and Sarjeant⁴⁵ for the jejunum. We were unable to find a previous description of such a maneuver, but the experiences of Kirschner²², Rienhoff⁴³ and Potts⁴⁴ with subcutaneous transplantation of the stomach, made it seem reasonable to attempt the use of this organ by the retrosternal route. One possible objection was the fact that it would be necessary to leave *in situ* a blind esophageal segment extending from the lower cervical region to the cardia, unless a separate Roux-Y anastomosis of jejunum and the lower end of the esophagus were done, as in Kirschner's operation. However, the animal experiments of Deaton and Bradshaw¹⁹ indicated that this closed segment would not be a source of trouble. In dogs, they found that only a harmless cyst of self-limited size was formed. With these points in mind, the operation was performed in the following case.

Case No. 6

Reconstruction with Retrosternal Stomach.—K. T. K., MMC No. 140601, a 40 year old Jain housewife, was admitted to the Wanless Hospital on December 5, 1954, with a history of increasing difficulty in swallowing for two months, with moderate pain during deglutition. On examination the larynx was freely movable and no enlarged lymph nodes were palpable in the

neck. On direct laryngoscopy and esophagoscopy, an ulcerated tumour was found in the post-cricoid area, involving both the cervical esophagus and the larynx. The biopsy report was "Squamous Cell Carcinoma".

Operation was performed on December 13, 1954. The neck was opened widely and the entire larynx and cervical esophagus were resected, including with the specimen the adherent right thyroid lobe and a group of the upper deep cervical glands, which were enlarged and firm. The distal open end of the esophagus was closed with inverting sutures. Through a right paramedian upper abdominal incision, the stomach was fully mobilized by dividing all of its blood supply except the right gastro-epiploic artery. The esophagus was divided at the cardia and the distal end of the esophagus and cardia of the stomach were both closed with inverting sutures, thus leaving *in situ* a blind segment of thoracic esophagus, closed at its upper and lower ends. A retrosternal tunnel was prepared by the method of Robertson and the fundus of the mobilized stomach was brought up through this tunnel into the neck. Pharyngogastrostomy was performed in the usual manner using two layers of interrupted cotton sutures. There was moderate tension on the stomach, but no tension on its blood supply and the circulation even at the extreme tip of the fundus, was excellent. The stump of the trachea was brought out to form a permanent tracheostomy in the left side of the neck in the usual fashion. The duration of the operation was 6½ hours and 1500 cc. of whole blood was given. The condition of the patient was good throughout.

The *post-operative course* was smooth. The only complications were some necrosis of the skin flap and a tendency to regurgitation

after eating. The patient was discharged on March 2, 1955, about six weeks after operation. She returned for examination on June 11, 1955, six months after operation. She looked well and said she had a good appetite, but her weight had fallen gradually from 82 pounds at the time of discharge to 70 pounds. She was still having trouble with regurgitation of food. This did not occur after every meal, but bothered her intermittently at intervals of two or three days. Palpation of the neck and pharyngoscopy showed no evidence of tumor. The anastomosis was widely patent and functioning well (Figs. 5 & 6).



Fig. 5 (Case 5)

Barium swallow shows the stomach in the midline in the retrosternal position after anastomosis with the pharynx at the upper end. Note that the stomach is stretched into a straight tube, but there was no tension on the blood supply of the organ.



Fig. 6 (Case 5)

Photograph of the patient six weeks after resection of the hypopharynx, larynx and cervical esophagus and reconstruction by means of the stomach brought up through a retrosternal tunnel.

Comment.—Our experience with these two cases has convinced us that, if the stomach is to be used for reconstruction, the retrosternal route is much to be preferred to the transpleural method. The principal advantage is the much more limited extent of the operation, which requires only a cervical and an abdominal incision. Two teams are readily employed simultaneously, thus further reducing the operating time. The stomach is easily mobilized by conventional techniques, and tension on the fundus forms it into a long tube, which is readily drawn up through the anterior mediastinal tunnel into the upper neck.

The use of the stomach by the retrosternal route has the same advantages over the use of the jejunum which was mentioned previously: (1) The excellent blood

supply of the mobilized stomach, as contrasted with that of the jejunum; (2) the fact that the stomach is not by-passed. However, it also possesses the disadvantages inherent in the use of the stomach by other methods: (1) troublesome regurgitation of gastric contents especially on coughing or sneezing or on reclining soon after eating; (2) possible difficulty due to pylorospasm and gastric dilatation, although this can be minimized by pyloroplasty and was not observed in our second patient (Fig. 7).

In summary, we feel that the technical ease and safety of using the stomach for this procedure considerably outweigh the minor discomforts of post-operative regurgitation and make it definitely preferable to jejunum for this type of reconstruction.

C. Colon

The use of colon in reconstruction of the esophagus has been reviewed by Mahoney and Sherman¹⁷. The first cases were reported by Vulliet and Kelling in 1911. Remarkably good results were obtained by

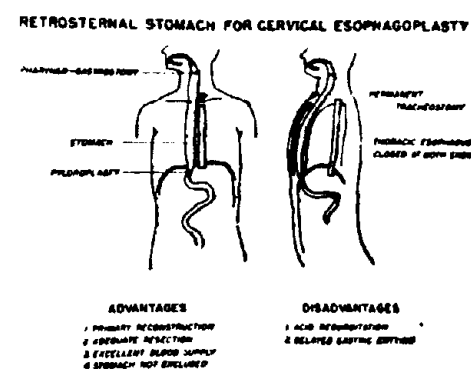


Fig. 7

Reconstruction by means of the stomach brought up through a retrosternal tunnel for anastomosis with the pharynx, following resection of the hypopharynx, larynx and cervical esophagus.

this method, even before the advent of chemotherapy and antibiotics, as indicated by Ochsner's comparative review of all methods of esophagoplasty in 1934.¹⁸ He found that the use of the colon produced the highest percentage of good results (56 per cent) and the lowest mortality rate (22 per cent). With improved methods of sterilizing the bowel, the technique has been revived by a number of surgeons in France, Britain and America. As in the case of the jejunum and stomach, the colon has been brought up to the cervical region by the subcutaneous, transthoracic and retrosternal routes.

The *subcutaneous route* has been used in a number of operations for the palliation of inoperable cancer^{19, 20, 21, 22}, for the reconstruction of the esophagus in infants with esophageal atresia²³, and in one case for reconstruction following esophago-laryngectomy¹³. In the latter instance, the left colon was used anti-peristaltically and an excellent result was obtained. *Transthoracic* esophagoplasty using the transverse colon was successfully performed by Montenegro and associates²⁴ in a case of benign stricture, and Kergin²⁵ transplanted a short segment of the transverse colon into the thorax to by-pass a benign parafinoma of the upper esophagus. The *retrosternal route* has been successfully employed for esophagoplasty by means of the right colon for both benign and malignant lesions by Rudler and Monod-Broca²⁶, Lortat-Jacob²⁶, Sherman and associates^{9, 27, 28}, and Watson²⁴. Sherman reported one early post-operative death in a series of five patients—three adults with cancer and two children with atresia. Watson used this method of reconstruction in five cases following resection of the entire thoracic esophagus for cancer of the upper third. There was one death due to infection of the cervical wound and haemorrhage from the carotid artery.

For the purposes of reconstruction after esophago-laryngectomy, it would seem that with the colon, as with jejunum or stomach, the retrosternal route is to be preferred, although the subcutaneous route may be used with satisfaction, as in the case reported Goligher and Robin¹⁴. The retrosternal transplantation provides all of the advantages of intrathoracic placement of the colon, but avoids the necessity of a thoracotomy in addition to the laparotomy and cervical dissection. Either the right or the left colon can be used for this type of reconstruction.

The technique of retrosternal transplantation of the right colon for esophageal reconstruction has been described by Sherman and associates²¹. Before operation the colon is prepared with neomycin and sulfathalidine. In a case of hypopharyngeal cancer, the cervical dissection is carried out by the first surgical team, as outlined previously. Meanwhile, a second surgical team proceeds with laparotomy and mobilization of the right colon. After appropriate testing of the circulation, the ileo-colic artery is divided, leaving the middle colic artery and the marginal artery as the sole source of blood supply to the right colon. The terminal ileum is divided and inverted into the caecum, appendectomy is performed, and the transverse colon is divided just to the left of the midline. Intestinal continuity is restored by ileo-colostomy. The retrosternal tunnel is prepared and the caecum is drawn up through the tunnel, avoiding twisting of the blood supply, for anastomosis of the caecum with the hypopharynx in the neck. Anastomosis of the distal end of the colonic segment to the anterior wall of the stomach completes the procedure. A similar procedure may be carried out utilizing the left colon instead of the right colon.

A number of advantages of the use of the colon for this type of esophageal reconstruction are immediately apparent (Fig. 8).

(1) It provides the advantages of an immediate, one-stage reconstruction.

(2) In contrast to the jejunum, a colonic segment of adequate length, with an excellent blood supply, is readily prepared. This makes the procedure much more certain of success and removes the hazard of intra-thoracic necrosis of the bowel. However, healing at the site of the cervical anastomosis is apparently somewhat uncertain. Temporary fistulae were reported in two of their five cases by Sherman and associates²¹, and in all five cases by Watson⁶³.

(3) The stomach is not excluded from the main digestive stream, as in the case of the Roux-Y type of jejunal reconstruction. Nor is the stomach distorted and deprived of its vagal innervation as in the case of reconstruction employing the stomach itself. Yet the danger of peptic ulceration of the colonic transplant is considerably less than it would be if a jejunal segment were joined to the stomach in the same way^{27, 31}.

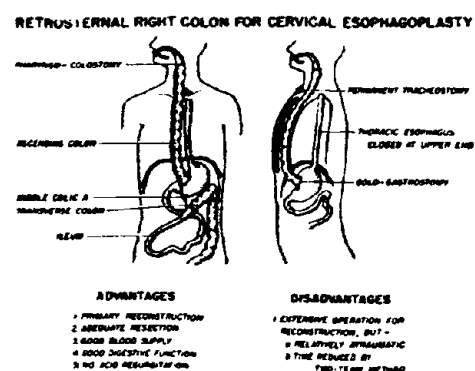


Fig. 8

Reconstruction by means of the right colon brought up through a retrosternal tunnel for anastomosis with the pharynx, following resection of the hypopharynx, larynx and cervical esophagus.

(4) There is no problem of acid regurgitation into the pharynx as in the case of pharyngo-gastrostomy, and regurgitation from the intra-thoracic colon was not a problem in the cases of Sherman and associates²¹. Due to the direct line of the colon from pharynx to stomach and the fact that an isoperistaltic segment is used, food and liquids should be transported rapidly to the gastric reservoir and there should be very little troublesome reflux.

The principal disadvantage of this method, in common with those of transplantation of jejunum and stomach, is that the reconstructive phase of the operation, after the cervical dissection has been completed, is rather long and exacting. However, this part of the operation is not traumatic and does not involve any significant blood loss, so there is no reason that the additional operating time should be detrimental to the patient. In addition, the total duration of the operation may be greatly reduced by the use of two surgical teams. While one team is performing the cervical resection, the other team can open the abdomen and prepare the colon for transplantation, completing all of the suture lines except the pharyngo-colostomy.

Case No. 7

Reconstruction with Retrosternal Colon.—R. S. C., M. M. C. No. 147324, a 35 year old Hindu housewife, was admitted to the Wanless Hospital on February, 27, 1956, with a history of increasing dysphagia, pain in the throat, hoarseness of voice and weight loss of 5 months duration. On admission she was unable to swallow even fluids or saliva. The patient was obviously cachectic and weighed only 66 pounds. No enlarged cervical lymph nodes were palpable. Direct laryngoscopy revealed an extensive post-cricoid tumor completely

obstructing the cervical esophagus. The left vocal cord was immobile. Biopsy report was "squamous cell carcinoma, Grade I". A gastrostomy was done on February 27 and the patient was put on high-protein, high vitamin gastrostomy feedings and given several blood transfusions.

Operation was performed on March 14, 1956. The two-team method was employed during most of the procedure. With the patient in the supine position, the neck was opened widely through an "I"—shaped incision. The larynx, cervical esophagus, strap muscles and left thyroid lobe (involved by tumor) were resected in continuity. A radical neck dissection was not done, since no enlarged nodes were palpable on either side. The distal open end of the esophagus was closed with inverting sutures and allowed to retract into the superior mediastinum. In the meantime, the abdomen was opened through a long right rectus incision and the right colon was mobilized. After testing the blood supply by temporary occlusion, the ileo-colic and right colic vessels were ligated and divided. The terminal ileum and transverse colon were then transected, producing an isolated segment of right colon receiving its blood supply through the middle colic artery. A retrosternal tunnel was prepared by blunt dissection by the method of Robertson and Sarjeant and the caecal end of the bowel segment was passed upward behind the stomach, through the retrosternal tunnel and into the neck. At this point the blood supply of the caecum and appendix appeared to be inadequate, so the caecum was resected and an anastomosis between the pharynx and the end of the ascending colon was performed, using two layers of interrupted cotton sutures. Blood supply was adequate and a satisfactory anastomosis was obtained. The stump of the trachea was sutured to the skin in the left lower

angle of the incision and the cervical wound was closed with soft rubber drains in the usual fashion. The abdominal procedure was completed meanwhile by anastomosis of the distal end of the isolated colon segment to the anterior wall of the stomach, and by end-to-end ileo-transverse colostomy. The abdominal incision was closed in the usual manner. The duration of the operation was 7½ hours and 2000 cc. of whole blood was given. The condition of the patient was good throughout.

The post-operative course was satisfactory. The partial pneumothorax was treated by aspiration in the first and third day after operation. Gastrostomy feedings were maintained for three weeks, after which the patient was allowed to take fluids and soft diet by mouth. She swallowed with ease and x-ray examination after barium swallow revealed prompt passage of fluid through the intrathoracic colon segment and into the stomach (Figs. 9 and 10). A small cervical fistula developed ten days after operation and closed spontaneously within two weeks. The patient was discharged in good condition six weeks after operation.

Case No. 8

Reconstruction with Retrosternal Left Colon.—T. K. P., WTS No. 7806, a 32-year-old male farmer, was admitted to the Thoracic Surgery Section of the Wanless Tuberculosis Sanatorium on February 14, 1957, with a two-month history of change of voice and dysphagia. Examination revealed cancer of the hypopharynx, involving the larynx. Two hard glands were palpable in the right side of the neck. Biopsy showed squamous cell carcinoma, Grade II.

Operation was performed on February 20, 1957. The procedure consisted of *en bloc* resection of the hypopharynx, larynx and

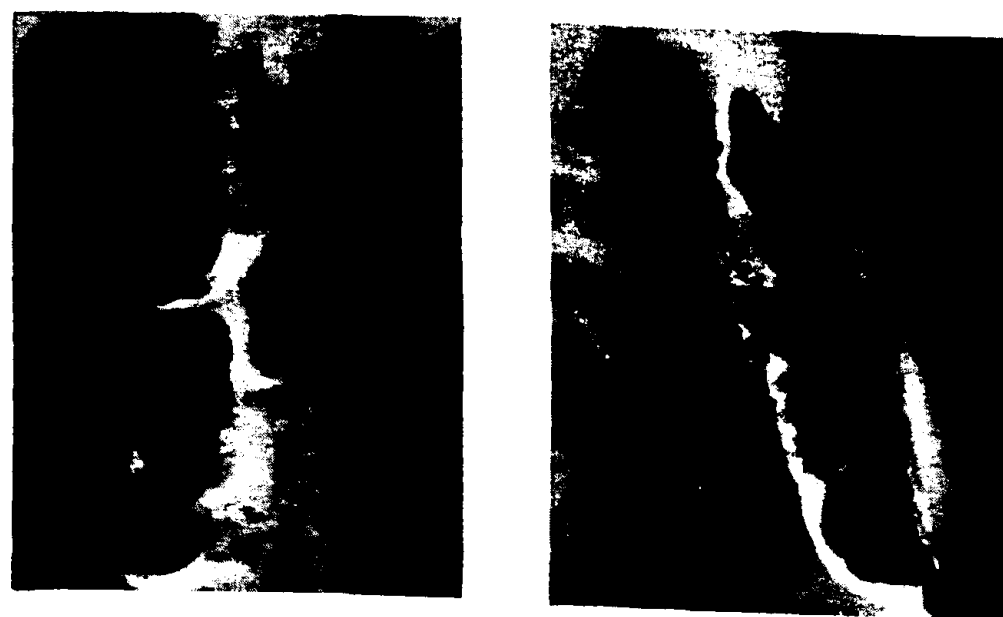


Fig. 9 (Case 7)

Barium swallow (AP and Lateral views) shows the right colon in the retrosternal position after anastomosis with the pharynx.

cervical esophagus, together with right radical neck dissection. For reconstruction the left colon was mobilized and brought up retrosternally for anastomosis with the hypopharynx proximally and the stomach distally. The left colon proved to be quite satisfactory for this purpose. The operation required 6½ hours. 2,450 cc. of whole blood was given during the operation.

The post-operative course was satisfactory at first but was marked later on by intermittent signs of partial intestinal obstruction and poor swallowing function. The patient refused to eat and failed to gain strength. Finally, one month after operation he apparently had a stroke, remained unconscious for several days and expired on the thirty-seventh post-operative day.

Case No. 9

Reconstruction with Retrosternal Left Colon.—M. N. P., W. T. S. No. 7825, a 25 year old male farmer, was admitted to the Thoracic Surgery Section of the Wanless Tuberculosis Sanatorium on March 1, 1957, with a three-month history of dysphagia, voice change, cough and respiratory difficulty. He was unable to swallow even liquids and a gastrostomy had been done elsewhere prior to admission. On examination, there was an indurated, tender mass surrounding the larynx and laryngoscopy revealed an extensive cancer of the hypopharynx with much necrosis and infection. Biopsy showed squamous cell carcinoma of the hypopharynx, Grade II.

Operation was performed on March 16, 1957. The procedure consisted of *en bloc* resection of the hypopharynx, larynx and

cervical esophagus, together with a modified neck dissection on the right side. Reconstruction was accomplished by means of retrosternal left colon, as in the previous case. Once again, the use of the left colon was found to be technically satisfactory. The operation required 6 hours and 2,500 cc. of whole blood was given.

Postoperatively, the patient did well at first, but it was quite a long time before satisfactory swallowing function through the colon segment developed. His course was further complicated by a severe case of homologous serum jaundice. Thus, he was very slow to gain weight and strength. However, he was finally discharged on June 22, 1957, three months after operation, at which time his general condition was fairly satisfactory. He did not return for further follow-up.

Case No. 10

Reconstruction with Retrosternal Right Colon. D. A. K., W. T. S. No. 7895, a 35 year old male farmer, was admitted to the Thoracic Surgery Section of the Wanless Tuberculosis Sanatorium on April 4, 1957, with a six-month history of dysphagia and pain in the throat. Examination revealed cancer of the hypopharynx with complete obstruction. A gastrostomy was performed.

On June 17, 1957 definitive surgery was undertaken. The hypopharynx, larynx and cervical esophagus were resected *en bloc*, together with modified neck dissection on the right. Because of the unsatisfactory condition of the patient, the operation was terminated at this point, leaving a temporary pharyngostomy. On August 15, 1957 reconstruction was carried out, using a retrosternal segment of the right colon and terminal ileum, performing the proximal anastomosis between the terminal ileum and the hypopharynx.

Postoperatively, a fairly large fistula developed at the site of the hypopharyngeal anastomosis. This was closed by an operation under local anaesthesia on October 24, 1957. The patient was finally discharged on December 22, 1957, approximately six months after resection of the tumor. At that time his general condition was satisfactory and he was swallowing freely. He was seen several times after discharge and remained well, except for a ventral hernia at the site of the abdominal incision. However, on November 18, 1958, a year-and-a-half after operation, he was readmitted because of recurrence of cancer in the tracheal stump, proven by biopsy, and died two days later due to a sudden, severe haemorrhage.

Comment.—Our experience with these four cases, in two of which the right colon was used, while the left colon was used in the other two, indicates that the colon is technically satisfactory for this purpose. The left colon provides a longer segment with a more adequate blood supply. Using the right colon, there was some difficulty with length and with blood supply in both cases and both of these patients developed temporary pharyngeal fistulae. This complication was not seen in the cases in which the left colon was used. On the other hand, the functional results using the left colon were not very satisfactory. In both cases, a period of several weeks was required to establish good swallowing function. This was perhaps partly due to abdominal complications but it is our definite impression that the retroperistaltic left colon functions less readily in this position than the isoperistaltic right colon.

To obviate this difficulty in deglutition, which may result from the use of such a long colon segment, Goligher and Robin¹⁴ have suggested the use of a short colon segment

on a long vascular pedicle, which is used to bridge the gap in the neck between the hypopharynx proximally and the distal cut margin of the cervical esophagus. Recently, we have employed this technique with gratifying results in five cases, which will form the basis of a separate communication.

D. Esophagus

For the sake of completeness, two reported cases in which the esophagus itself was mobilized and used for reconstruction by anastomosis with the pharynx may be mentioned. Wooler⁶⁸ resected the laryngo-pharynx in a case of cancer of the pyriform fossa and, by mobilizing the distal esophagus as far as the aortic arch, was able to bring it up sufficiently high for anastomosis with the pharynx. Results of the operation are not given, but it seems likely that only a very short segment of esophagus was resected in this instance.

In the case reported by Jack¹⁹, the larynx and most of the cervical esophagus were resected for a post-cricoid carcinoma. Through a left thoracotomy, the stomach and esophagus were mobilized, carefully preserving the vascular supply to the esophagus from the vessels of the gastric cardia. The stomach was brought up to the level of the aortic arch, thus providing a sufficient length of esophagus to reach to the pharynx for pharyngo-esophagostomy.

Both of these patients did well in the immediate postoperative period. While these techniques, particularly that of Jack, are extremely interesting, it does not seem likely that they will prove applicable in more than an occasional case.

Summary and Conclusions

(1) Cancer of the hypopharynx and upper cervical esophagus is a lesion which is well-suited to radical surgical extirpation; the

bloc of tissue removed should include the pretracheal muscles, larynx, hypo-pharynx, cervical esophagus, and bilateral jugular lymphatic chains. Unilateral or bilateral complete radical neck dissection may also be included if indicated.

(2) The problem of reconstruction involves: (a) a permanent tracheostomy; (b) the restoration of esophageal continuity to permit swallowing.

(3) A review of the available methods of reconstruction of the cervical esophagus in this situation leads to the following conclusions:

(a) Local plastic reconstruction by skin flaps or free grafts leaves much to be desired.

(b) Some method of reconstruction employing an abdominal viscus to form a substitute esophageal tube is to be preferred.

(c) The retrosternal tunnel proposed by Robertson offers the best route for elevating the abdominal viscus to the neck.

(d) Of the three abdominal viscera available for reconstruction:

1. The jejunum presents technical difficulties and dangers due to limited blood supply when such a long limb is required. Gastric exclusion also presents post-operative functional problems.
2. The stomach, is technically satisfactory and has an excellent blood supply, but the functional result is not ideal, due to acid regurgitation into the pharynx.
3. The colon is technically satisfactory, in that a long segment with a good blood supply is readily obtained.

TABLE V

Results of Reconstruction after Resection of Larynx and Cervical Esophagus

Patient	Reconstruction	Complications	Results	Palliation
1. A. N. D. ...	Wookey	Stricture and Perforation	Died 6 months	Poor
2. A. V. P. ...	Edgerton	Necrosis of Graft	Died 1 month	None
3. T. N. K. ...	Retrosternal Jejunum	Cardiac Arrest	Operative Death	—
4. G. D. M. ...	Retrosternal Jejunum	None	Successful Reconstruction	Good
5. N. D. G. ...	Transpleural Stomach	Empyema	Died 4 months	Poor
6. K. T. K. ...	Retrosternal Stomach	None	Well 6 months	Good
7. R. S. C. ...	Retrosternal Right Colon	Temporary Fistula	Successful Reconstruction	Good
8. T. K. P. ...	Retrosternal Left Colon	Intestinal Obstruction, Stroke	Died 1 month	None
9. M. N. P. ...	Retrosternal Left Colon	Jaundice	Well 3 months	Good
10. D. A. K. ...	Retrosternal Right Colon	Temporary Fistula	Died 18 months of Recurrent Tumour	Good

The distal end is joined to the stomach, thus restoring near-normal function of the intestinal tract.

(4) At the Miraj Medical Centre and the Wanless Tuberculosis Sanatorium, ten patients have undergone esophago-laryngectomy from September 1953 to June 1957 and reconstruction has been accomplished in several ways (Table V). There was one operative death and four late deaths, one six months after operation, with poor palliation. In five cases reconstruction was successful and, although one of these patients died 18 months after operation due to recurrence of cancer, good palliative results were obtained. In each of these cases an abdominal viscus was brought up

through a retrosternal tunnel for anastomosis with the hypopharynx—the jejunum in one case, the stomach in one case and the colon in three cases.

(5) As a result of these experiences, it is our opinion that the colon is the most satisfactory organ to use in this type of reconstruction, though good results may be obtained with the stomach or jejunum as well.

(6) It remains to be seen whether many of these patients can be cured by means of a more radical surgical approach, but in the meantime adequate resection, combined with immediate, one-stage reconstruction of the esophagus, offers the patient immediate palliative relief and at least a reasonable hope of long-term survival.

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THE SUPRASTERNAL ROUTE FOR DIRECT VISUALISATION OF THE GREAT VESSELS OF SUPERIOR MEDIASTINUM

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Introduction

The need for exact visualisation of the great vessels of the mediastinum has brought into sharp focus with the advances made in the field of vascular surgery during the recent years and though many techniques have been advocated, they all suffer from one disadvantage or the other and the search for an accurate, safe and easy method of radiographic visualisation of not only the aorta but other mediastinal and thoracic vessels as well, continues. Intravenous angiocardiology while extremely useful does not always delineate as clearly as needed and in addition requires experience and complicated apparatus. Retrograde arterial catheterisation and injection of radio-opaque substances *via* a peripheral artery such as the radial¹, brachial, carotid² or femoral has been adopted from as early as mid 1940s and they require operative exposure of the vessel, puncture or even open arteriotomy and may be attended with occasional mishaps consequent on arterial thrombosis or the urgent need for arterial ligation at the time of arteriotomy. The percutaneous method of direct aortic puncture developed by Dos Santos³ for the abdominal aorta naturally led to the search for similar methods for application in the thoracic region and Wickbom¹² reported a simple direct method of percutaneous direct injection *via* the cervical approach using a supra clavicular route following the right carotid artery. The suprasternal approach was used first by Swedish workers¹³ and is now fairly widely accepted as a good

method of puncturing the arch of the aorta and roots of the great vessels arising from it. Other methods of puncturing the mediastinal vessels were the transbronchial approach developed by Allison¹ and direct left atrial route developed by Rander¹¹. A direct puncture of the left ventricle as initially advocated by Ponsdomench and Nunez² and subsequently Brock³ and co-workers, was utilised for angiography as well but none of these methods were suitable for attempting visualisation of *all* the important vessels in the mediastinum. These vessels are; arch of the aorta and its branches, pulmonary artery and its main branches, superior and inferior venae cavae, and the innominate veins and lastly the coronary arteries.

Methods and Materials

Our experience with suprasternal angiography is limited to 32 cases. During the performance of the technique of thoracic aortic puncture as suggested by the Swedish workers we have been able to utilize this method for puncturing directly other vessels in the mediastinum as well. This technique as employed by us with certain modifications is as follows:

The patient is starved for about 6 hours to ensure an empty stomach and is tested for iodine sensitivity. Bleeding and coagulation time is determined. Premedication with nembutal 1½ Grs. orally and phenergan 50 mgms. intramuscularly is useful in allaying the anxiety and reducing the pulse rate

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and blood pressure of the patient. Slow pulse rate and basal blood pressure levels are very necessary for ensuring larger concentrations of dye in the blood vessels. Injection of atropine, so uniformly advocated by numerous workers in this field was avoided during this study, on account of its effect on the pulse rate and blood pressure and we did not have any mishap because of this omission.

Subject is placed on the X-ray table in supine position with shoulders depressed and the neck fully extended. A deep penetrating scout X-ray film of upper chest and neck is taken in this position with a tube table distance of about 48". This film is carefully studied to gain a mental impression of the possible disposition of various vessels. Approach to the desired vessel as regards the direction, the angle of inclination and the depth of penetration of the needle is planned to the last detail on this film and a marker thread is tied on the needle about $\frac{1}{2}$ inch beyond the calculated distance so that accidental penetration beyond this length is prevented.

The X-ray pictures were taken on a single plane roentgenography machine with a Potter-Bucky diaphragm and 200 mA tube current. An 18 gauge large bore, thin walled short beveled B. D. needle 15 cms. long with non-cutting edges and opening at the terminus has been utilized. This needle is connected to a 20 cc. Record type syringe with a metal piston and metal tip, through a translucent soft and compressible but non-distensible 4 inch long plastic polythelene tube connection. Mere manual pressure has been used throughout this study for delivering the bolus of dye, in preference to a mechanical pressure injector. This we thought had a number of advantages. First, the amount of dye required was quite small as the deadspace locking up the dye was

reduced to a bare minimum of 4 inches of the polythelene tube connection. This reduction, of dead space by a translucent tube also helped minimise chances of accidental air embolism, as everything that passed through the needle was under vision. Secondly, in absence of a rapid serial film changer, a single plate angiogram had to be made and the method of manual injection of dye enabled the operator to call for the X-ray exposure with greater precision and optimum timing. Finally, the use of non-locking connections which can withstand the pressure of manual pressure injection had an advantage of snapping open and acting as an insurance against over-distension of the injected vessel. With mechanical pressure injector system which requires locking of all connections, the over distending vessel had no safety-valve outlet and the dye could unduly distend and damage such arteries as coronaries and spinal, causing myocardial ischaemia¹⁵ or spinal cord paralysis^{2, 5, 7} after aortography as reported in the literature. We did not encounter these complications in our small series.

As a routine, a pilot X-ray film after injecting about 5 ccs. of radio-opaque dye in the punctured vessel was made and this helped as a guide in several ways. It gave

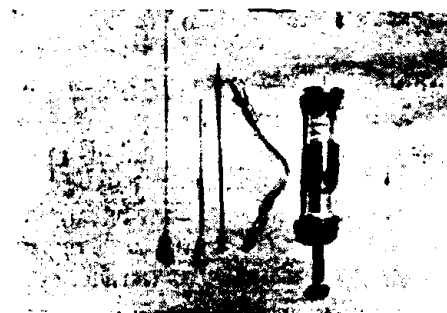


Fig. 1

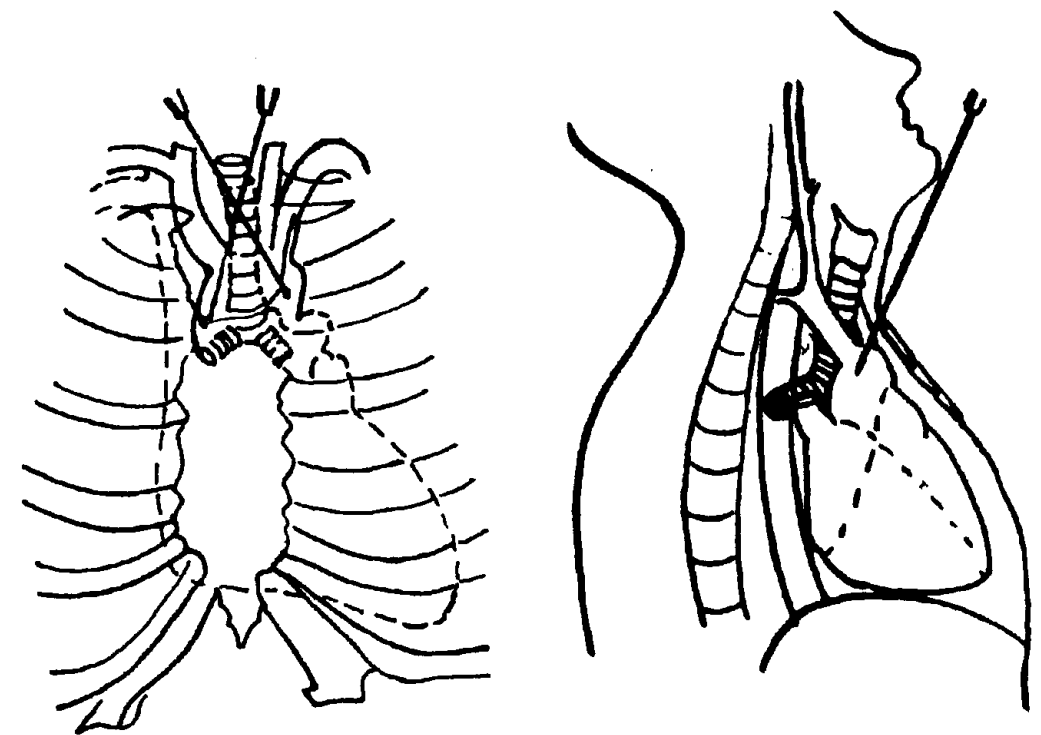
Essential equipment for suprasternal aortography.

a rough idea of the vascular pathology, of the amount of main dye bolus required subsequently, and of iodine sensitivity of the patient to intravascular injection. Adjustment in the position of needle tip was also done as required.

We utilised 76% organic iodine dye—sodium methylglucamine 3, 5—diacetylaminio—2, 4, 6—triiodobenzoic acid salt solution (Urografin) in doses of 12-15 ccs. per injection and a total dose of as much as 60-80 ccs. was tolerated by patients without any side effects.

The skin of the upper chest and neck is surgically prepared and draped and the operator positions himself at the head end of the X-ray table. The chin is continuously kept extended to keep the trachea straight and in the midline. The skin of the

suprasternal notch is stretched over the manubrium to prevent it from pursing up during progression of the needle in the superior mediastinum, and 1% procaine is infiltrated all along the needle track. The aortography needle with stylet is introduced in the suprasternal space and pushed gently downwards and posteriorly at an angle of 30° with the table parallel to the front of trachea till the expansile pulsations of ascending aorta are felt by the needle tip. The lateral inclination, the direction and the angle of the needle is then changed according to the individual vessel that is to be punctured. Before entering the vessel or the aorta, the stylet is removed and a few ccs. of $\frac{1}{2}$ % novocaine is infiltrated in the periadventitial tissues of the vessel. The needle is connected through the polythelene tube connections to the syringe which is



Figs. 2 & 3

Direction and course of approach of the needle—posteroanterior and lateral views.



Fig. 4
Innominate arteriogram.

filled upto the half with 5% glucose, and the required part of aorta or vessel is entered in with a short sharp jab. The entry is heralded by a sudden gush of red blood in the polythelene tube and the blood jet is seen to pulsate in the syringe with every heart beat. To prevent the dye extravasating along the needle tract after forcible injection, the needle is permitted to rest in position for 5-7 minutes (depending on the clotting time) and help seal the sides of the

puncture hole by circulating platelets. Just before injecting the dye, 5 to 6 ccs. of 1% novocaine is squirted in the vessel so as to coat the intima with an anaesthetic. This procedure was introduced later in the series and was found to considerably reduce the incidence of spasm of small calibre vessels, especially of collaterals, induced by the hypertonic and irritating dye. Immediately after squirting the novocaine the radio-opaque dye is injected as a bolus as rapidly as possible. The patient is asked to hold the breath and when the picture is shot, a few ccs. of dye are still left in the syringe.

The needle is kept patent by continuous infusion of small quantities of glucose. The patient experiences a feeling of warmth all over the body after the completion of each injection and is required to be warned of such an occurrence. In between two injections of dye, about 15-20 minutes are allowed to elapse.

At the end of the procedure the needle is withdrawn quickly and the skin puncture site is kept pressed along the needle tract for about 5-7 minutes. If, on removal of pressure the suprasternal space starts bulging, pressure is reapplied and maintained for a longer period. The puncture hole is



Figs. 5 & 6
Left subclavian arteriogram. Posterior and left oblique views.

finally sealed with collodion. An X-ray of urinary tract is taken at the end of the procedure. If the concentration of dye in bladder and kidneys appears to be good, patient is made to pass urine and asked to drink plenty of water.

After the procedure the patient is allowed to assume sitting posture as early as possible if he does not feel giddy, but is not permitted ambulation till about 6 hours. During this period he remains well sedated.

Earlier in the series, careful electrocardiographic control of the behaviour of the heart was kept during injection of the dye under pressure, but later this practice was discontinued. The patient's reaction and sensation and the rhythm rate force and colour of the blood that pulsates back into the syringe provided adequate information about the patient's condition.

Discussion

The primary object of the procedure is accurate visualisation of large vessels in the superior mediastinum and their branches. This method of visualisation was not only restricted for intra thoracic disease, as for example in a case of extensive cerebro-vascular disease with quadriplegia and vascular insufficiency of major cerebral vessels, the only way of studying the cerebral circulation was by instilling radio-opaque dye in the ascending aorta through the suprasternal route and visualising its flow in the cervical and cranial vessels.

The most common discomfort was the sensation warmth and flushing in the area of the distribution of the vessel. In vessels with smaller calibre injection under the same pressure as in aorta caused sensation of moderate constrictive pain in the part supplied by the vessel. This experience is annoying to the patient and to avoid it we started first

squirting a small amount of novocaine in the vessel and then using 50% glucose as a dummy solution to see the rate and pressure of injection that is just short of giving this constrictive pain. This formed a very useful index for the subsequent injection of dye. Occasionally, nausea and rarely vomiting occurred after the first injection of dye although the patient did not show any sensitivity to iodine pre-operatively. Most patients experienced a feeling of severe thirst and dryness of tongue after the procedure, and occasionally a mild headache was complained of.

No manifestations of cerebral, myocardial or renal damage developed in any of the cases following this study. Routine chest skiagrams in standing position 12 hours later did not reveal any pleural complications. Accidental periaortic or intramural injection of the dye did not occur in any of the cases.

Of the 32 patients in the series, 7 were subjected to exploratory thoracotomy some time following the procedure. This afforded



Fig. 7
Superior vena cava angiogram.

an opportunity to determine the amount and nature of bleeding and damage to the mediastinal structures caused by this puncture. Actually two patients were operated within 16 hours after the procedure. None of the cases showed anything more than moderate ecchymosis of anterior mediastinal tissues and this included one case in whom 4 different vessels including the aorta were punctured.

The arch of the aorta was punctured 19 times. In majority of these cases, large part of the ascending aorta showed filling and the cusps of aortic valve were outlined when the heart rate was slow. In 2 cases this outlined the saccular aneurysm of ascending aorta and in 2 cases coronary arteries were well opacified. In 1 case with aortic incompetence some dye regurgitated in the left ventricle, and in a case of tubular narrowing of descending thoracic aorta, the abdominal vessels were extremely well opacified. The ascending aorta was punctured in 1 case. All the branches of the aorta were outlined whenever dye was deposited in the ascending part or arch

of the aorta. But more peripherally the concentration of dye faded progressively.

Innominate artery was punctured in 4 instances and this gave a much better contrast visualisation of the right common carotid and subclavian arteries than usually seen after aortic injection. A certain amount of dye usually regurgitated, outlining the arch and descending aorta. In one of these cases, by compressing the right common carotid and right subclavian arteries, the dye was made to regurgitate and opacify the arch of the aorta and also the left common carotid and collateral circulation of left arm.

Left innominate vein was punctured in 1 case and superior vena cava in 2 cases. Visualisation of the venous side of heart however, has not been as excellent as by angiocardiology, probably because the dye was deposited through a smaller size needle (18 gauge B. D.).

Intra thoracic portion of left subclavian artery was punctured near its origin from



Figs. 8, 9 & 10

Ascending aortic angiogram. Posterior, left oblique and right oblique views.



Fig. 11

Descending aortic angiogram.
Oblique view.

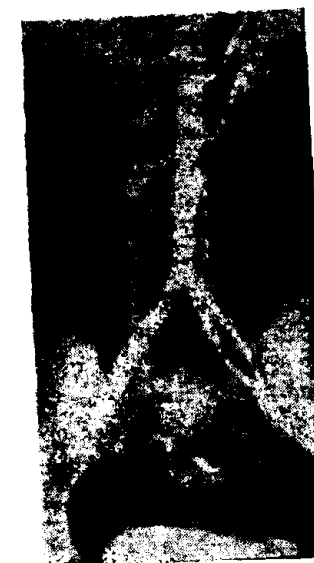


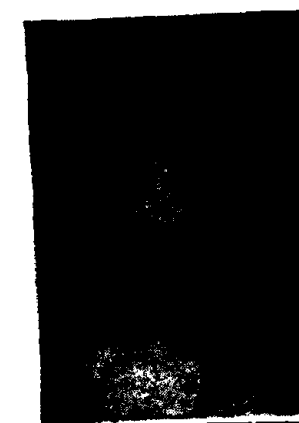
Fig. 12

Abdominal aortic angiogram.

the aorta in 1 case, which demonstrated a block in the artery at the root of the neck. The dye regurgitated in the aortic arch outlining it.

In 1 case of aneurysm of anterior sinus of Valsalva the communications with the main stream in ascending aorta was narrow. The aneurysm therefore was not well opacified

and clearly outlined by aortography. In this case the aneurysm was punctured at its origin from the aorta and the dye was deposited into it to see its full extent. Pulmonary artery was punctured directly without puncturing the arch of the aorta, in one case of severe pulmonary hypertension, where the diagnosis of patent ductus arteriosus was doubtful and where there



Figs. 13 & 14

Pulmonary arteriogram. Posteroanterior and left oblique views.

was probably a phasic reversion of shunt from pulmonary artery to aorta. The dye clearly outlined both the branches of pulmonary artery and a small amount of dye flowed into aorta outlining its proximal part thus proving the existence of a shunt between the pulmonary artery and aorta.

The final radiological visualisation was graded according to the opacification of the desired vessel in the vicinity of the lesion, into good, fair, poor and failure of opacification. This opacification was good in 23 cases, and fair in 9 cases. There were no failures.

There was 1 death in this series. This occurred in a patient aged 17 years with Patent Ductus Arteriosus, severe pulmonary hypertension and phasic reversion of the shunt. Anticoagulants were being routinely administered to this patient with an idea to prevent the severe pulmonary hypertension causing pulmonary thrombosis. This fact however slipped our notice when his pulmonary artery was punctured. During the puncture and pulmonary angiography, the patient behaved normally, but within

5-7 minutes after the removal of the needle he developed severe cardiac tamponade and cardiac arrest. On exploration the pericardial cavity was found to contain large amount of uncoagulated blood and the puncture hole in the pulmonary artery was leaking. On cardiac massage the heart action revived but for a few hours. The cause of death in this case probably was inability of the blood coagulation mechanism to seal the puncture hole in the pulmonary artery, which caused unchecked intrapericardial haemorrhage aggravated by the associated severe pulmonary hypertension.

This study however revealed certain limitations of this procedure especially in consistent and clear visualisation of ascending aorta and the coronary arteries. It was only when the heart rate was slow or the blood pressure at basal level that the ascending aorta filled adequately by retrograde flow from the arch and the coronaries were opacified. This made us attempt a more direct approach and deposit the dye in ascending aorta proper, whenever visualisation of this part of aorta and coronaries was desired.



Fig. 15
Parasternal ascending aortogram.



Fig. 16
Coronary arteriogram.

Following the original work done by Italian workers in 1940s and after conducting preliminary anatomical studies we tried to approach the ascending aorta directly by the right parasternal route through the second intercostal space. So far we have successfully done this in two cases. This will form the subject for a future communication.

Summary

1. A method of percutaneous suprasternal approach to aorta and major vessels in the superior mediastinum is described, and a procedure of instilling radio-opaque dye to outline these vessels is detailed.

2. Various advantages and disadvantages of this procedure are compared with similar other procedures.

3. Out of the 32 cases, 23 gave satisfactory visualisation of the required vessel without any major complications. There was one death in the series which probably was not directly related to the procedure.

4. Attention is drawn to the limitations of this procedure in visualisation of ascending aorta and coronary arteries, and another method—percutaneous parasternal aortography—is suggested.

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PARACARDIAC AND CARDIAC FOREIGN BODIES

BY

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Cardiac and paracardiac foreign bodies are rarely found in civil practice, but are not uncommon in war. Usually all missiles, projectiles, bullets or penetrating injuries, where intention is to kill are directed to the heart. Accidental foreign bodies may also find its way to or near the heart. They are either secondary to the direct violence or to embolic phenomena. Foreign bodies have been known to travel up from the iliac vein to the right side of the heart (Collins, 1948, Bland Sutton, 1919) Solid missiles which enter the vascular system may migrate there in a direction, which is determined by a balance between the effect of gravity and the propelling pressure of the blood stream. Projectiles are more likely to enter the right than left chambers of the heart and may arrive there by direct wound of the heart by a low velocity missile or by carriage through the veins. There are two reasons for this. First, the heart is usually wounded from the front and the anterior aspect of the heart exposes about twice as much as of the right as the left ventricle. Secondly, foreign bodies may be also carried as emboli in the systemic veins to reach the right side of the heart.

Foreign bodies may be situated near the pericardium, in the pericardial sac in the heart muscle, or in one of the chambers of heart, and therefore can be grouped as cardiac and paracardiac. Pericardial or paracardiac foreign bodies are commoner than the intra-cardiac ones, presumably because death is likely to follow in the later case.

Once within the heart, the missile may move about within the chamber or even, pass back and forth from one chamber to another. Eventually, however, the missile usually becomes arrested by clot and is encysted, ultimately encased in a fibrous covering, where death does not take place. In this way some foreign bodies may remain unsuspected and undiagnosed Turner (1940) observed a man with a bullet in the wall of left ventricle for 23 years.

Pericardial or paracardiac foreign bodies are often just as latent. On the other hand, both intracardiac and pericardial foreign bodies may give rise to serious or fatal trouble. These may be :—

- (i) Embolism.
- (ii) Sepsis or bacterial endocarditis.
- (iii) Recurrent pericardial effusion.
- (iv) Myocardial rupture or hernia.
- (v) Myocardial aneurysms.
- (vi) Injury to the coronary arteries.
- (vii) Psychoneurosis at the knowledge of the patient that "he harbours in unwelcome visitor in the citadel of his well being" (Grey Turner).

Operative Indications

The presence of a retained or embolic metal foreign body in or about the heart has always presented a challenge to the surgical craftsmanship, yet the indications for surgical intervention have not been

very clear. Marked disagreement on the risk and value of such intervention still exists on non-emergent cases. Penetrating wound of the heart with repeated severe haemorrhage, cardiac tamponade and shock are cases where urgent surgical intervention might be life saving, whereas in a non-emergent case surgical intervention is still a controversial problem, and conservative treatment may have some place. However, the recent advances in surgical understanding of the intrathoracic procedures, anaesthesia, availability of new roentgenological diagnostic method make possible a new evaluation of this problem, particularly, where hypothermic methods or cross circulation could be possible. Decker (1939) attempted to evaluate the indications for surgical removal of intracardiac foreign bodies, his evidence suggested that it is dangerous to allow large foreign bodies to remain in the pericardium or in the heart.

Generalization is unreasonable and each foreign body must be evaluated as a specific problem in terms of :

- (i) The presence or absence of sepsis.
- (ii) The probability of dangerous sequel inherent in its position in or about the heart.
- (iii) Size—extremely small size may have a contraindication for operation whereas large foreign bodies are more liable to have carried in infection and are more liable to occupy a space relationship, threatening myocardial erosion and rupture.

Indications for elective operative removal of each foreign body may exist in the following circumstances :—

- (i) in patients who have evidence of persistent sepsis.

- (ii) evidence of progressive myocardial damage or dysfunction.
- (iii) when a foreign body is :
 - (a) free in the heart,
 - (b) impinging upon a valve leaflet,
 - (c) impinging upon myocardium during cardiac activity,
 - (d) in cardiac neurosis related to the presence of foreign bodies.

Contraindications

Contraindications to elective removal are these :—

- (i) when a foreign body is very small. 3 mm. or less in greatest diameter.
- (ii) asymptomatic patient in whom the foreign body is identified as lying entirely within the myocardium.

Diagnostic Problems

It is essential before any operative procedure is undertaken that the foreign body must be accurately localised. Herken (1946) lays great stress on screening and positioning in addition to plain radiography in diagnosis and localisation of these foreign bodies. Angiocardiography may be admirably suited for identifying the anatomical location of radio-opaque foreign substance. Electrocardiogram may be of help.

Case Report

Krishna 8 years H. M. child was admitted to the Hospital for Children, Patna on 10-9-56 with a history of gunshot injury on the chest. On admission he had the following complaints :—

- (i) Sinus left side of the chest following a gunshot injury—duration one month.
- (ii) Pain and swelling chest just close to the left side of sternum—duration one month.

History.—While looking after grazing cattle he received a gun shot injury on the chest and fell down. He was taken to the Purnea Sadar Hospital from where he was referred to Patna Medical College Hospital and on 10-9-1956, he was admitted in the Hospital for Children.

On Examination.—He had a discharging sinus about one inch above the nipple on the left anterior aspect of left side of the chest $3\frac{1}{2}$ " away from the lateral edge of sternum. Besides he had a tender and firm swelling on the left lateral part of sternum extending over to the medial ends of the 2nd, 3rd and 4th intercostal spaces. There was no other abnormalities detected. In the ward the patient had several bouts of fever.

Investigations.—Blood - Total R. B. C. - 4.8 million/cmm. W. B. C. - 8500/cmm.

Diff. count :	Poly.	...	69%
	Lympho.	...	22%
	Mono.	...	6%
	Eosino.	...	3%
	Baso.	...	0%
Hb%	...	70%	
B. P.	...	90/65 - S/D.	

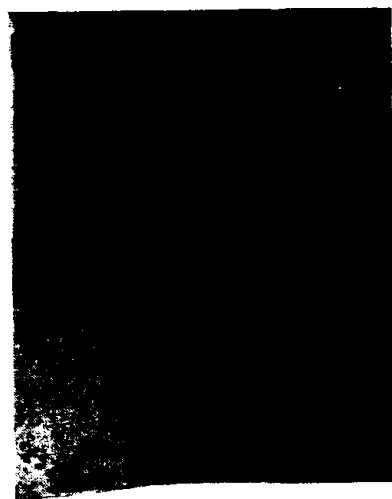


Fig. 1
P. A. - View of Chest.

Radiological Examination.—P. A. and lateral views of the chest revealed a rounded radio opaque foreign body in the mediastinum close to the medial edge of the 3rd intercostal space behind the sternum lying in the heart (Figs. 1 & 2).

P. A. view of the chest was also taken with metallic wires kept stuck up to the anterior aspect of chest screening.

On Screening (Hourosocopy).—The above position of the foreign body was confirmed. It was found moving with the contraction of the heart.

A diagnosis of metallic foreign body lying in the substance of the myocardium of the right ventricle on its anterior aspect was made and surgical intervention was thought necessary.

Operation was undertaken on 10-10-56 under general Anaesthesia by Dr. Mukteshwar Prasad, M.B., B.S. (Pat.), D.A. (Dublin), Chief Anaesthetist of the Patna Medical College Hospital.



Fig. 2
Left lateral view of chest.

The mediastinum was approached by a left interolateral incision through the 3rd intercostal space after cutting the medial ends of the 3rd and 4th costal cartilages. The pleura was pushed laterally and a flap of pericardium was reflected. 2 cc. of 1% Procain solution was injected in the pericardial cavity. Then the foreign body was palpated and then observed stuck on the anterior aspect of the right ventricle in the substance of the myocardium. This was gently enucleated out. Myocardium did not require repair. A small flap of the pericardium was cut out to allow the drainage of the pericardial cavity.

In the operation theatre the patient developed tachycardia which gradually settled down with digitalis. Recovery was smooth and uneventful. The patient was discharged cured on 30-10-56. The foreign body weighed 27.76 gms. and its maximum Diameter was 2.1 cm. The patient is doing well.

Comments.—There are many interesting points about this case. It is rather uncommon to have survivalship after the gunshot injury

of this nature. The bullet was directed to the heart and was actually lying in the substance of the heart muscle for several weeks before it was actually removed. Besides the local infections giving rise to the pain, tenderness, swelling and bouts of fever there was obviously no other serious complications secondary to the injury and to the presence of the foreign body. The survival of the child is rather a miraculous episode more assigned to the destiny than to the surgical acumen.

Summary

A short review of the problems of the paracardiac and cardiac foreign bodies has been presented.

Indications and contra-indications of surgical removal of foreign body in and around the heart has been discussed.

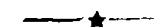
Diagnostic problems have been indicated.

A case of a metallic foreign body of about 1 oz. weight which was successfully removed by the author has been reported.

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PLASMA CLOT REPAIR OF NERVES*

(An Experimental Study)

BY

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Fibrosis at the site of suture is the most important avoidable factor. This, if excessive, hinders the proper regeneration and growth of axons. The type of suture material used, besides other factors like haemorrhage at the site of suture from the nerve ends and the bed, contusion of the nerve ends, excessive tension and local sepsis, is an important factor in the laying down of fibrous tissue in the union scar.

Sargent and Greenfield in 1919 and Gutman in 1943 worked out comparative studies of different suture materials to evaluate the local reaction produced by them and concluded that linen, white silk and fine human hair are the best. Spurling in 1945 advocated tentalum wire as the best suture material.

Inclusion of some nerve fibres inspite of great care to take the bites from the sheath, knuckling of the fibres at the ends when the sutures are tied and twisting and rotation of the stumps because the bites cannot be taken from exactly the same points on the circumference of the nerve ends are some factors which determine the final results and which cannot be avoided even with the least irritant suture material.

Young and Medawar (1940) evolved a non-suture technique to obviate these difficulties, especially in the thinner nerves. They 'glued' the two ends of the divided

nerve by cockerel plasma clot. Later Tarlov and Benjamin (1943) studied various autologous, homologous and heterologous plasma and blood clots. They reached the conclusion that mammalian plasma clots and, particularly, the autologous, are the best as regards their tendency to provoke the inflammatory and fibrotic reaction and their strength and adhesive property. Tarlov et al (1952) after studying the clots made by various methods concluded that the tensile strength of the clots obtained from citrated recalcified plasma are the best provided the reagents used are in dry form.

In this study an attempt is made to compare the process of nerve repair by silk suture and autologous citrated recalcified plasma clots in the sciatic nerves of dogs.

Material and Methods of Study

The material consists of sciatic nerves of 8 mongrel dogs. On one side the nerve was sutured with fine silk and on the other side plasma clot was used to 'glue' the two ends. The nerves were studied after 3, 9 and 15 days in two dogs each and after 40 and 60 days in one dog each.

Under I. V. Thiopentone anaesthesia the sciatic nerves were exposed on both sides through the intermuscular septum between the biceps femoris and the vastus lateralis. The nerves were divided 4 to 5 cms. below their exit from the pelvis. The

bleeding from the cut ends was controlled and one nerve was sutured by two laterally placed stitches of fine 5-0 black silk. On the other side plasma clot prepared by the technique advised by Tarlov et al (1952) was used.

14 cc. of blood of the same dog was collected and mixed with 0.038 gm. of dry sodium citrate. The plasma from this was separated in two test tubes and kept ready for use during the operation. After the nerve ends had been arranged in the specially designed mould, the plasma was mixed with 0.01 gm. of dry calcium chloride and immediately poured into the mould. All this was done under aseptic conditions.

The rubber moulds recommended by Tarlov et al (1943) were used. Two sizes, one with the capacity of 18 drops for thicker nerves and the other of 12 drops for thinner ones were used. Two hypodermic needle stillet wires were used as rails in the moulds to prevent sagging of the nerve ends.

The plasma after being poured in the mould was not disturbed for about 15 to 20 minutes to allow proper setting of the clot. The mould was then removed after taking out the wire rails. Various stages are shown in figures 1, 2 and 3.

During operation the following points were noted:—

1. Retraction of the nerve ends after section.
2. Initial separation of the stumps when the mould was removed. They were approximated.

Post-operatively all the dogs were given 2 lacs units of Procaine Penicillin I. M. for three days. Splints were not used in any dog.



Fig. 1
Showing the nerve stump being arranged in the mould.



Fig. 2
Nerve lying in the mould, plasma clot has set.



Fig. 3
Plasma clot repaired nerve.

*A part of Thesis of R. N. S. on, "Nerve Repair by Suture and Non-suture Technique in Experimental Animals", submitted for M.S. (Surgery) Examination of 1958 of the Vikram University Ujjain.

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After the periods mentioned the nerves were again exposed under light anaesthesia to study the adhesions at the site of repair, and the distance at which pinching the nerve could elicit a reflex response. The nerves were then divided 0.5 cm. proximal to the suture and about 1 cm. distal to the site of pinch test. These were tied on cardboard to prevent shrinkage, preserved in 10% formol saline and later cut longitudinally into 10 microns thick sections which were stained with Haematoxylin and Eosin, Van Gieson's stain for collagen and Gros Bielchowsky's stain for axons and studied under the following heads:—

1. Inflammatory reaction at the site of repair.
2. Fibrotic reaction at the site of repair.
3. Collagen laid in the scar.
4. Pattern of the scar and the axons in it, whether regular and parallel or irregular.
5. Distance to which the axons had grown from the proximal stump.

The inflammatory and fibrotic reaction was classified as +, ++, +++ and ++++ as suggested by Tarlov and Benjamin (1943). Separate case sheets were maintained with all the above points for each dog.

Observations

Retraction of the nerve ends after section.—Table No. I shows the retraction of all the nerves after they were divided. It is seen that in 10 (62.5%) nerves the retraction was more than 0.5 cm., while in only 6 nerves it was less.

Initial Separation of the stumps.—No initial separation was seen in the sutured nerves. In the plasma clot repaired nerves the initial separation noted on removal of the moulds is shown in Table No. II.

Table I
Showing Retraction of Stumps

Retraction	No.	%
Nil	2	12.5
0-0.5 cm.	4	25
0.5-1 cm.	9	56.25
Above 1 cm.	1	6.25

Table II
Showing Initial Separation

Separation	No.	%
Nil	5	62.5
0-1 mm.	2	25
1-2 mm.	1	12.5

Relation of Retraction to the Initial Separation.—Table No. III shows this. It is clear from the table that after a retraction of about 1 cm. the nerves could be 'glued' satisfactorily by the plasma clot.

Table III
Relation of Initial Separation to Retraction of Stumps

Retraction and No.	Initial Separation		
	Nil	0-1 mm.	1-2 mm.
Nil = 1	1	—	—
0-0.5 cm. = 2	2	—	—
0.5-1 cm. = 4	3	—	1
Above 1 cm. = 1	1	—	—

Late separation of the Stumps as measured under the microscope.—Among the sutured nerves no late separation was expected but

had occurred in one nerve where the ends had separated by 13 mm. but were connected by a bridge.

In the plasma clot repaired nerves late separation noticed is shown in Table No. IV.

Table IV
Showing Late Separation

Late Separation	No.	%
Nil	3	37.5
0-1 mm.	1	12.5
1-2 mm.	3	37.5
Above 2 mm.	1	12.5

Relation of Initial and Late Separation.—Table No. V shows this relationship. It is seen that of the 5 nerves which did not show initial separation only in one nerve late separation was not seen. This indicates that the binding power of the clot is not permanent.

Table V
Showing Relation of the initial to the Late Separation

Initial Separation with No.	Late Separation			
	Nil	0-1 mm.	1-2 mm.	Above 2 mm.
Nil in 5	1	1	2	1
0-1 mm. in 2	2	—	—	—
1-2 mm. in 1	—	—	1	—

Histological Examination

A. Plasma clot junctions.—At 3 days—The sheath continuity was restored (Fig. 4). The junction was invaded by polymorphs, lymphocytes, histiocytes and occasional



Fig. 4
Sheath continuity restored on 3rd day.
× 100.

giant cells, eosinophils and plasma cells, no fibrous tissue or collagen was seen in the scar (Fig. 5). The fibrin meshwork was being arranged in the clot and the denser fibres were arranged in a longitudinal pattern (Fig. 6). There was no evidence of growth of axons. The reaction was ++ in both the nerves.

At 9 days—The inflammatory reaction had passed on to a chronic phase. Fibrous tissue, collagen and capillaries were seen in the scar. The reaction was classified as + in one and ++ in the other. The pattern was regular and parallel in one and irregular in

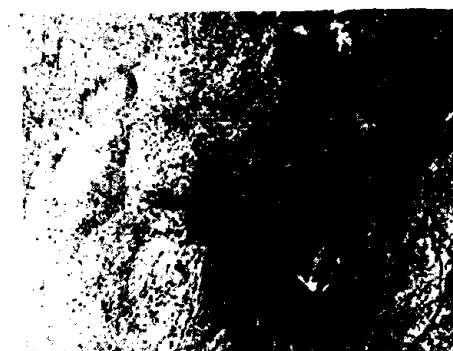


Fig. 5
Plasma clot infiltrated uniformly with cells and fibrin network being laid on 3rd day.
× 100.



Fig. 6

Fibrin network on 3rd day. $\times 450$.

the other. The axons had grown to 14 mm. in one and to 17 mm. (Fig. 7) in the other. The average distance being 15.5 mm.

On the 15th day—The reaction was still more chronic. The fibrous tissue and collagen had increased. The reaction being + in one and ++ in the other. The pattern was irregular in both. The axons had grown to 22 and 24 mm. (average 23 mm.).

At 40 and 60 days—Only occasional lymphocytes and histiocytes were seen. The reaction was + in both the nerves. The pattern was regular and parallel in both (Fig. 8) and the axons had grown through the whole of the 9 and 15 cms. pieces removed.

B. Sutured nerve junctions.—The cells were the same as those seen in the plasma clot junctions but instead of being scattered they were aggregated around the sutures. The reaction was classified as + in 2 and ++ in 6 (75%) nerves. The pattern was regular in 2 and irregular in 6 nerves. The axons had grown to an average distance of 12 mm. at 9 days and 16 mm. at 15 days. At 40 and 60 days the 9 and 15 cms. pieces removed had been innervated.



Fig. 7

Growing axons at 17 mm. on 9th day in plasma clot. $\times 1,000$.

Comments

The type of the suture material used, the other factors influencing the fibrosis remaining constant, is the only avoidable factor in nerve repair. In this study an attempt is made to study the process of repair after suture of the nerves by silk and plasma clot.

A study of table No. I shows that the majority of the nerves retract more than 0.5 cm. a sufficient retraction to cause tension at the suture site. It would be apparent that most of the nerves need a strong binding material to keep the two ends together for a sufficient period so that the axons have crossed the gap. Silk sutures



Fig. 8

Regular parallel pattern in clot junction at 60 days. $\times 100$.

do not present much difficulty but if the tension is excessive even they may cut through as was seen in one nerve in this series. Greater tension is important in the plasma clots. The initial separation seen in 37.5% in this study is comparable to 31.7% in Tarlov and Benjamin's (1943) series. The total incidence of 87.5% of initial and late separation in this study was much higher than 46% of their series. This might have been due to the movements because splints were not used. In no case was the separation more than a few mms. (Table V) indicating that the clot prepared by this technique is efficient for nerves with gaps of about 1 cm. These results are comparable to those of Adlar, Kaplan and Arthur (1956).

The inflammatory and fibrotic reaction was less marked in the plasma clot junctions. It was + in 5 and ++ in 3 nerves. In the silk sutures it was + in only 2 and ++ in 6 nerves. The cells were more uniformly scattered than in the sutured junctions.

The pattern of the scar was regular and parallel in a greater percentage (62.5%) with plasma clot than with (25%) sutured nerves. This is due to the longitudinal tension at the ends which is taken off by the sutures, as pointed out by Weiss and Taylor (1943). The sutures get ensheathed with the inflammatory cells and fibrous tissue. The scar pattern was irregular in 75% of the sutured nerves when only two stitches were used. If more stitches were used the scar would have been worse. This would be particularly so with the thinner

nerves where the ratio of the sutures, and hence the fibrous tissue, to the nerve elements would be greater.

The distance the axons had grown was more with the plasma clot than with sutures. It was 15.5 and 23 mm. at 9 and 15 days respectively with plasma clot as compared to 12 and 16 mm. during the same periods with sutures. This may be due to the longer time they take to penetrate the sutured junctions due to the irregular pattern and excessive reaction. With plasma clots where the pattern is regular, longitudinal and parallel the resistance offered to the delicate axons is less. This confirms Young and Medawar's (1940) observations.

Conclusions

1. Majority of the divided nerves need a strong binding material.
2. Autologous recalcified citrated plasma clots are efficient for gaps upto about 1 cm.
3. The inflammatory and fibrotic reaction is more marked with silk sutures than with plasma clots.
4. The pattern of the scar and the growth of the axons is regular and parallel with greater number of plasma clot junctions than with sutured ones.
5. The axons grow to a longer distance with plasma clot than with sutures.
6. Repair of thin nerves would be more suitable with plasma clot than with sutures.

Summary

An experimental study of repair of the sciatic nerves of dogs by silk sutures and by plasma clots is presented. The comments and the conclusions drawn are briefly described.

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HYDRO-CORTISONE IN NERVE REPAIR*

(An Experimental Study)

BY

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Fibrosis at the site of suture if excessive hinders the proper regeneration and growth of delicate axons. To quote the words of Weiss and Taylor (1943), "The heavier the fibrosis, the denser the interstitial tissue would be and fewer nerve fibres will penetrate and more will be prematurely arrested, slower will be the advance of the successful ones, the lesser their ability to recover normal diameter and greater their danger of becoming strangulated and pressure blocked."

The cortico-steroids inhibit the inflammatory and fibrotic reaction during wound healing. The effect on nerve repair has not been studied before. It was presumed that their administration might help the process of regeneration after nerve suture. With this in view this work was undertaken and an attempt was made to study the effect of Hydro-cortisone on the repair process following suture of nerves in dogs.

Material and Methods of Study

The material consists of 18 sciatic nerves of dogs. These were divided into two groups of 12 and 6 nerves. The first group of 12 nerves constituted the dogs that were given hydro-cortisone while the second were kept as controls.

The nerves were exposed through the intermuscular septum between the biceps femoris and the vastus lateralis under intravenous thio-pentone anaesthesia. The nerves were divided about 4 to 5 cms. below their exit from the pelvis. The bleeding from the

cut ends was controlled and they were sutured with fine 5-0 black silk by two laterally placed stitches. Care was taken to take the bites only from the nerve sheath and to avoid knuckling of the nerve fibres when the sutures were tied. The nerve beds were cleaned and the wounds closed.

During the post-operative period all the dogs were given 2 lacs units of Procaine Penicillin I. M. for three days. Splints were not used in any dog.

The first group was divided into three sub-groups of four nerves each. These were studied after 3, 9 and 15 days respectively. These dogs had been given hydro-cortisone acetate, in doses of 1 mg./Kg. of the body weight I. M. for 3, 7 and 10 days respectively. The second control group was also divided in three sub-groups of two nerves each studied after 3, 9 and 15 days respectively.

Only those nerves where the wounds had healed by primary intention were included in this study. After the above mentioned periods the nerves were again exposed under light anaesthesia and the adhesions at the site of suture, separation of the stumps where the sutures had disrupted and the distance at which pinching the nerve could elicit a reflex response were noted. The nerves were then divided about 0.5 cm. proximal to the suture and 1 cm. distal to the site where the pinch test was positive. They were tied on cardboard to prevent shrinkage, preserved in 10% formol saline,

*A part of Thesis of R. N. S. on "Nerve Repair by Suture and Non-suture Technique in Experimental Animals", submitted for M.S. Surgery Examination of 1958 of the Vikram University, Ujjain.

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and later cut into 10 microns thick longitudinal sections which were stained by Haematoxylin and Eosin, Van Gieson's stain for collagen and Gros Bielchowsky's stain for axons and studied under the following heads:—

1. Inflammatory reaction at the site of suture.
2. Fibrotic reaction at the site of suture.
3. Collagen laid in the scar.
4. Pattern of scar and axon growing through it whether regular and parallel or irregular.
5. Distance to which the axons had grown from distal end of the proximal stump.

The inflammatory and fibrotic reaction was classified as +, ++, +++ and ++++ as advised by Tarlov and Benjamin (1943). Another grade where the reaction was less marked than + in the hydro-cortisone group, it was designated as ±.

Separate case sheets with all the above mentioned points were maintained for each dog.

Observations

Adhesions at the site of suture.—They were dense in all the six nerves of the control group. Under hydro-cortisone they were flimsy in all the four nerves at 3 days, dense in two and flimsy in two at 9 days and dense in two and flimsy in two at 15 days. In a total of 8 (75%) of the 12 nerves under hydro-cortisone they were flimsy.

Separation of the stumps.—In the control group in only one of the six nerves the sutures had cut and the stumps had separated to a distance of 13 mm. connected by a bridge of scar.

With hydro-cortisone, the suture site had completely disrupted without any bridge in

3 (25%) and in another 3 (25%) nerves it had disrupted but the ends were connected by a bridge of tissue, which was 14, 5 and 3 mms. long. So that in a total of 6 (50%) of the nerves the suture site had disrupted.

Inflammatory and Fibrotic reaction.—The suture site at 3 days had been invaded by polymorphs, lymphocytes, some histiocytes and occasional giant cells, eosinophils and plasma cells. No fibrous tissue, collagen or capillaries were seen in the scar. The cells were aggregated around the sutures (Fig. 1) and fibrin meshwork was seen being laid irregularly between the nerve stumps. The grading of the reaction was ++ in both the controls and ++ in two and + in two of the hydro-cortisone group nerves.

At 9 days the reaction had become more chronic and some fibrous tissue, collagen and capillaries were seen in the union scar. It was ++ in both the control nerves but was ± in all the three of the 4 nerves that had united under hydro-cortisone.

On the 15th day the reaction was ++ in both the control nerves while in the hydro-cortisone group two nerves had completely separated and the other two were bridged by 14 and 3 mm. scars. The reaction in these two was +.

The reaction was therefore ++ in all the six nerves of the control group while it was ± in 3 (33%), + in 4 (44.4%) and ++ in only two of the 9 nerves that had united under hydrocortisone.

Pattern of the Scar and the axons.—It was irregular in all the six nerves in the control group. With hydrocortisone it was irregular in 7 (77.7%) of the 9 nerves united. In the other two where the pattern was regular the sutures had cut through.

Growth of the Axons.—At 3 days no nerve elements were seen in the scar in both the groups.

At 9 days in the control nerves they had grown to 12 mm. in both while in the other group they had grown to 15, 11 and 10 mms. (average 12 mm.) in three of the 4 nerves that had united.

On the 15th day in the control group they had grown to 15 and 17 mm. (average 16 mm.) and in the other group to 16 and 15 mm. (average 15.5 mm.). In the other two nerves the suture site had completely disrupted.

Comments

Hydro-cortisone acetate is primarily meant for intra-articular and topical use. It was therefore decided to use it at the site of suture through a polythene tube but it was not possible to keep it in place for many days without the danger of infection in dogs. Mary Hewitt Loveless (1957) has mentioned its use by intramuscular route in human beings. The action starts in 3 to 4 hours, reaches the peak level in 8 to 12 hours and lasts for about one day. One daily injection was therefore considered sufficient and was very convenient.

Weiss and Taylor (1943) mention that the adhesions at the site of suture produce distortion of tension pattern and subsequently the scar pattern. It was therefore presumed that under hydro-cortisone by preventing the dense adhesions at the suture site, the pattern of the scar might be affected. A study of the pattern of the scar revealed that in 7 (77.7%) nerves it was irregular. In two only it was regular and these were the nerves where the sutures had cut putting the scar under the conditions of tension seen with plasma clot repairs of the nerves. This shows that the pattern of the scar does not depend on the prevention of adhesions and that hydro-cortisone has no special advantage.

The reaction in the scar was classified as ± and + in 7 of the 9 nerves united under hydrocortisone while it was ++ in only two. In the control group it was ++ in all the nerves. This indicates the inhibitory effect of the hydrocortisone (Figs. 1 & 2). From this again it was presumed that the reduction in the fibrosis in the scar might have



Fig. 1
Intense inflammatory reaction around silk sutures in the control group. $\times 300$.

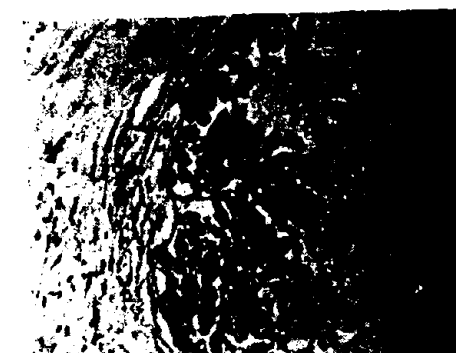


Fig. 2
Mild reaction around the sutures under hydro-cortisone. $\times 300$.

helped the axons to grow to longer distance but the average distance the axon had grown at 9 and 15 days were similar in both the groups. This again shows that hydro-cortisone has no added advantage.

A high incidence of disruption of the suture site (50% in this study) is definitely more harmful than the slight apparent advantage gained by reducing the adhesions and the fibrosis in and about the sutures in a nerve repair.

Summary and Conclusions

An experimental study of the effect of Hydro-cortisone on the process of nerve repair after sutures is presented. It is concluded that it does not favourably affect the

growth of the axons through the scar although it reduces the adhesions and the inflammatory reaction and fibrosis at the site of suture. A high incidence of disruption of the sutures is very harmful under its effect.

Acknowledgements

We are thankful to Dr. C. M. Rangam, Professor of Pathology, M. G. M. Medical College, Indore, for the opinion on the histological studies and Dr. B. C. Bose, Principal, M. G. M. Medical College, Indore, for the facilities provided to complete this work. We are also thankful to Dr. D. P. Mukerjee for the excellent photographs, and the Unichem Laboratories for supplying Hydro-cortisone used in this work.

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RETROPUBIC PROSTATECTOMY

(Observation on 100 Cases)

BY

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Urinary discomfort amounting from simple dysuria to acute retention and uraemia in old people has been recognised since long to be caused by enlargement of the prostate. However, it was Lessar, a Venetian physician of the 16th century who was the first to point out that swelling of the prostate produced urinary blockage and successfully treated his patients by incising the bladder neck to relieve retention. The first attempt to remove prostatic tissue was probably made by Mercier who devised a punch to cut a tunnel through the gland; but this operation was discredited by severe haemorrhage and infection. Subsequently in 1873 Bothilina devised a galvano cautery to replace the punch of Mercier as the former had the advantage of controlling bleeding. In 1887 McGill of Leeds and Bellfield of Chicago published the technique of partial suprapubic prostatectomy to relieve prostatic obstruction. Still not being satisfied, Fuller in 1895 and Freyer in 1901 practised and advocated suprapubic transvesical prostatectomy for the enlarged gland.

The fact that the prostate is an extravascular organ prompted many surgeons to develop a technique by which the prostate could be removed without traumatising the bladder proper which has already long suffered the pathological insult. In 1909 W. J. Van Stockum of Holland first approached the prostate through the retropubic space and removed the gland, what he called, "Paravesically". In this attempt Young in 1917 practised and published the perineal route

of prostatectomy. Mair in 1924 reported 4 cases of prostatic enucleation by inguinal extravesical route. L. Clive Jacobs and J. C. Asper (1933) of San Francisco, not knowing about Van Stockum's retropubic approach, removed the enlarged gland by this route and described it as perivesical prostatectomy. Hybbinette in 1935 and Utean and Leroy in 1936 practised this route with success. Later on, in the search for finding out a safer technique to remove the prostate extravascularly, Sir Terence Millins in 1945 developed the technique of retropubic prostatectomy. Commenting on



Fig. 1.

Photograph of an Adenoma Prostate removed from a case of Senile Enlargement by Retro-pubic route. A notable feature is very big median lobe sitting at the top.

Millin's paper in the Royal Society of Medicine in 1947, Clifford Morrison of London observed that it is dangerous to dogmatise about the result of a new operation until it has had a fair trial but he certainly liked the simplicity and the minimum amount of damage to the surrounding tissues in Millin's operation. W. A. Adams of England while appreciating this operation observes that this has a direct attack on the obstacle, spares the bladder of added surgical trauma and overall, the intact bladder is ready for action as soon as artificial drainage is removed. E. W. Riches of England is of the opinion that though the approach is difficult, the reconstruction is easier and concludes that there appears to be little difference over the suprapubic approach in the final results but the immediate convalescence is smoother after the retropubic operation. Souverneur and Aboulker of Paris comment that the stages of the operation in the retropubic approach are harmonious and conducted directly under visual control.

From the literature it appears that though this operation is very popular in western countries it has not got its due in this part of the world. The only paper published on this subject is that of Srivastava (1959) who has recorded 40 cases in this paper. The present paper puts forward observations by the authors in 100 cases which were operated

on by the retropubic approach in the Patna Medical College Hospital during the period 1956-1959.

Observations

Out of the 105 cases admitted and operated on by the authors, in the years 1956-1960, 100 cases were operated on by the Retropubic approach. The general condition of the patient is tabulated in Tables III and IV. Of these cases 11 were hypertensives. They were treated by hypotensive drugs. All but 3 cases responded to the drug. The remaining 3 had to be operated on with systolic pressures above 200 mm. Hg. and diastolic 110 mm. Hg. Ten cases had high blood urea level which could not be brought down. Fifteen cases had previous cystostomy, but they too were subjected to retropubic Prostatectomy; these cases presented difficulty in separating the bladder from the abdominal wall.

Table No. 1

Techniques used for the removal of the prostate in a series of 105 cases

Total No. of Prostatectomies done	Retropubic technique	Transvesical Freyer's Tech.
105	100	5

Table No. 2

Retropubic Prostatectomy with or without pre-operative treatment

No. of cases with Suprapubic done	No. of cases without suprapubic	No. of cases with catheterisation done	No. of cases without catheterisation done
15	85	62	38

Table No. 3

Preoperative condition of the patients in whom retropubic prostatectomy was done

General Condition.			No. of cases with acute retention	No. of cases with chronic retention	No. of cases with Dysuria	No. of cases with Haematuria
No. of cases in good condition	No. of cases in fair condition	No. of cases in poor condition				
20	55	25	48	41	70	20

Table No. 4

Urinary Physiology and Vascular State

Blood Urea.			Blood Pressure.		I. V. P.	
Between 20-40 mgm. per 100 c.c. of Blood	Between 40-100 mgm.	Between 100-200 mgm.	Normal B.P.	High B.P.	Normal functioning of Kidney	Poor functioning of Kidney
90	10	Nil	89	11	70	30

Table No. 5

Cystoscopy was undertaken as a routine. Trabeculation was rather a constant feature, though of varied degree. But the most important revelation was that of a diverticulum in one of the cases.

Cystoscopic Findings

Condition of Bladder Wall.		Congestion	Diverticulum	Stone
Normal	Trabeculation			
1	90	10	1	4

Anaesthesia Spinal Anaesthesia was given only in cases having normal blood pressures. Most of the cases were operated on under general anaesthesia with gas oxygen and relaxant.

Table No. 6

Anaesthesia used in Operation

No. of cases operated under Spinal Anaesthesia	No. of cases operated under General Anaesthesia
41	59

Operation

Incision—In a few early cases of the series, transverse incision in the suprapubic region was employed. The rest of the cases were operated on by vertical incision. This provided quite satisfactory exposure of the operation field. Difficulty was met mostly while ligating the dorsal vein of the penis and the prostatic plexuses. Bladder neck resection was done as a routine. A wedge was excised from the posterior wall of the neck of bladder. All bleeders were take care off before closure. Boomerang needle was

used exclusively in all cases. Foley's catheter was used in all cases. Vasectomy was the routine procedure, patients got blood transfusions 300 cc. usually. In a few cases one point of blood was used.

Table No. 7*Weight of the gland removed*

Weight	No. of Cases
Between 20—29 gms. ...	32
Between 30—39 gms. ...	28
Between 40—49 gms. ...	17
Above 50 gms. ...	23

Table No. 8*Lobes of the Prostate Enlarged*

No. of cases with lateral and median lobe enlargement	No. of cases with only median lobe enlarged	No. of cases with posterior lobe enlarged
90	10	Nil

Table No. 9*Shock during Operation*

No. of cases not developing shock	No. of cases developing shock
94	6

Post-Operative.—As a routine patients got antibiotics, Penicillin and Streptomycin in most cases. Free drainage of urine was always assured by washing and sucking out clots whenever they blocked the catheter. In cases having unusual bleeding, silver nitrate, solution 1 in 10,000 was used to

wash the bladder. Catheter was removed when urine got clear. It usually happened by the 5th day.

Table No. 10*Immediate Post-Operative Complications*

Complication	No. of Cases
1. Shock ...	6
2. Haemorrhage Primary ...	4
Secondary ...	3
3. Catheter Blockage ...	67
4. Suprapubic Leak ...	24
5. Oliguria ...	1
6. Anuria ...	1
7. Uraemia ...	1

Table No. 11*No. of days taken by the patients to become afebrile after operation*

No. of days	No. of Patients
3rd ...	10
4th ...	46
5th ...	21
6th ...	14
7th ...	3
8th and Afterwards ...	6

Table No. 12*Types of Infection encountered*

Types of infection	No. of patients
Coli and B. Coli ...	24
B. Pyocyaneus ...	6

Table No. 13*No. of days for which Catheter was kept*

No. of days catheter was removed	No. of Patients
5th day ...	65
6th day ...	11
7th day ...	10
8th day ...	9
9th day ...	5

Table No. 14*No. of days taken by the urine to clear up after operation*

No. of Days	No. of Patients
1st day ...	Nil
2nd day ...	5
3rd day ...	21
4th day ...	35
5th day ...	4
6th day ...	25
7th day ...	10

Table No. 15*Temporary behaviour after removal of catheter*

Behaviours	No. of Patients
Acute Retention ...	Nil
Incontinence ...	20
Suprapubic leak ...	29

Follow up

Patients were instructed to come for check up after one month or earlier if any trouble. The cases with evidence of stricture were dilated and one or two dilations

were sufficient. The cases with incontinence were reassured and advised to forget about it as it would clear by itself; it did in all but one case. Recently one case reported with pain and tenderness at the pubic symphysis. 'X'-ray showed slight rarefaction. He was advised antibiotics and analgesics.

Table No. 16*No. of days for post operative stay in hospital*

No. of Days	No. of Patients
8 to 10 days ...	55
11 to 13 days ...	30
14 to 15 days ...	8
Beyond 15 days ...	7

Table No. 17*Follow Up*

Behaviour	No. of Cases
Stricture ...	3
Incontinence ...	2
Suprapubic leak ...	Nil
Infection ...	3
Osteitis of the Pubic bone ...	1

Operative Mortality

Four patients died. One patient was a case of cardiac insufficiency. He died on the second day after operation of heart failure. One case, 80 years old, developed sudden secondary haemorrhage, which was further complicated by uraemia.

Table No. 18
(Mortality)

Cause of Death	No. of cases died
Uraemia ...	1
Shock ...	1
Cardiac Failure ...	1
Secondary Haemorrhage ...	1

Discussion

Out of the hundred cases presented here, fifteen had previous suprapubic drainage. Though all cases, without previous suprapubic drainage were discharged from hospital in 8 to 13 days' (average 10 days) time after operation, those with suprapubic drainage had to be kept in the wards from 14 to 20 days (average 17 days) because of troublesome urinary leakage. These figures compare very favourably with those of Lowsley and Gentile (9.5 days in 28 cases) Owsley Grant and Robert Lick Jr. (13.5 days in 50 cases), Thomas D. Moore (10.6 days in 116 cases), Houston et al (14.3 days in 100 cases) and Robert Lick (12.3 days in 663 cases). Millin's average in his first 50 cases were 16.6 days in one stage prostatectomy and 22.9 days for second stage prostatectomy. The post-operative stay in cases with second stage prostatectomy, though long when compared with the one stage operation, is still quite short when comparison is made with post operative stay after Freyer's transvesical prostatectomy. There were two important problems in the immediate post-operative period. Blockage of the catheter due to blood clots was one. This responded very

well to suction by a bladder syringe. A few cases having excessive bleeding had a remarkable response to silver-nitrate bladder wash. The other problem was that of suprapubic leakage while the catheter was in the bladder. This was common in cases having second stage prostatectomy because in most of these cases water tight closure could not be affected due to extreme fibrosis. However, the leak stopped easily and early in cases which had free flow through the catheter and subsequently through the urethra and there was no infection. Infection was the exclusive cause of persistence of suprapubic leak. In this connection it was also noted that preoperative instrumentation or catheterization predisposed to post operative infection in most cases. Hence the authors always tried to avoid any instrumentation prior to the day of operation.

In continence was another problem in the late post operative period. Persistent incontinence occurred in two cases. One regained power after two months of continuous reassurance and treatment. In this case the cause was the poor health of the patient with lurking infection in the urine. The other case, after about a year of persistent reassurance has reported improvement recently, though he has not been completely free from the nuisance.

Summary

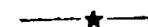
Observations on 100 cases of Retropubic prostatectomy have been presented.

The post operative problems and the final results have been discussed.

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MEDULLARY FIBROSARCOMA OF BONE

BY

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Bone tumours have always been a fascinating subject both to the Surgeon and the Pathologist. The variety of tumour types has resulted in a number of attempts at classification, none of which has found universal acceptance. Fibrosarcoma arising in bone is a relatively less frequent tumour and in this group the medullary type is very rare. Much controversy prevails on this subject and hence we record a case of such a tumour and the views of different authorities regarding the tumour.

Case Report

S. B., Male. Aged 40 years was admitted on 31-8-1959 for (1) Aching near the Rt. knee - 5 months (2) Swelling over the lateral aspect of the upper part of the Rt. leg - 3 months (3) Pain in the swelling - 15 days.

The present complaint started five months back with aching below and lateral to the Rt. knee. This used to worsen towards the evening. Two months later he noticed a swelling at the same site. The swelling was rapidly increasing in size. For about a fortnight prior to admission the patient was having increasing pain in the swelling. There was no history of trauma prior to the onset of the complaints, nor any fever during the course of the illness. The patient was able to walk only with the help of a support during the last month prior to admission.

Physical examination.—General condition—A moderately nourished individual—Anaemic. There was a swelling over the lateral aspect of the upper part of the Rt. leg. Rt. foot was in equino varus position.

Local examination.—A uniformly firm swelling over the head and upper third of the shaft of the Rt. Fibula. No ulceration. Dilated veins were seen coursing over the swelling. Surface smooth. Margins made out superiorly, anteriorly and posteriorly and merging indistinctly inferiorly. Not movable apart from the Fibula. No egg-shell crackling. No pulsation or

bruit. No clinical evidence of any pathological fracture. Regional glands not palpable. No other swellings in the body.

Muscles of the anterior and lateral crural compartments in the same limb were weak. Sensation over the middle of the dorsum of the Rt. foot impaired. No vascular disturbance.

Radiographs.—(1) Radiograph of the part showed expansion of the head of the Fibula with a rarefied area within it. There were none of the typical cystic areas and trabeculae of a Giant-cell tumour or the marked destruction of an osteolytic type of Osteogenic Sarcoma. The shaft in its upper third showed a surrounding soft tissue shadow. The cortex showed a woolly moth-eaten outline and a periosteal reaction. The lateral tuberosity of the Tibia where it came into contact with the Fibula showed a periosteal reaction.

(2) Skiagram of the lungs did not reveal any evidence of secondaries.

The pre-operative diagnosis was a problem. The possibilities that were thought of were (1) Osteoclastoma (2) Fibrosarcoma (3) Central chondroma. The expanding tumour of the end of the bone was highly suggestive of a Giant-cell tumour but the large soft tissue tumour and the destruction of the shaft were not easy to reconcile. Even the expanded end did not show a typical soap-bubble picture. From the clinical findings alone a fibrosarcoma appeared highly probable but the expanding lesion of the end of the bone was one that was new to us. A central chondroma was suggested from the radiological picture alone. A malignant variant of Osteoclastoma was suggested to explain the unusual features and the evidence of nerve involvement. Post-irradiation fibrosarcoma developing in an osteoclastoma was proposed to bring into line the first two probabilities but was not entertained in the absence of a history of irradiation.

At operation it was found that there was a large soft tissue tumour encircling the upper half of the Fibula. There was a capsule on the outer aspect though on the medial aspect it was not made out. The

lateral Popliteal nerve and its branches were coursing through the tumour. A resection of the tumour and the upper half of the Fibula was done. All tumour tissue evident to the naked eye was removed. On the under surface of the lateral tuberosity of the Tibia an area of cortex appeared eroded by the tumour and this was gouged out. During the resection the lateral Popliteal nerve, the anterior Tibial vessels and Peroneal vessels had to be severed. An amputation appeared desirable but was postponed to a latter date as by that time the pathology report on the tumour was also expected to be known.

Following surgery there was anxiety about the circulation as the toes were cyanosed and there was oedema of the foot but these settled down after the third day. The wound healed after a preliminary breakdown of a short length of it. An amputation above the knee was suggested but the patient refused and had to be discharged against medical advice.

It was reported that the patient expired in the last week of January, 1960. The cause of death is not known but may be from recurrence and spread of the tumour.

Pathological features.—The gross specimen was about 8" x 5" x 4". Cut section showed the head of the Fibula expanded into a sphere of 2½" diameter, and a thin shell of cortex broken here and there. The shaft itself was of normal dimensions. The rest of the tumour was made up of a grayish-white fleshy mass which filled up the cavity in the head and was encircling the shaft. There were no areas of haemorrhage, necrosis, or calcification.

Microscopic features.—Sections studied from the various parts of the tumour showed a typical picture of Fibrosarcoma. Spindle cells with elongated nuclei arranged in streams constitute the chief feature. In certain areas there were collections of round cells and in other areas collagen fibres were liberally interspersed with spindle cells. Sections from the end of the bone showed destruction of trabeculae along with the spindle cells in their characteristic arrangement. Giant cells of either the Osteoclast type or the Osteogenic sarcoma type were not seen. The bits taken from the Tibia showed a similar picture. None of the sections studied showed any evidence of osteoid or cartilage formation.

The pathological examination revealed a fairly typical picture of fibrosarcoma. The expanding lesion is due to the central origin of the tumour. Once the cortex broke down the tumour spread into the soft tissues and caused pressure erosion of the bone lower

down. In the absence of any form of giant cells neither Osteoclastoma nor Osteogenic sarcoma need be considered. As a further point against the latter is the absence of any formation of Osteoid tissue.

Comment

Lichtenstein defined a fibrosarcoma of bone as "a primary malignant fibroblastic tumour which upon a thorough histologic sampling fails to exhibit any tendency to form tumour osteoid and bone either in its local growth or in its metastasis". The definition is clear about what is to be considered a Fibrosarcoma of bone but a study of the subject leaves one in a maze of conflicting views held by eminent authorities. The revised classification (1939) of the Bone Registry of the American College of Surgeons includes Fibrosarcoma of bone—both the

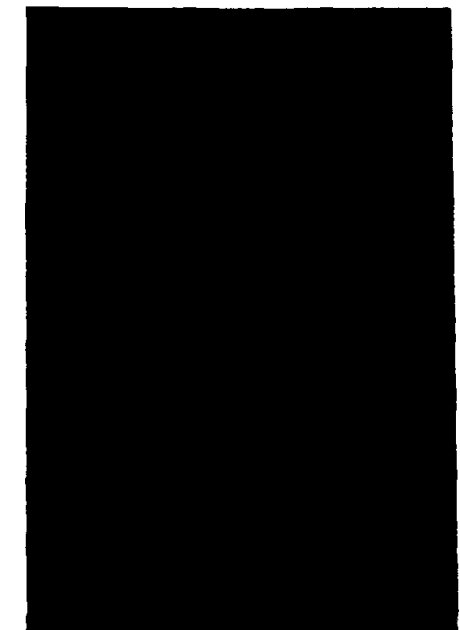


Fig. 1

Radiograph of the Tumour showing expanding lesion of the upper end of Fibula with a moth-eaten appearance of the shaft. Both the fibula and the lateral tuberosity of Tibia show a periosteal reaction.



Fig. 2

Low power microphotograph of tumour showing the bone trabeculae and spindle shaped fibroblasts arranged in "Streams" between trabeculae.

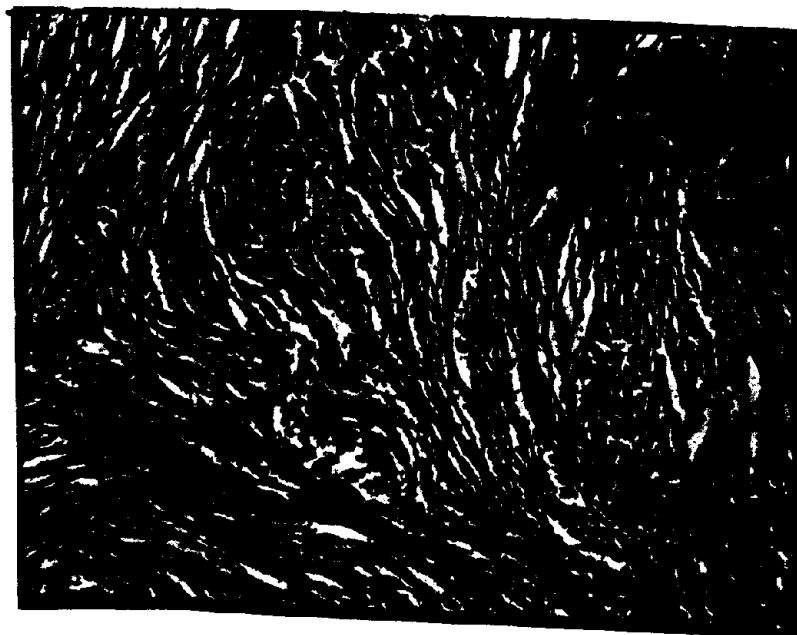


Fig. 3

The same picture under high power.

periosteal and medullary, among the subtypes of Osteogenic sarcoma. Geschickter contends that the Osteogenic portions of bone do not give rise to sarcoma of fibro-spindle cell type. Fibrosarcoma of bone according to him arises from periosteum or from fascia investing muscles, vessels and nerve trunks in overlying soft tissues and they invade bone only secondarily and cause pressure erosion. Both Geschickter and Stout deny the existence of a medullary form of fibrosarcoma and hold the view that they are less differentiated Osteogenic sarcoma. As opposed to this Lichtenstein holds the view that fibrosarcoma of bone is a distinct entity which he further subdivides into medullary and periosteal types. Budd and Mac Donald are in agreement with this as also are Coley, Dahlin and Willis whose monographs contain many examples of these two types. Ewing differentiates fibrosarcoma as a distinct entity in the Bone Registry classification and gives a good description of both types. But he also states that these have a tendency for osteoid formation and calcification and that the tumor may be fibrous, cartilaginous or calcified. Clearly this is in complete divergence with Lichtenstein's definition of fibrosarcoma and if a tumour shows any of these features it is only a less differentiated osteogenic sarcoma which has repeated in its evolution one or more phases of development from fibrous tissue through cartilage to bone. A tumour, predominantly fibroblastic and with areas of osteoid or cartilage is a fibroblastic type of osteogenic sarcoma. How then are we to differentiate fibrosarcomata from this form of osteogenic sarcoma? Dahlin considers that such distinction is only of academic value and careful search is needed to find areas of osteoid formation. Clearly then, the acid test is the tendency for osteoid formation and complete absence of osteoid would place a tumour in the fibrosarcoma group.

This over rigid adherence to a particular histological feature *viz.* the presence of osteoid in the differentiation of the two tumours may seem to be unjustified. Every one is conversant with the wide potential of young mesenchymal tissue—be it the granulation tissue of a wound or the undifferentiated cells of a sarcoma—to differentiate into a wide variety of tissues like fibrous tissue, cartilage, bone, vascular tissue etc. If it is agreed that the formation of bone in scar tissue is nothing more than the aberrant metaplasia of the granulation tissue and that fibromas ossify, then the presence of osteoid or cartilage in a fibrosarcoma is a further proof of the diverse differentiation of young mesenchyme. All the above controversy appears pointless if this capacity of intermutability of mesenchymal tissue is kept in mind.

Most authorities are agreed that the medullary form is more common than the periosteal form though our impressions are contrary to theirs. The latter are slow growing and cause pressure erosion but do not invade the medulla. The medullary forms arise from the metaphysis though rarely they may start in the centre of the shaft. They are said to arise commonly in the lower end of the Femur and occasionally in the Tibia and the Humerus. They cause expansion of bone, absorption and destruction, and eventually break through the cortex and periosteum and spread in adjoining soft tissues.

Much difference of opinion exists regarding the course and prognosis. Ewing is of the view that they are of low vitality and moderate degree of malignancy with a slow and comparatively benign course. This statement has to be taken with certain reservations, because, as pointed out earlier, the tumour that he described may be the fibroblastic type of osteogenic sarcoma. Coley recognises the separate entity and

considers them as slow growing tumours of low grade malignancy while Lichtenstein differs from this view and regards them as highly malignant. The limited material with which each worker had to study might be responsible for the divergent opinions and it is reasonable to expect a wide range of malignancy as in any other tumour.

Radiological features.—The tumour causes an irregular expansion not unlike that of a Giant-cell tumour or a central chondroma but differs from the former in being opaque and in the absence of multicystic areas.

The purely destructive lesion in the centre without expansion and resembling the Osteolytic form of Osteogenic sarcoma is also reported. The shaft may show a moth-eaten appearance. Periosteal reaction results in cortical new-bone formation.

Pathological features.—Capsule formation appears to be a common feature. Typically it is a spindle cell sarcoma with no Osteoid tissue or cartilage. The more malignant forms may give a picture of round cell sarcoma. Collagen formation may vary from little to a very marked deposition depending on the degree of differentiation; Vascularity is not marked.

Treatment.—In the belief that these were relatively benign neoplasms a conservative line was advocated but the consensus of opinion now is in favour of amputation.

A conclusion to the study of the subject cannot be put in more apt words than those of Lichtenstein's—“Clearly this remarkably interesting group of fibroblastic neoplasms calls for further study and explanation but in view of the limited relevant material available I must be content at this time with pointing out some of the problems involved. It is possible that some of these may be malignant Schwannian tumours”. This opinion regarding a Schwannian origin is shared by others too and Stewart and Copeland think that many periosteal fibrosarcomas are of this type. Peer's case of medullary sarcoma of ulna was neurogenic in origin.

Summary

- (1) A case of Medullary fibrosarcoma of bone is reported.
- (2) The conflicting views on the subject are reviewed.
- (3) The important features of the tumours are described.

Acknowledgement

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ORTHOPAEDIC SECTION

ATLANTO-AXIAL DISLOCATIONS

(Review of eight cases treated operatively)

BY

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Cases of atlanto-axial dislocations form a small but highly interesting group of cases among the various affections of the cervical spine, presenting in some cases a picture of early or late manifestations of cord involvement.

Review of Literature

The earlier publications on this subject are mostly reports of single cases. Blockley and Purser in their recent review attribute the earlier descriptions to Corner (1907), Jefferson (1927), Fritzsche (1912). More detailed reports have been published recently by Blockley and Purser, Lipscomb, McRae, McRae and Barnum and Rogers. Cone and Turner's description of the operative approach has become a fairly standard one.

Various authors have also mentioned the role of infection in producing atlanto-axial dislocations. Washington in a recent report of a case credits Bell with the initial description in 1830. Later on Watson-Jones has mentioned it as following acute pharyngitis, tuberculous adenitis in neck, retropharyngeal abscess, etc. It has also been a factor in two cases in Lipscomb's series.

Anatomical Aspects

The security of the atlanto-axial joint is mainly dependent on an intact odontoid process being held against the posterior surface of the anterior arch of the atlas by the transverse ligament, aided by the alar ligaments. (Any factor that affects either of

these structures will lead to a displacement of the atlas forward with the skull, or of the odontoid backwards, causing pressure on the spinal cord). Congenital anomalies which are not uncommon in this region may play a part in producing this dislocation. These are:

(i) Absence or weakness of the transverse and alar ligaments: (Although complete anatomical proof is lacking, it has been felt that this may be a factor in dislocations following minor trauma or infections).

(ii) Persistence of a broad cartilagenous bar between the base of the odontoid process and the body of this axis. Normally the odontoid process ossifies from two centres, the lower centre fusing with the body at the age of four years. Absence of such fusion may lead to the above anomaly, producing a weak spot. (However it is a known fact that in all individuals a small cartilagenous mass remains in the centre of the odontoid axis junction all through life. It represents the disc between Cervical 1 and 2 vertebrae).

(iii) Non fusion of the tip of the odontoid with the body. (The tip of the odontoid process normally ossifies from one centre but may have two centres in some cases. One or both these may fail to unite with the rest of the odontoid or with each other. They show as a break in a radiogram and may be mistaken for fractures. They also form a weak point and may lead to a separation).

(iv) Complete absence of the odontoid process: This is a well recognised though uncommon anomaly and may well be a predisposing factor in producing dislocations, following minor trauma (Case 4 of this series).

In cases of inflammatory nature the common site for such inflammation is the pharynx and the retropharyngeal lymphoid tissue. The resulting hyperaemia seem to affect the transverse ligament. The actual displacement of the atlas may occur gradually over a period of months or years.

Pathogenesis

These cases can be divided from the etiological view point into two groups: (i) Traumatic cases including cases with congenital anomalies where minor trauma precipitates the onset of symptoms; (ii) Pathological dislocations associated with infection of the pharynx or retropharyngeal tissues of a tuberculous or pyogenic etiology.

Clinical Review

Traumatic Group.—The cases have been arranged according to the time interval between the injury and attendance in hospital.

Case Reports

Case 1.—Name Vithal Parmar, age 11 years was admitted immediately after a fall from the first floor. He had complete quadriplegia, including paralysis of the intercostal muscles and incontinence of urine. The diaphragm was working. He was immediately put in an iron lung. His progress report was:

24 hours later: Slight movements of the left upper limb.

6th day: Both lower limbs moving well. Slight movements of left upper limb. Breathing is easier.

9th day: Urinary bladder control regained. Movements in all extremities improving.

15th day: Can stay out of the iron lung. Power grade 4 in all limbs.

25th day: Normal power in all limbs. Spasticity present.

Radiograms.—The patient was x-rayed on arrival. The routine A. P. and lateral views showed no definite abnormality (Fig. 1). Later pictures were taken in maximum flexion and extension. These showed the forward displacement of the atlas and the mobility on movements of the neck (Figs. 2 & 3). Tomograms were done and showed the odontoid to have separated and moved forward.

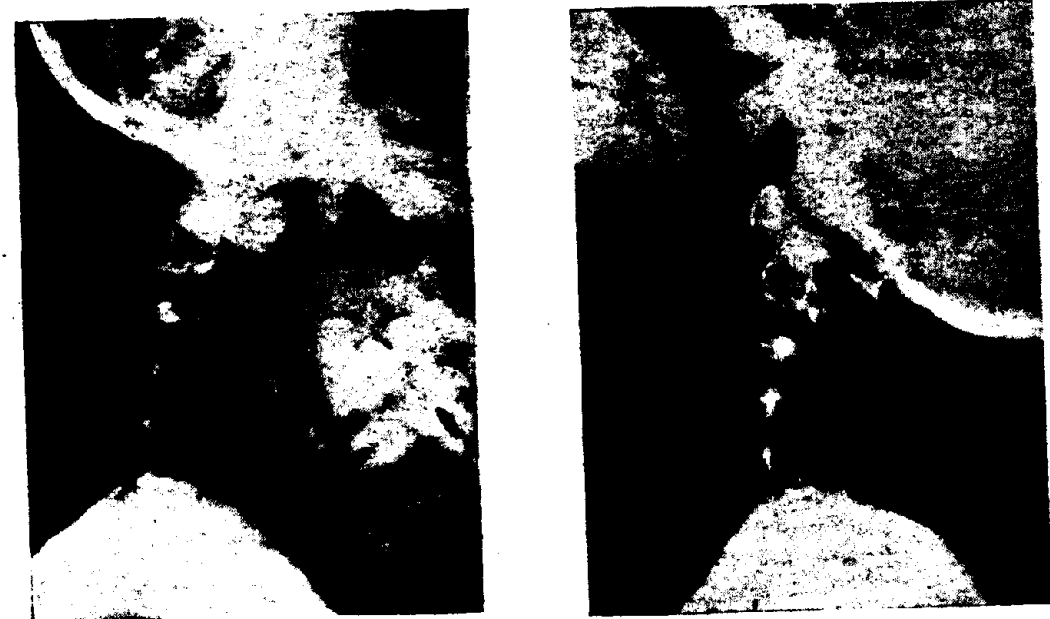
Treatment.—On admission as stated above the patient was put in the iron lung. At this stage the atlanto-axial dislocation had not been diagnosed, and hence no attempt to reduce it by skull traction was made. Later the diagnosis had been established, it was felt that fusion would suffice as the dislocation was mobile and the atlas fell into position on slight extension of the neck. An atlanto-cervical fusion was therefore done. Split rib grafts (autogenous) were used but they were not wired to the spinous processes. This was an error in technique.

Patient was last seen 11 months after operation. He is leading a normal life. Power in all muscle groups is normal or grade 4. Last radiogram however shows complete absorption of the graft, with persistent anterior displacement of the atlas (Fig. 4). It would be advisable to reoperate and do a decompression and occipito-cervical fusion. This would obviate the risk of later neurological damage.



Fig. 1 (Case 1)

Lateral view shows a doubtful forward shift of the atlas.



Figs. 2 & 3 (Case 1)

Flexion and extension views—the atlas moves forwards and backwards.



Fig. 4 (Case 1)

Post-operative: the graft is found absorbed. Atlas is still displaced anteriorly.

Case 2.—Name Laxman Dharma, age 12 years sustained a fall while playing one month prior to admission. Three days after the fall he found that he could not move the head to the left, and was unable to raise the right upper limb and felt weakness in the lower limbs. This has persisted. On admission examination showed evidence of spastic paraplegia (of grade 2), in the lower limbs, while the upper limbs showed flaccidity. There was also sensory loss of the spino-thalamic type in the upper extremities. Movements of the neck were almost normal except for nodding movements and rotation to the left which were absent.

Radiograms.—Routine A. P. and lateral views were done; the latter showed a considerable shift forwards of the atlas with the formation of a mass of new bone fusing the atlas and axis together (Fig. 5). Tomograms showed the odontoid process in the normal position (Fig. 6).

Treatment.—Decompression was carried out by removal of the posterior arch of the atlas and the posterior margin of the foramen magnum for $\frac{1}{2}$ ". As natural fusion had occurred in front, no fusion was considered necessary.



Fig. 5 (Case 2)

Lateral view: shows the forward shift of the atlas with a mass of new bone in front fusing atlas to axis.



Fig. 6 (Case 2)
Tomograms: shows the odontoid pr. in the normal position.



Fig. 7 (Case 2)
Post-operative: 7 months after operation. Atlas in the same position.

The patient recovered full range of power in four weeks. He was rechecked 7 months after operation, when he was perfectly normal. Radiograms were taken and confirmed the earlier assumption that no further forward displacement of the atlas would occur (Fig. 7). The new bone formation is an unusual feature in this case. No similar case has been found in the literature.

(The time factor between injury and onset of neurological evidence has been shorter in this case than most others).

Case 3.—Name Mohmed Husein, age 22 years had a fall from a swing four months prior to admission. He was unconscious for two hours following the fall. On recovering consciousness he noticed pain and stiffness of the neck. This has persisted and is aggravated by movement and swallowing solid food. Examination showed the head and neck to be deviated to the left a little. The normal cervical curve was obliterated and there was tenderness below the occipital protuberance. All the movements of the neck were greatly restricted, and nodding movements were absent. There was no involvement of the nervous system.

Radiograms.—The routine lateral view showed a fracture of the base of the odontoid process with

forward displacement of the atlas and the odontoid (Figs. 8 & 9). Flexion extension views within limits of movements showed no change in the position of the atlas.

Treatment.—Patient was operated on, and a decompression and occipito-cervical fusion carried out, using autogenous iliac chips. As the patient was anxious to go back to his home he was given a Minerva plaster jacket on the fourteenth day and discharged. It is three months to date from operation.

Case 4.—Name Aoran Datta, age 10 years was admitted with a history that a school mate hit him on the back of the head two and half years back. He was unconscious for ten minutes after the injury. There was no external bleeding. After the injury it was noticed that he was weak in the legs, and still later he started dropping things from his hands. Gradually the weakness in all four limbs increased and prior to admission he could not walk, but was carried to school by his father. On examination he was a boy of average intelligence. Both upper and lower limbs were weak, power being roughly grade 2 to 3. There was well marked spasticity, with increased deep jerks, ankle clonus +, and plantar extensor. Sphincter control was normal. The movements of the neck were normal.



Fig. 8 (Case 3)
Lateral view: the atlas is forwards.



Fig. 9 (Case 3)
Tomograms: The odontoid pr. is broken and carried forward with the atlas.



Fig. 10 (Case 4)
Lateral view: the atlas appears in the normal position.

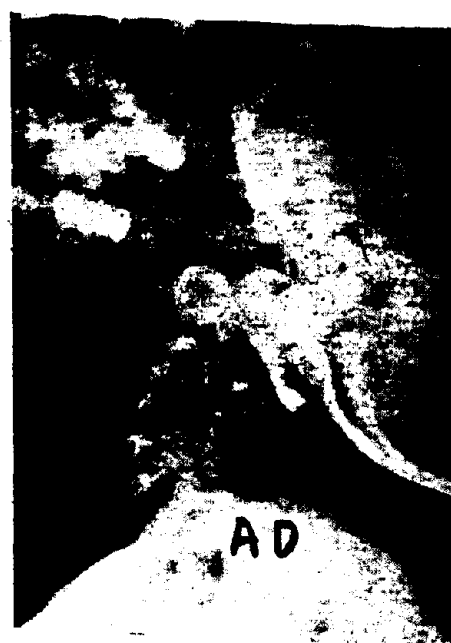


Fig. 12 (Case 4)
Lat. view in extension: marked backward slide of the atlas.



Fig. 11 (Case 4)
Lat. view in flexion: atlas has slid forwards.



Fig. 13 (Case 4)
Tomogram: No odontoid pr. seen.

Radiograms.—These showed marked instability of the atlas on the axis in flexion and extension, specially the latter where the atlas can be seen to slide backwards over the axis (Fig. 10, 11 & 12). The odontoid process was not visualised even in tomograms, and was therefore presumed to be absent (Fig. 13).

Treatment.—A decompression was done by excising the posterior arch of the atlas and the posterior margin of the foramen magnum. Fusion of the occiput to Cervical 2nd and 3rd vertebrae was done using bone from the bone bank to avoid further trauma to the child.

The boy was last seen 5 months after the operation. The power in the limbs had returned to normal in almost all the muscles, grade 4 to 5, but the spasticity and clonus persisted. This prevented the normal smooth functioning of the limbs. Radiograms taken then showed only a faint trace of bone formation and fusion of the graft. It is now considered advisable to use autogenous grafts only. The patient who lives outside Bombay has been since lost to follow-up for the last one year.

Case 5.—Name Dattaram Balagi, age 30 years was admitted with the complaint of severe and increasing pain in the neck and stiffness for the last one year. He had sustained a fall from a height of nearly 12 feet fifteen years earlier. He had felt weakness of the right upper and lower limbs for some time after the fall, but that had passed away, only to return in the last one year. On examination the right upper and lower limbs were weak, power grade 3 to 4, spasticity present in all limbs, with exaggerated deep jerks, and plantar extensors. The movements of the cervical spine were restricted with nodding absent.

Radiograms showed a fracture of the odontoid process with forward displacement of the odontoid with the atlas (Fig. 14). Flexion and extension views showed no change in the position of the atlas (Figs. 15 & 16). Tomograms confirmed the forward shift of the odontoid process.

Treatment.—Patient was operated on, and a decompression and occipito-cervical fusion done. It was noted that the dura underlying the posterior arch of the atlas was markedly thick in this case, and almost felt like cartilage. It was nicked to release the pressure on the cord. Split rib grafts were used for the fusion. As the wound was being closed, the patient's respirations stopped. He was given artificial respiration on the table for some time and then shifted into an iron lung. Although he remained alive for three

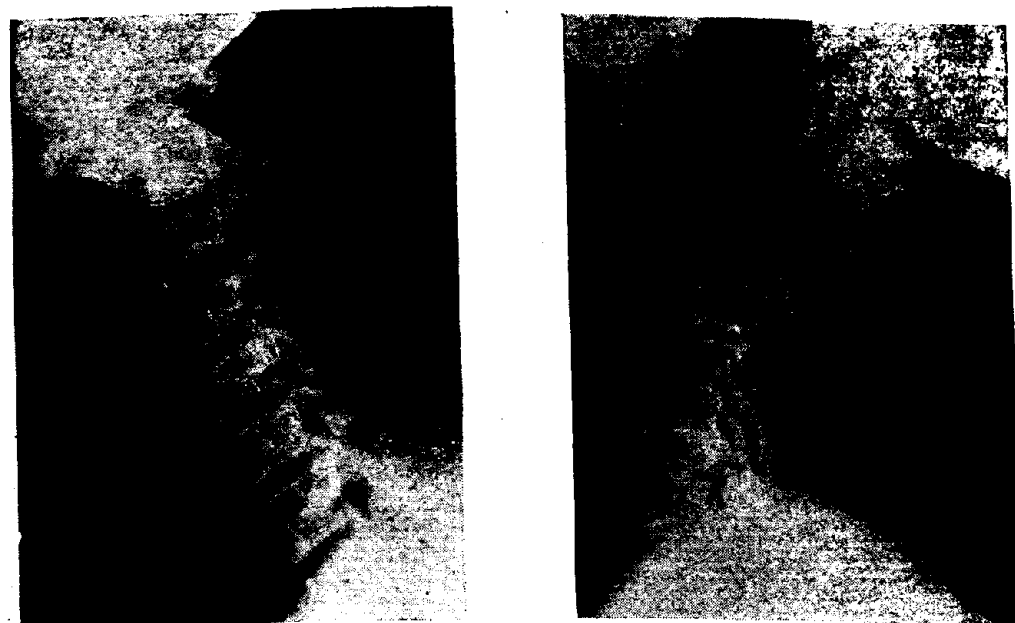
days, normal respirations did not return and he died of uraemia and circulatory collapse. A partial post-mortem was done. It showed the dura opposite the C. 1. vertebra thickened and constricted all round and that there was a corresponding narrowing of the spinal cord underneath. There was no evidence of damage to the cord at the operation. Sections taken from the cord at the site of constriction showed 'the architecture of the cord was grossly affected. The central portion shows large empty spaces. At the periphery round empty spaces of varying size are seen. In some of them hyaline material is seen, in others degenerating nerve cells are observed. The latter show alteration of shape, eccentric nucleus and hazy cytoplasm with loss of Nissels granules. Sections taken from above and below this level show similar but diminishing changes'. The exact cause of the respiratory paralysis could not be made out. The voluntary movements and bladder were not affected at any stage after the operation.

Pathological group.—There are three cases in this group.

Case 6.—Name Krishnabai Apte, age 32 years was admitted for pain and stiffness in the neck for the last 7 months. The pain and stiffness had been



Fig. 14 (Case 5)
Lateral view: shows the fracture of the odontoid pr. with forward shift of odontoid and the atlas.



Figs. 15 & 16 (Case 5)

Flexion and extension views: no shift in the position of the atlas.

steadily increasing during this time, and for the four days prior to admission she had been finding increasing difficulty in swallowing. She did not give any history of fever or pain in the throat during this time. On examination there was restricted mobility of the neck. No external swellings were seen but there was a forward bulging of the posterior wall of the pharynx as seen through the mouth. There was no evidence of pressure on the spinal cord.

Radiograms showed a forward displacement of the atlas on the axis (Fig. 17). The odontoid process was in the normal place (Fig. 18). Flexion extension views were not possible owing to the anti-restricted mobility of the neck.

Treatment.—The patient was put on tuberculous antibiotics, Streptomycin $\frac{1}{2}$ gm. B. D. and P. A. S. 4 gms. T. D. S. and these were continued for three months. Skull traction was applied in the hope of easing the pain, and reducing the dislocation. The retro-pharyngeal abscess was twice aspirated through the mouth and pus drawn out, but it filled up in two days. It was therefore decided to evacuate it by the transpharyngeal route following the description of the procedure by Southwick et al. This was done, and pus and granulation tissue removed. Histological examination confirmed the tuberculous nature of



Fig. 17 (Case 6)

Lateral view: shows the forward shift of the atlas. No lesion of the spine.



Fig. 18 (Case 6)

Tomogram: the odontoid pr. is in the normal position.



Fig. 19 (Case 6)

Post-operative: shows good occipito-cervical fusion.

the infection. The lady made an uneventful recovery, the swelling in the throat subsiding completely in four weeks.

Six weeks from admission a decompression and occipito-cervical fusion was done using autogenous iliac bone chips. Radiograms taken 6 months after the operation show good fusion of the graft (Fig. 19). One year later the patient is going about normally.

Case 7.—Name Kharunissa Suleman, age 30 years had suffered from pain in the neck, swellings on the right side of the neck, and difficulty in swallowing three years back. She had been treated on anti-tuberculous lines by another surgeon and had made a complete recovery. She now reported with the complaint of recurrence of pain in the neck and increasing weakness of all the four limbs for the last one month. On examination the neck was held fixed and movements were slightly limited at extremes. All the limbs showed spasticity with increased jerks and plantars extensors. Power in the limbs varied from grade 2 to 3.

Radiograms showed a forward displacement of the atlas on the axis with considerable mobility in flexion and extension (Fig. 20). The odontoid process was in the normal position (Fig. 21). No erosion of any of the cervical vertebrae was seen.



Fig. 20 (Case 7)

Lateral view shows the forward shift of the atlas. No evidence of disease of the cervical vertebrae.



Fig. 21 (Case 7)

Tomogram: Odontoid process is in the normal position.



Fig. 23 (Case 8)

Tomograms: shows the odontoid pr. in the normal position.



Fig. 22 (Case 8)

Lateral view shows the forward shift of the atlas and the erosion of the Cervical 6th and 7th vertebrae.



Fig. 24 (Case 8)

Post-operative: 3 months: Fusion is progressing satisfactorily. Lower lesion also shows improvement.

Treatment.—Skull traction was applied to hold the head in the neutral position. The power in the limbs returned to normal and the spasticity disappeared in four weeks. Decompression with occipito-cervical fusion was then done. The grafts were found to be fused after 3 months. The patient is going about normally.

Case 8.—Name Sarabai Timbakrao, age 35 years was admitted for pain in the neck, limitation of movements and tingling and numbness in both the arms for the last six months. On examination the neck was held stiff. The normal curve of the neck was obliterated. All the movements of the neck were painful and markedly restricted. There was some tenderness just below the occiput. There were no objective neurological signs.

Radiograms showed the forward displacement of the atlas with the odontoid in the normal position. There is also erosion of the adjacent margins of the cervical 6th and 7th vertebrae, with a small retro-pharyngeal abscess (Fig. 22). Tomograms confirmed the position of the odontoid process.

Treatment—As the atlanto-axial dislocation was considered likely to produce neurological trouble in the future a decompression and occipito-cervical fusion was done. The patient was put in a Minerva plaster and kept on anti-tuberculous anti-biotics.

Discussion

Mechanism of Injury and Anatomical Factors.—The exact mechanism of injury is not always clear, though a number of cases are associated with automobile and other severe accidents including falls from a height. (cases 1, 3 & 5). In other cases the injury may be trivial (cases 2 & 4), or no definite history may be given. Blockley and Purser in reviewing a collected series of 51 cases of fractures of the odontoid process seen immediately on injury, distinguish two varieties. The common type is where the force of the blow is directed forwards with the head flexed. This results in a fracture of the odontoid process at its base and a forward displacement of the atlas with the odontoid. In the second variety the force is directed backwards and the neck extends at the moment of impact, resulting in a fracture of the odontoid process and its being pushed

back into the spinal canal. The atlas is not displaced. In their series they had 22 cases of the forward variety and 12 of the backward variety. In other cases the mechanism of the injury was not clear. All the five cases in this series were of the forward variety.

McRae et al. have similarly differentiated between median and lateral dislocations. In the former the odontoid process has tilted backwards into the spinal canal following a break of the odontoid process and a tear of the transverse ligament. The atlas is not displaced, but in a large number of cases there is either occipitalisation of the atlas or fusion of the upper three cervical vertebrae, i.e. Kieppel-Fiel syndrome, or both. They believe that in all these cases it is the posteriorly displaced odontoid which is responsible for the neurological manifestations. There are no cases of this type in my series.

In the second group of lateral dislocations, the atlas has moved forwards the dislocation being mainly at the joint between the lateral masses of the two bones, the atlas and axis. In most of the traumatic cases the odontoid has also moved forwards with the atlas, the separation from the body of the axis being either a fracture or a break at the site of a congenital defect (cases 1, 3 & 5). In some cases the odontoid may not be displaced forwards, the transverse ligament having given way (cases 2, 6, 7 & 8). More rarely the odontoid process may be absent (case 4). Mild trauma may then be responsible for the occurrence of the dislocation and the onset of neurological signs, as happened in case 4. It may be stated here it is not possible to distinguish radiologically whether the separation of the odontoid process is traumatic or due to a congenital defect. Watson-Jones has stated that in cases where the odontoid process has moved forwards with the atlas neurological signs will be less marked

than when the odontoid process has remained in its normal place. Our experience does not bear this out. (Thus two cases out of four in whom the odontoid was in the normal site showed signs of cord pressure, while two out of three showed cord involvement in spite of a forward shift of the odontoid process. There was evidence of cord involvement also in the one case in which the odontoid was absent).

Clinical Aspects.—In the clinical history of these cases an interesting feature is the relationship of the time factor between the injury or onset of infection and the onset of neurological signs, in some cases, and the absence of the latter in others. In our series 3 cases showed no evidence of cord involvement, while the remaining five showed various degrees of affection. The time factor between injury or onset of infection as judged by the history, and the attendance in hospital has been shorter in the former group on an average, 4, 7 and 6 months respectively, as against immediately after injury, one month, two and a half years, 15 years and 3 years respectively in the latter group. It is obvious even from this brief record that the time factor is not the only deciding factor for the onset of cord changes. It is possible that the extent of forward displacement of the atlas and the mobility at the atlanto-axial joint, combined with the actual size of the spinal cord and its vascular supply are more important factors in deciding whether and when signs of cord pressure will appear. How much compression the spinal cord can withstand and for how long without clinical evidence has still to be proved.

It is a matter of recurring surprise to the clinician to see the spinal canal reduced greatly in all cases and the neurological picture vary from normal to a considerable deficit. It is certain that in cases showing

prolonged and more advanced neurological changes, vascular factors like thrombosis and endarteritis play a significant part. In this connection reference to the sections of the spinal cord of case 5 who died three days after operation is of value. It is worth noting that his was the longest period between injury and operation, viz. 15 years. The sections showed marked vacuolation of the grey and white matter with loss of cell outline at the site of constriction in the cord at the level of the atlas, and coinciding with the dense constriction in the duramater. These findings are highly suggestive of secondary vascular changes.

In eliciting the history of injury from these cases careful questioning of the patient or the parents is required specially when the interval has been a long one. Many patients may not attribute their neurological changes to the previous injury which occurred many years back, and may have been trivial. It is also necessary to remember this syndrome as the clinical picture is often bizarre, with a combination of motor and sensory changes. (These cases have been known to be diagnosed as multiple sclerosis (McRae & Barnum), posterolateral sclerosis, cerebral diplegia and neuropathy (Wadia), and cerebellar tumours (Lipscomb). It is therefore very essential to have detailed radiological examination in all cases where there is a possibility of an atlanto-axial dislocation).

Radiological aspects.—All cases where there is a suspicion of an atlanto-axial dislocation are studied in detail. Routine antero-posterior and lateral views, open mouth, and lateral views in maximum and flexion and extension where these movements were possible, are done. Tomograms in the lateral plane are done to visualise the odontoid process and establish its position whenever necessary. The pertinent findings may be summarised as under:

- (a) Where the atlas is fixed in its forwardly displaced position.
- (b) Where there is considerable mobility of the atlas as seen on flexion extension views.
- (c) The presence and position of the odontoid process.

(The demonstration of the mobility of the atlas is an interesting feature of some of these cases as it must lead to varying degrees of pressure on the spinal cord with the movements of the head and so is a potent factor in producing thrombosis of the blood vessels and intra and extra dural fibrosis. The need for adequate fusion in much greater in this group than in the first type where decompression alone may suffice, as the atlas is fixed in its abnormal position by bone or fibrous tissue. However case 2 is the only instance I have come across in my series or in the literature of such bone formation. In most other cases the fixation is by local fibrosis).

From the treatment viewpoint these cases do not present a difficult problem, and there is diversity of opinion only regarding details. Blockley et al. in their review of 51 cases of fracture dislocations of the odontoid and atlas seen immediately after injury advocate skull traction followed by the use of a cervical collar. With this line of treatment the results showed bony union in 18 cases, non-union in 22 cases and the result was not known in 11 cases. In this series 22 cases had forward displacement of the atlas and the odontoid process and of these 11 (50%) developed late neurological complications. I have felt that in view of the social and psychological background of our cases and taking into account the above figures for the occurrence of late paraplegia, it is in the

best interest of the patient to have a decompression and fusion done early. Initial skull traction is used with advantage in the more acute cases to reduce the dislocation and maintain the position while the patient is recovering from the paraplegia or quadriplegia. Hence the one acute case in this series (case 1) had a fusion done after recovering from the total quadriplegia.

In the chronic cases opinion is unanimous as regards the need to fuse the spine. Decompression is not done as a routine procedure by all, being reserved for those cases where the forwardly displaced atlas cannot be reduced to its normal position by skull traction, but remains displaced anteriorly. With the atlas in the normal position, it should be feasible to do an atlanto-cervical fusion rather than an occipito-cervical fusion; this would permit nodding movements later on. This has been recommended by some authors (Lipscomb) and was tried in case 1. I however feel that this approach has two dangers. If the posterior arch of the atlas is not removed the pressure on the cord may not be completely relieved. Secondly it is more difficult to obtain satisfactory union of the graft. If it is decided to do an atlanto-cervical fusion the grafts must be wired to the spinous processes of the cervical vertebrae. It is now felt that the simplest and most satisfactory approach to this problem is to excise the posterior arch of the atlas with the posterior margin of the foramen magnum for half an inch, and fuse the skull to the second and third cervical vertebrae. (Lipscomb from the Mayo clinic in reviewing 9 cases who underwent occipito-cervical fusion for traumatic and pathological conditions of this type, found pseudoarthrosis in 3 cases. The average time of union in his cases was 9 months.

(We have operated on our cases in the face down position, and not the sitting

position favoured by neurosurgeons. I use a small burr fitted to a hand drill to make two small holes on either side of the midline on the occipital bone $\frac{1}{2}$ " from the posterior margin of the foramen magnum. The bone is then nibbled away easily. To raw up the occipital bone for the graft, a sharp chisel may be used very lightly to take off the outer table of the skull or the same burr may be used. Except in one case autogenous grafts from the ribs or iliac bone have been used as chip grafts. There is no occasion to wire these grafts).

In this series 6 cases had an occipito-cervical fusion done and of these one died on the third postoperative day. In one case the grafts have failed to consolidate adequately till 5 months after operation. The others have shown good consolidation in 3 to 6 months after the operation. The case of atlanto-cervical fusion (case 1) has also proved a failure and will require revision. In case 2 only a decompression was done as natural bony fusion had occurred anteriorly.

Inflammatory Group.—A few special remarks are pertinent to this group.

The three cases in this series followed tuberculous infection of the retro-pharyngeal lymphoid tissue. Since tuberculosis is such a common disease in our country, this is not surprising. (Watson-Jones has described a number of cases following tuberculous cervical adenitis, and non-specific pharyngitis. Lipscomb has mentioned a case who developed an atlanto-axial dislocation after an attack of mumps and one after acute pharyngitis).

Case 6 is of further interest in that it was the first occasion when we did a trans-pharyngeal drainage of a retropharyngeal abscess. It helped to confirm the etiology and to drain a collection of pus which could not have been drained from any other route. In case 7 the etiology was based on the definite history of the treatment of a cold abscess in the neck 3 years previously. In case 8 the affection of the Cervical 6th and 7th vertebrae by tuberculosis points to the nature of the lesion at the higher level. The infection must have travelled up the retro-pharyngeal lymphoid tissue. Whether, as Lipscomb believes that underlying congenital weakness of the transverse and alar ligaments is a factor in leading to the occurrence of the dislocation, is a matter for speculation.

(The treatment of these cases has not differed from that of the traumatic group, except for the additional use of anti-tuberculous antibiotics. The results have been satisfactory).

Conclusions

The number of cases is too small for statistics. After an initial phase where some variation in the treatment was tried, I have come to the conclusion that the approach of decompression and occipito-cervical fusion is the most satisfactory. The loss of nodding movements has not proved a handicap to any of the cases.

Summary

Eight cases of Atlanto-Axial dislocations from the orthopaedic service of the J. J. Group of Hospitals have been reviewed and the detailed clinical picture described.

The anatomical and radiological aspects as well as the diagnosis of the cases have been analysed and the part played by congenital anomalies considered.

Detailed examination of the spinal cord in a case who died has substantiated the view that degenerative changes are present, due probably to vascular factors.

The technique of decompression and fusion is a standard one. Occipito-cervical fusion is the method of choice.

This syndrome is not very common but can be met with if looked for.

Acknowledgements

My thanks are due to my colleagues Mr. J. C. N. Joshipura who has operated on some of the cases and Dr. J. Merchant who has given anaesthesia on all the cases. My thanks are also due to Drs. Wadia and Gagindrsigh our neurophysician and surgeon for their cooperation and help. To the various registrars and housesurgeons who have looked after these cases I am thankful for their attention. Lastly to the Superintendent of the Hospital my thanks for the whole hearted support.

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LESIONS OF SYNOVIAL MEMBRANE

BY

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We are presenting a representative set of lesions of the synovial membrane some rare, some very common with a view to compare the benign and the malignant lesions and the evolution of the process from normal synovial membrane.

Benign lesions

(a) localized nodular synovitis or tenosynovitis so called giant celled tumour of synovial membrane.

This represents a condition in which only a limited area of the synovium of a joint is affected and usually shows a single sessile or stalked, Yellowish brown distinctly firm nodular outgrowth. The tendon sheath is the most commonly involved site especially in the fingers but a similar pathological process is well known in the knee.

A representative case of this is presented. Patient Mrs. K. aged 36 with a firm nodular swelling on the flexor aspect of the Rt. thumb over the proximal phalanx attached to the flexor tendon which was present for one year and six months and slowly increasing in size. The nodule was excised under local block with the preoperative diagnosis of giant cell tumour of synovium. This was confirmed histologically. The basic cell of the nodule is a round cell admixed with a variable number of multinucleated giant cells and the cells containing lipid and haemosiderin. The nuclei in the giant cell are distributed throughout the cell. The study of the Lipochrome pigment in some of these cases has been done and though no conclusion

has been reached this seems to be a significant feature of a fair number of giant cells in a representative case.

This case represents a typical clinical and histological pattern of this common benign lesion of the synovium in connection with a tendon.

Case Reports

II. *Pigmented villonodular tenosynovitis*.—N. K. male aged 32 years was seen with a firm nodular swelling on the flexor aspect of the Rt. fore finger which was present for over three years very slowly growing in size, mobile in the transverse axis, fixed to the tendon sheath and extending from the proximal phalanx to the distal phalanx.

The lesion was excised under local block anaesthesia and the histological pattern was representative of a condition which Jaffe, Lichtenstein and Suto have designated as pigmented villonodular synovitis. A large number of villi with a coating of synovial lining cells are seen. Their supporting stroma of loose meshed connected tissue contains a considerable number of blood vessels, most often thin walled, with a number of round or polyhedral cells. Brownish pigment consisting of haemosiderin is present in the cytoplasm of the lining cells and of the polyhedral cells and extra cellular pigment is also noticed.

This name Pigmented villonodular synovitis, bursitis and tenosynovitis is a comprehensive one and represents a group of inter-related benign lesions which develop in connection with synovial membrane and allied structures. They all seem to start as villous and nodular proliferations, are diffuse in nature involving the entire synovium; pigmentation is due to a large amount of haemosiderin and lipid of the nature of cholesterol. Because of the proliferation, the tissue may show cleft like spaces lined by synovial membrane, a similarity noticed with synovial sarcoma benign. Hence many pathologists have labelled this lesion as a benign synovioma. The lesion most often is in the knee joint and the condition has a predilection for males, mostly young adults.

The lesion occurring the hip joint and the ankle have also been reported. Involvement of bursa principally the subdeltoid and the ileo-pectineal bursa have been reported. I have seen bilateral involvement of the subdeltoid bursae. One of the characteristic feature is that the lesion can be bilateral especially in the knee joint and with radiological feature seen often in haemophilia. The condition can be reproduced in experimental animals by the injection of blood inside the knee joint to which a small quantity anticoagulant like heparin has been added. There is therefore a belief that this represents the synovial response to multiple haemorrhages inside a closed cavity. The haemosiderin pigment seems to be a point in favour of this. However no known coagulating factor is absent in these cases, even after very extensive investigation. Neither do they have any post operative bleeding of any remarkable degree. This condition has also to be differentiated from haemo-chromatosis which has been described in detail by Douglas Collins in which the excised synovial tissue gives an intense prussian blue response. It is interesting that unlike haemochromatosis this condition does not have subchondral pigment.

III. *Lipoma arborescens of the synovial membrane of the knee (Hawley's disease)*.

Patient Baljeet aged 16 years was seen by us on the 27th of March 1960 with the history of a bilaterally symmetrical painless swelling of the knees of about one year duration. The swelling was more prominent on the right than on the left knee. The patient clinically had no limitations of movement though on the right side an increase in the antero posterior instability could be demonstrated. There was a distinct palpable thickening of the synovial membrane and very little synovial effusion inside the joint. No other joint was involved. No stigmata of congenital syphilis was present. W. R. and Kahn were negative and so was the T. I. T. and V. D. R. L. There was no evidence of any coagulation disorder. A clinical diagnosis of Pigmented villonodular synovitis was made. Radiological examination showed a very marked thickening of the synovial membrane which actually had produced an indenting of the anterior supracondylar surface of the femur.

A synovectomy of right knee was done. The synovial membrane showed marked villous proliferation, was velvety in colour and its appearance was smooth with occasional nodules palpable.

Histologically however the picture was entirely different from the pigmented villonodular pattern

previously shown. There was extensive lipomatous infiltration and the synovia was stretched out as a thin lining membrane.

The picture seems to fit in with the description of lipoma arborescens of the synovial membrane in which the predominant histological change is increased lipomatous infiltration of the synovia with plenty of lipochrome pigment. I have been unable to obtain more information on this rarer variety of villonodular synovitis of the lipomatous variety.

IV. *Synovial chondromatosis*.—Mrs. P. aged 42 years was admitted on the 8th of August 1960 with a history of pain in the left knee with limitation of movement of three years duration and limitation of extension of one year duration. Clinical examination showed limitation of movement from 90 to 165°. No instability was noticed and no neurological deficit was found. There was pain on movement. Radiological examination showed multiple loose bodies in the knee both in the anterior and posterior compartments. A preoperative diagnosis of synovial chondromatosis was made and the joint explored by anterior medial parapatellar incision and a posterior popliteal approach. From the posterior compartment ten to twelve loose bodies of various sizes were removed and posterior synovectomy was done. The anterior compartment showed a normal suprapatellar pouch but in the joint proper the synovial membrane was studded with an enormous number of loose bodies over one hundred of every size and description most of these were tagged to the synovial membrane, and also on the under surface of the medial semilunar cartilage at its synovial reflection. The loose bodies under the medial semilunar reflection and of the patellar retinaculum under medial and lateral ligaments was excised. The patient had a smooth post operative course. Histopathological confirmation of the diagnosis was made.

Jaffe believes this lesion is rare and his experience covers six cases.

It is a condition which again as many other synovial lesion has a strong predilection for the knee and is usually monoarticular. Cases have been reported also with involvement of the shoulder and hip.

The cartilage which develops in the synovial membrane in a case of synovial chondromatosis results from metaplasia of the sublining connective tissue of the membrane. In support of this idea is the fact that the synovium is a part of the mesenchyme which gives rise to the skeleton. The histological slide

shows the evidence of cartilagenous metaplasia beautifully and the nest of connective tissue cells which undergo cartilagenous metaplasia are seen at a number of areas. Once cartilage formation has been initiated at a given site increase in the size of the cartilage focus results from multiplication of the cartilage cell and not from accretion of cartilage from further metaplasia. The growing nodules of cartilage compress the neighbouring connective tissue so that they are surrounded by a fibrous capsule. The cartilage nodules which have not yet become calcified or ossified are richly cellular. A number of loose bodies are thus literally manufactured by the synovial membrane and thrown into the joint cavity. This case represents a typical synovial metaplasia to form cartilage and bone.

Malignant Synovial Lesions.—Three cases are presented (a) Mrs. D. D. aged 26 years who presented herself of having a swelling which has been rapidly increasing in size, in the posterior surface of her right knee. She had noticed a small nodule in the region of the medial aspect of the popliteal fossa of 18 years duration which was firm, mobile and painless. She had three earlier pregnancies which were normal and full term. Ever since her present pregnancy started (4 months ago) she had noticed a rapid increase in size of this tumour. On clinical examination the tumour occupied the entire postero-medial aspect of the right knee filling the popliteal fossa and the area of the posterior surface of the leg which corresponded approximately to the soleal line. There was no fluctuation. The knee joint itself was not involved and there was no effusion inside the knee or in the supra patellar region. Regional lymphnodes were palpable though they clinically were not suspected of having malignant deposit. A chest X-ray done on the day of examination showed no metastatic deposit in the lung. A preoperative diagnosis of synovial sarcoma was made and the patient was advised amputation. This she promptly refused. A ligation of the femoral vein was done on the day after admission and then an exploration of the tumour mass with an attempt at removal was planned. It was however very evident that the tumour was massive, had infiltrated every structure

including the posterior capsule of the joint with the exception of the popliteal vessel and nerve. As thorough an excision as was possible was done and the wound closed. The patient was given 6000 r deep X-ray therapy, postoperatively. A chest X-ray done approximately 2 weeks post operatively showed a metastatic deposit in the lung. The patient has not returned to us since and is probably no longer alive.

II. Gendoo Ram aged 65 was seen in the outpatient with the history of painful limitation of movement of the left knee of about 4 months duration. Extension was especially painful. On examination there was a pulsatile swelling of the supracondylar portion of the left femur, principally on the lateral side. The patient on general examination showed a firm nodule in the thyroid, a palpable liver which was hard and four fingers below the costal margin. A preoperative diagnosis of metastatic deposit in the lower end of femur either from the thyroid or liver was made. X-rays of the knee were interpreted as negative. A biopsy of the lesion was done which showed a highly vascular infiltrating tumour arising from outside the cortex of the femur and the synovial membrane infiltrating the lateral condyle of the femur. The patient died on the 10th postoperative day due to a massive intestinal bleeding. Unfortunately no postmortem was obtained.

III. Pt. R. M. aged 25 was seen in the outpatient department with the history of a rapidly increasing swelling in the left foot arising from the dorsum of the foot, principally involving the region of the midtarsal and calcaneotalar articulation. The swelling was firm, painless and unattached to the tendon sheath arising from the capsule of the joint. A preoperative diagnosis of synovial sarcoma was made. On exploration we found a tumour which had arisen from the capsule of the foot joints and had widely infiltrated the talus and the os calcis. The bone was curetted out and the entire lesion was excised. The tumour promptly recurred and an amputation was advised which the patient did not consent to. There were no secondaries in the chest on last examination. Neither has the patient come back for follow up.

These three cases represent the three gradations in which a synovial sarcoma may present itself histopathologically. The first on histopathological examination was a classical synovial sarcoma. Clinically and radiologically the lesion presented classical features. The para articular location of a tumour of some duration with a rapid spurt of growth, principally located on the popliteal surface of the knee should make any one suspect a synovial sarcoma. The classical histopathological features of two elements namely a fibrosarcomatous and a synovial element represented principally by clefts shows the totipotent character of the primitive stem cell giving rise to this tumour. The synovial spaces and lining membrane can be clearly demonstrated by the ability of these cells to take up mucicarmine stain.

The second case represents the extreme variant where the synovial counterpart has

proliferated to such an extent as to give a pattern resembling an adenocarcinoma. An initial diagnosis of a secondary metastatic deposit from a hepatoma was entertained.

The third case represents the other fibrosarcomatous variant where the mesenchymal cell has differentiated more in the direction of a fibrosarcomatous stroma with a few cleft like spaces which denote the synovial origin of this tumour.

The prognosis of synovial sarcoma is extremely poor.

In this attempt to present the pathological lesions of synovial membrane we have tried as far as possible to select a single representative case from each entity with the purpose of showing the link between the various lesions and the basic cell of the pathological lesion *viz.* the synovial cell.

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A FEW OBSERVATIONS OF EXTENSION MONTEGGIA FRACTURE-DISLOCATION

BY

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This study is based on 17 cases. There were 14 males and 3 females. Eleven cases were 5 to 10 years of age and six between 11 to 45 years—minimum age being 5 and maximum 45 years. Six cases sustained injury on the right side and eleven on the left side (*vide* chart). There were greenstick fracture ulna in one (Fig. 7—Case No. 10) and complete fracture in 16 cases. There were one open fracture (Case No. 7) and 16 closed fractures.

Observations made here are not hitherto reported in English Medical Literature to my knowledge.

The very name "Extension or Anterior type of Monteggia fracture-dislocation" is misleading. It is well known that this injury may result either from indirect or direct violence.

Extension type was thought to be due to fall on outstretched palm with elbow in

extension (indirect violence), but this is not always so. This may result from direct violence on the back of upper fore-arm, that is why in America it is known as "parry fracture".

Anterior type is probably nomenclatured because of anterior ulnar angulation with anterior radial head dislocation. But, in addition to the above there may be antero-lateral or purely lateral or no ulnar angulation (overlapping of fragments) with antero-lateral or purely lateral radial head dislocation and this has not been taken into account while nomenclaturing the injury.

In absence of a better name we will adhere to the original nomenclature "Extension Monteggia fracture-dislocation".

Difference between observations made by various authors and those of the writer are charted below:—

Observations by various authors	Observations by the writer
1. Ulnar fracture:— (a) Site of Fracture:—There is fracture of ulna at its upper third. (b) Displacement of fragments:—The fragments may make angulation or may overlap. Different authors describe different types of ulnar angulation. No author has mentioned about all types of angulations viz., antero-lateral, anterior and lateral ulnar angulations. Following types of displacement are observed by different authors:— (a) Ulnar angulation:—According to Watson-Jones there is only Antero-lateral angulation of the ulnar fragments. No reference is made by him about anterior and lateral ulnar angulations.	1. Ulnar fracture:— (a) Site of Fracture:— It ranged from the base of the Olecranon upto the middle and lower thirds junction of the shaft. (b) Displacement of fragments:—The fragments mostly make angulation and rarely overlap. Following types of displacement were observed:— (a) Ulnar angulation:— (i) Antero-lateral type— 10 cases. (Case Nos. 1, 4, 5, 6, 8, 10, 12, 13, 14 & 15).

C H A R T

Case No.	Age in years	Sex	Occupation	Side of injury	Mechanism of injury	Type of displacement of ulnar fragments	Type of Radial head dislocation	Associated Fracture
1	19	M	Student	Left	Indirect	Antero-lateral angulation	Antero-lateral	×
2	8	F	Student	Left	Indefinite	Anterior angulation	Anterior	×
3	8	M	Student	Left	Indirect	Lateral angulation	Lateral	Colles' Fracture
4	8	M	Student	Right	Indirect	Antero-lateral angulation	Antero-lateral	×
5	6	M	Student	Right	Indefinite	do	do	×
6	6	M	Nil	Left	Indefinite	do	do	Fracture upper 1/3 shaft radius.
7	5	F	Nil	Left	Direct	Overlapping	do	Fracture lower and mid-thirds junction shaft radius
8	45	M	Loader	Right	Direct	Antero-lateral angulation	do	Colles' Fracture
9	25	M	Khalasi	Left	Indirect	Lateral angulation	do	×
10	9	M	Student	Left	Direct	Antero-lateral angulation	do	×
11	26	M	Loader	Left	Direct	Anterior angulation	Anterior	×
12	5-9 mths.	M	Student	Right	Direct	Antero-lateral angulation	Antero-lateral	×
13	28	M	Trolleyman	Right	Direct	do	do	×
14	6	M	Student	Left	Indirect	do	do	×
15	8	M	Student	Right	Indefinite	do	do	×
16	28	F	Kamin	Left	Direct	Anterior angulation	Anterior	×
17	8	M	Nil	Left	Direct	Lateral angulation	Anterior	×

Observations by various authors	Observations by the writer
Perkins, Holdsworth, Adams, Compere, Milch and Wiles hold the view that there is only Anterior ulnar angulation. They do not mention about antero-lateral and lateral ulnar angulations. Smith observes Anterior as well as Lateral ulnar angulations, but not antero-lateral angulations. (b) Overlapping of fragments:—No authors except Perkins mention about overlapping of ulnar fragments.	(ii) Anterior type—3 cases. (Case Nos. 2, 11 & 16). (iii) Lateral type—3 cases. (Case Nos. 3, 9 & 17).
Smith observes Anterior as well as Lateral ulnar angulations, but not antero-lateral angulations. (b) Overlapping of fragments:—No authors except Perkins mention about overlapping of ulnar fragments.	(b) Overlapping of ulnar fragments (without forming any ulnar angulation)—1 case. (Case No. 7).
II. Dislocation of the Radial Head:—	II. Dislocation of the Radial Head:—
Different types of dislocations are described by different authors. None of them has mentioned about all types of dislocation viz., antero-lateral, anterior and lateral dislocation of the radial head.	Following types of dislocations were observed:—
According to Watson-Jones there is only Antero-lateral dislocation of the radial head. He does not mention about anterior and lateral types of dislocation of the radial head.	(i) Antero-lateral type—12 cases. (Case No. 1, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14 & 15).
Perkins, Holdsworth, Adams, Compere, Cave and Milch and Wiles observe that there is only Anterior dislocation of the radial head. They do not mention about antero-lateral and lateral types of dislocation of the radial head.	(ii) Anterior type—4 cases. (Case Nos. 2, 11, 16 & 17).
Smith & Christopher record both Anterior and Lateral dislocation of the radial head, but not Antero-lateral type of dislocation.	(iii) Lateral type—1 case. (Case No. 3).
III. Types of Fracture - dislocation:—	III. Types of Fracture - dislocation:—
(a) Watson-Jones:—Antero-lateral angulation of the ulnar fragments with antero-lateral dislocation of the radial head.	(a) Antero-lateral angulation of the ulnar fragments with antero-lateral dislocation of the radial head—(Case Nos. 1, 4, 5, 6, 8, 10, 12, 13, 14, 15)—10 cases. (Fig. 1—Case 13).
(Comment—No mention about anterior and lateral fracture-dislocation).	(b) Anterior angulation of the ulnar fragments with anterior dislocation of the radial head—(Case Nos. 2, 11, 16)—3 cases. (Fig. 2—Case 11).
(b) Holdsworth, Perkins, Adams, Compere, Milch and Wiles:— Anterior angulation of the ulnar fragments with anterior dislocation of the radial head.	

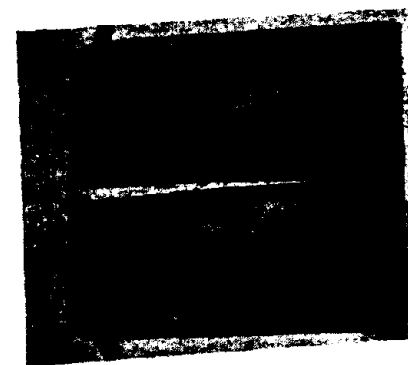


Fig. 1 (Case 13)
Antero-lateral angulation of the ulnar fragments with antero-lateral dislocation of the radial heads.

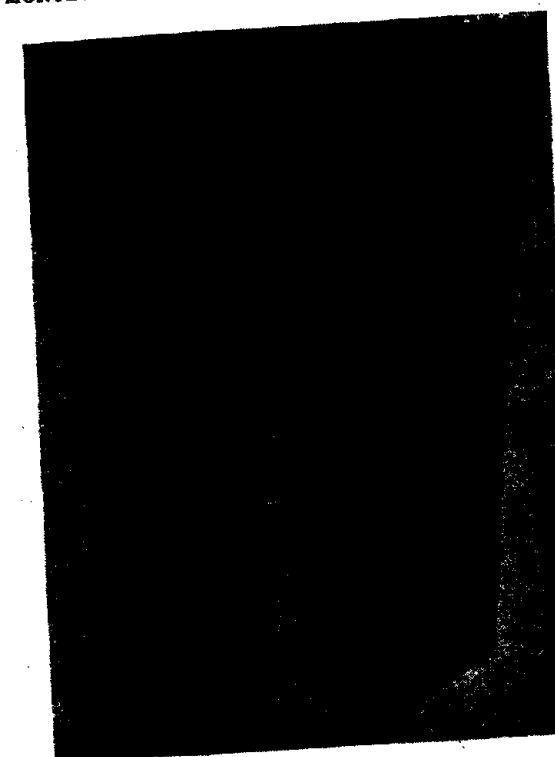


Fig. 3 (Case 3)
Lateral angulation of the ulnar fragments with lateral dislocation of the radial head and Colles' fracture.

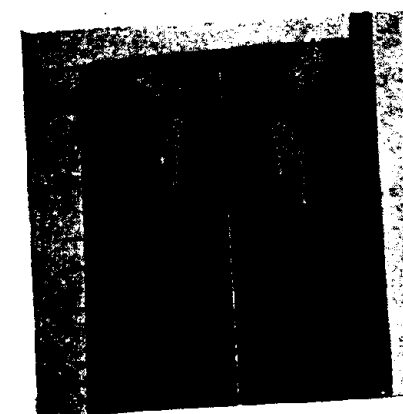


Fig. 2 (Case 11)
Anterior angulation of the ulnar fragments with anterior dislocation of the radial head.



Fig. 4 (Case 9)
Lateral angulation of the ulnar fragments with antero-lateral dislocation of the radial head and Colles' fracture.

Observations by various authors	Observations by the writer
(Comment—No mention about Antero-lateral and Lateral fracture-dislocation). (c) Smith: (i) Anterior angulation of the ulnar fragments with anterior dislocation of the radial head. (ii) Lateral angulation of the ulnar fragments with lateral dislocation of the radial head. (Comment—No mention about Antero-lateral fracture—dislocation). (d) Christopher: Fracture upper third ulna with anterior or lateral dislocation of the radial head. Cave: Fracture shaft of ulna with anterior dislocation of the radial head. (Comment—No mention about displacement of the ulnar fragments. Nothing is also mentioned about type of fracture—dislocation). IV. Associated fracture of the radius: None reported. V. Mechanism of Injury: (a) Watson-Jones observes that due to direct violence on the back of the upper fore-arm the ulna is angulated forwards and the radial head is dislocated forwards.	(c) Lateral angulation of the ulnar fragments with lateral dislocation of the radial head—(Case No. 3)—1 case. (Fig. 3—Case 3). (d) Lateral angulation of the ulnar fragments with antero-lateral dislocation of the radial head—(Case No. 9)—1 case. (Fig. 4—Case 9). (e) Lateral angulation of the ulnar fragments with anterior dislocation of the radial head—(Case No. 17)—1 case. (Fig. 5—Case 17). (f) Overlapping of ulnar fragments (without forming any ulnar angulation) with antero-lateral dislocation of the radial head—(Case No. 7)—1 case. (Fig. 6—Case 7). IV. Associated fracture of the radius: (i) Fracture Colles—2 cases (Cases No. 3 & 9). (Fig. 3—Case 3). (ii) Fracture shaft—2 cases (Cases No. 6 & 7). (Fig. 5—Case 7). V. Mechanism of Injury: (a) In a separate group of 6 cases of isolated fracture upper third ulna, five sustained fractures from direct injury on the back of the upper fore-arm. In each case ulnar fragments angulated lateralwards, but there was no radial head dislocation. Direct violence though caused ulnar angulation but could not dislocate the radial head. Probably the violence was not strong enough to cause both the injuries i.e. ulnar fracture and radial head dislocation.

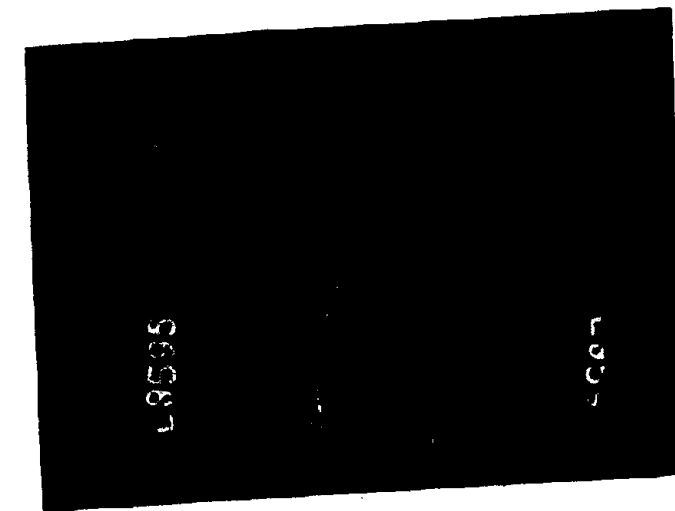


Fig. 5 (Case 17)

Lateral angulation of the ulnar fragments with anterior dislocation of the radial head.

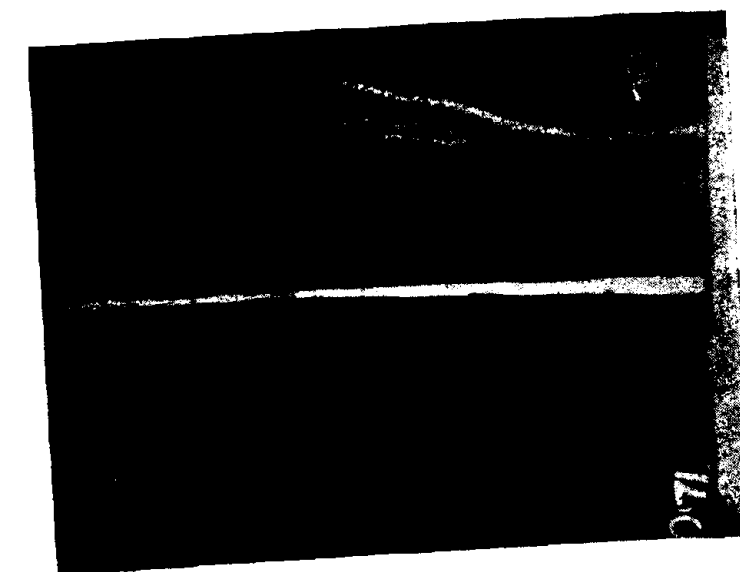


Fig. 6 (Case 7)

Overlapping of the ulnar fragments (without forming any angulation) with antero-lateral dislocation of the radial head and fracture shaft radius.

Observations by various authors	Observations by the writer
(b) Even believes that the ulnar fragments, by making volar angulation, come in more direct contact with the radius. This ulnar angulation forms a fulcrum over which the upper end of the radius gets dislocated forwards.	(b) In all 6 cases of isolated fracture, ulna, there was lateral ulnar angulation in each case. Though ulnar fragments, by making a lateral angulation, came in more direct contact with the radius and made a fulcrum over which the upper end of the radius could get easily dislocated laterally, but there was no lateral dislocation of the radial head (Fig. 8—Case 5). Out of 17 cases of Extension Monteggia fracture—dislocation there were lateral angulations of ulnar fragments in 3 cases (Nos. 3, 9 and 17) with different types of radial head dislocation. In case No. 3 there was lateral dislocation of the radial head (Fig. 3); in case No. 9 there was Antero-lateral dislocation of the radial head (Fig. 4); and in case No. 17 there was Anterior dislocation of the radial head (Fig. 5). It is understood that the ulnar fragments by making lateral ulnar angulation, caused lateral dislocation of the radial head (Case No. 3); but it is difficult to understand how lateral ulnar angulations caused Antero-lateral dislocation in Case No. 9 and Anterior dislocation of the radial head in Case No. 17. In Case No. 7 (Fig. 6) though there was no ulnar angulation but radial head got dislocated antero-laterally.



Fig. 7 (Case 10)

Antero-lateral fracture - dislocation. Ulnar fracture is of green stick type.

A line drawn through the centre of the head and neck of the radius, if projected upwards, normally always passes through the centre of the capitellum or its epiphysis irrespective of the degree of extension or flexion of the elbow-joint.

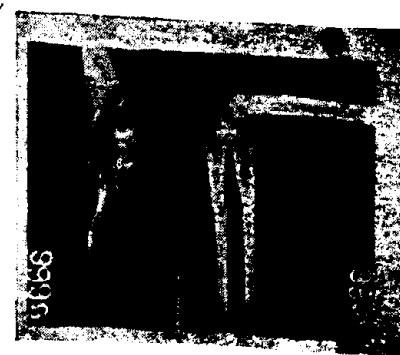


Fig. 8 (Case 5).

Isolated fracture upper third ulna with lateral angulation. Mark there is no dislocation of the radial head.

Summary and Conclusion

From the present study following summary and conclusion may be drawn :—

A. Ulnar fracture may be anywhere between base of olecranon and junction of middle and lower thirds shaft ulna.

B. Sub-type of this Fracture—Dislocation may be as follows :—

- (i) Antero-lateral angulation of the ulnar fragments with antero-lateral dislocation of the radial head—58·8% cases.
- (ii) Anterior angulation of the ulnar fragments with anterior dislocation of the radial head—17·6% cases.
- (iii) Lateral angulation of the ulnar fragments with lateral dislocation of the radial head—5·9% cases.
- (iv) Lateral angulation of the ulnar fragments with antero-lateral dislocation of the radial head—5·9% cases.
- (v) Lateral angulation of the ulnar fragments with anterior dislocation of the radial head—5·9% cases.
- (vi) Overlapping of ulnar fragments (without forming any ulnar angulation) with antero-lateral dislocation of the radial head—5·9% cases.

C. Associated Fracture.—There was associated fracture of the radius in 23·5% cases.

D. Mechanism of Injury.—Though direct violence on the back of the upper fore-arm generally causes, angulation of ulnar fragments with dislocation of the radial head, but it may simply cause angulation of ulnar fragments without dislocation of the radial head.

Dislocation of the radial head over the fulcrum formed by the ulnar fragments, as is believed by Evans, may not occur. This is evidenced from a group of 6 cases of isolated fracture upper third ulna forming lateral angulation in each case.

Acknowledgement

I am thankful to the Superintendent, Central Hospital, Asansol for permitting me to use hospital materials.

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THE XXIII ANNUAL CONFERENCE

The 23rd Annual Conference of the Association of Surgeons of India will be held at the Medical College, Baroda, from the 27th to the 30th of December 1961.

The Main subjects for the scientific discussion at the Annual Conference are as follows :—

1. (a) Injuries of the Hand.

by Dr. Subir K. Chatterjee, Calcutta.

(b) Early repairs of Hand Injuries.

by Dr. C. Balakrishnan, Nagpur.

2. Spinal Cord Tumours.

by Dr. R. Chatterjee, Calcutta.

Besides this, a few "Short Papers" will be presented at the Conference.

Dr. A. B. Kothari, M.B., F.R.F.P. & S., M.S., F.I.C.S., Lecturer in Surgery, Medical College, Baroda, is the Local Secretary, who is making arrangements for the Conference.

Further details about the Conference will be announced later.

* * *

SUBJECTS FOR DISCUSSION AT FUTURE MEETINGS

24th Meeting (1962)

1. **Tumours of Urinary Bladder.**
by Drs. K. K. Ghosh and H. K. Sarkar, Calcutta.
2. **Management of Burns.**
by Dr. Anjali Mukherji, Calcutta.
3. **Experiences in the Use of Extracorporeal circulation for Cardiac Surgery.**
by Dr. A. K. Basu, Calcutta, P. K. Sen, Bombay and Dr. S. N. B. Roy, Calcutta.
4. **Septic and Suppurative Arthritis of the Hip.**
by Dr. B. Mukopadhaya, Patna,
and
5. **A Paper on Anaesthesia (to be decided in due course).**

25th Meeting (1963)

1. **Hypothermia.**
2. **Experiences in Surgery for Chronic Pancreatitis.**
by Dr. R. S. Gupta, Calcutta.

NOTICES

THORACIC SURGERY SECTION

The Sectional Meeting of the Thoracic Surgery Section of the Association of Surgeons of India is to be held at Irwin Hospital, New Delhi on the 19th and 20th August, 1961.

All Surgeons interested in Thoracic Surgery are invited to attend this meeting and take part in its deliberations. The arrangements as regards accommodation and other details are being made by Dr. V. K. Saini, and those who are interested to read papers or attend the Conference should contact him at the following address :—

Dr. V. K. Saini, M.S., F.A.C.S., F.C.C.P., F.A.C.S.,
Reader in Surgery,
Moulana Azad Medical College, New Delhi.

*

*

*

INDIAN CANCER SOCIETY

The Hony. Secretary, Indian Cancer Society writes :—

Under the sponsorship of the Indian Cancer Society it is proposed to hold the First All India Cancer Conference on 8th, 9th and 10th December, 1961 at Bombay. Scientific papers on tumours and related problem are invited. The last date for sending the abstracts is 30th September, 1961. Other details about the Conference can be had from the Hony. Secretary, Dr. D. J. Jussawalla, M.S., F.R.C.S.E., Surgeon, Tata Memorial Hospital, Bombay-12.

INTERNATIONAL FEDERATION OF SURGICAL COLLEGES OSLO MEETING, 1961

A Meeting of the International Federation of Surgical Colleges will be held in Oslo on the 12th, 13th and 14th of September, 1961. The following is a brief programme of the meeting :—

12th Sept. (Council and Working Parties only).

Other events on this day are by invitation.

13th Sept. Registration in the Foyer of the Main Hall (Aula) of the University of Oslo.

9-30 to 11-00 a.m. *Initiator*: Professor I. S. Ravdin (U.S.A.)
Communications by 4 American Surgeons on:

- (1) Malignant Diseases.
- (2) Infection of Wounds.

11-15 to 12-45 p.m. (3) Transplantation of Tissues and Organs.
(4) Mass casualties from mass radiation and accidents.

(5) Open discussion.

2-00 to 4-30 p.m. Open discussion on "How can the International Federation foster Surgical Research on an International basis".

Initiator: Prof. I. S. Ravdin (U.S.A.)

Discussion: Professor Philip Sandblom (Sweden) and others.

14th Sept.

9-30 to 12-45 p.m. Short communications on Research, to be contributed by the Scandinavian Societies.

Those who wish to attend the Meeting are requested to obtain an enrolment form from their own national surgical college or association and return it to Prof. Carl Semb, Ulleval Hospital, Dept. 3, Oslo, as soon as possible.

CONTRIBUTORS—JUNE, 1961

1. Dr. A. G. Fletcher, Jr., F.A.C.S., F.R.C.S. (C), Director of Surgery, Wanless Tuberculosis Sanatorium, Miraj (on leave),
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9. Dr. D. P. Ghosh, Resident Surgeon, Central Hospital, Asansol Buriwan, West Bengal.

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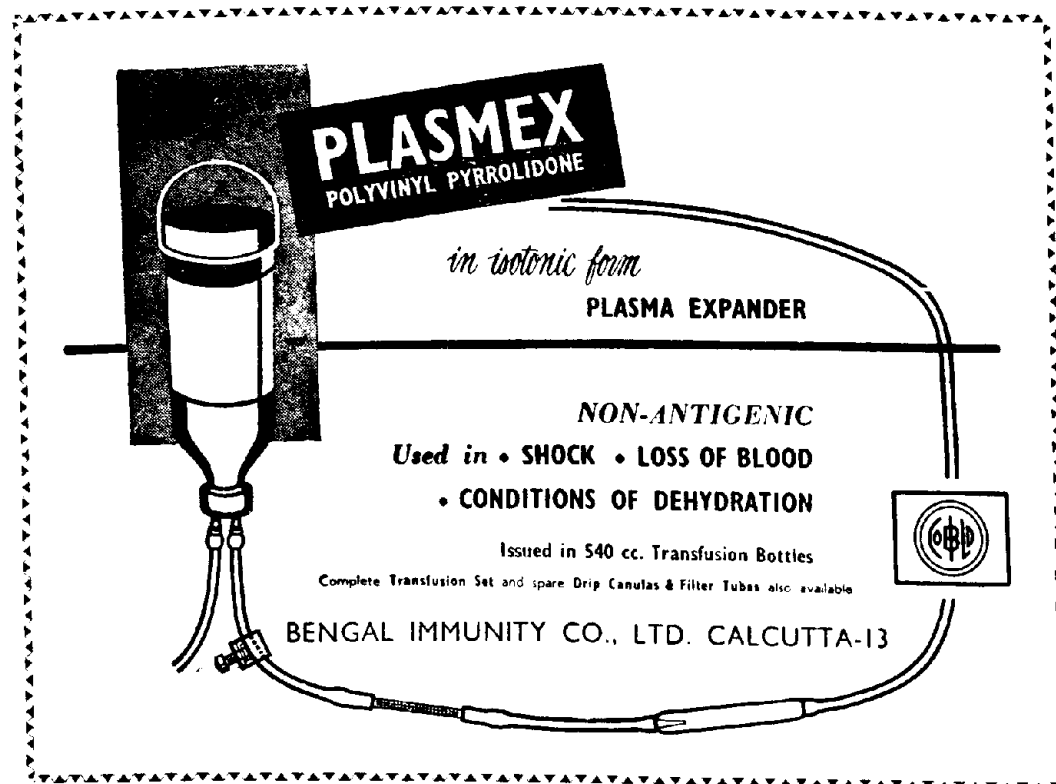
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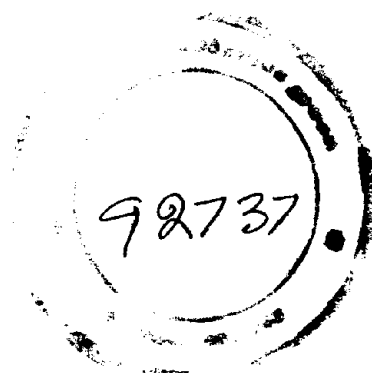
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