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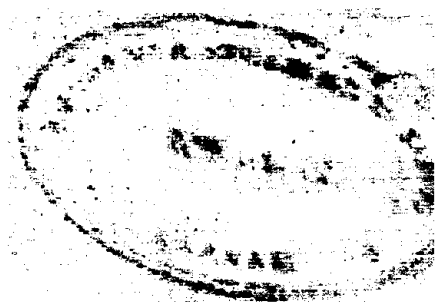
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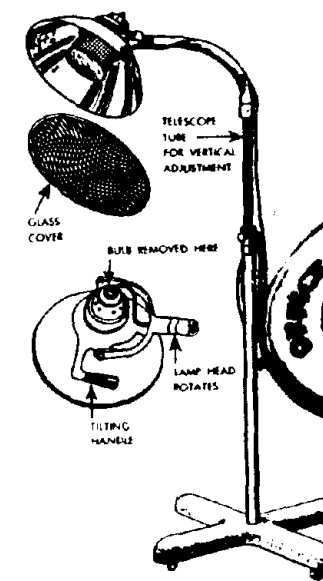
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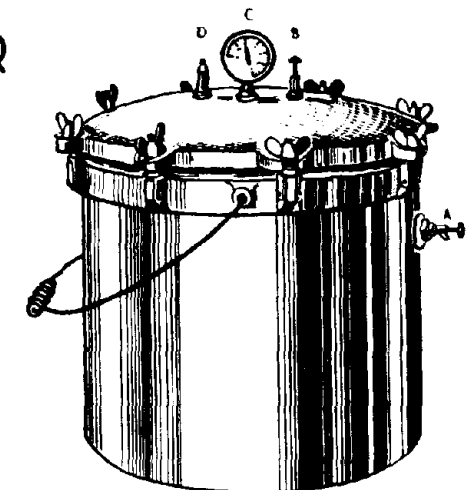
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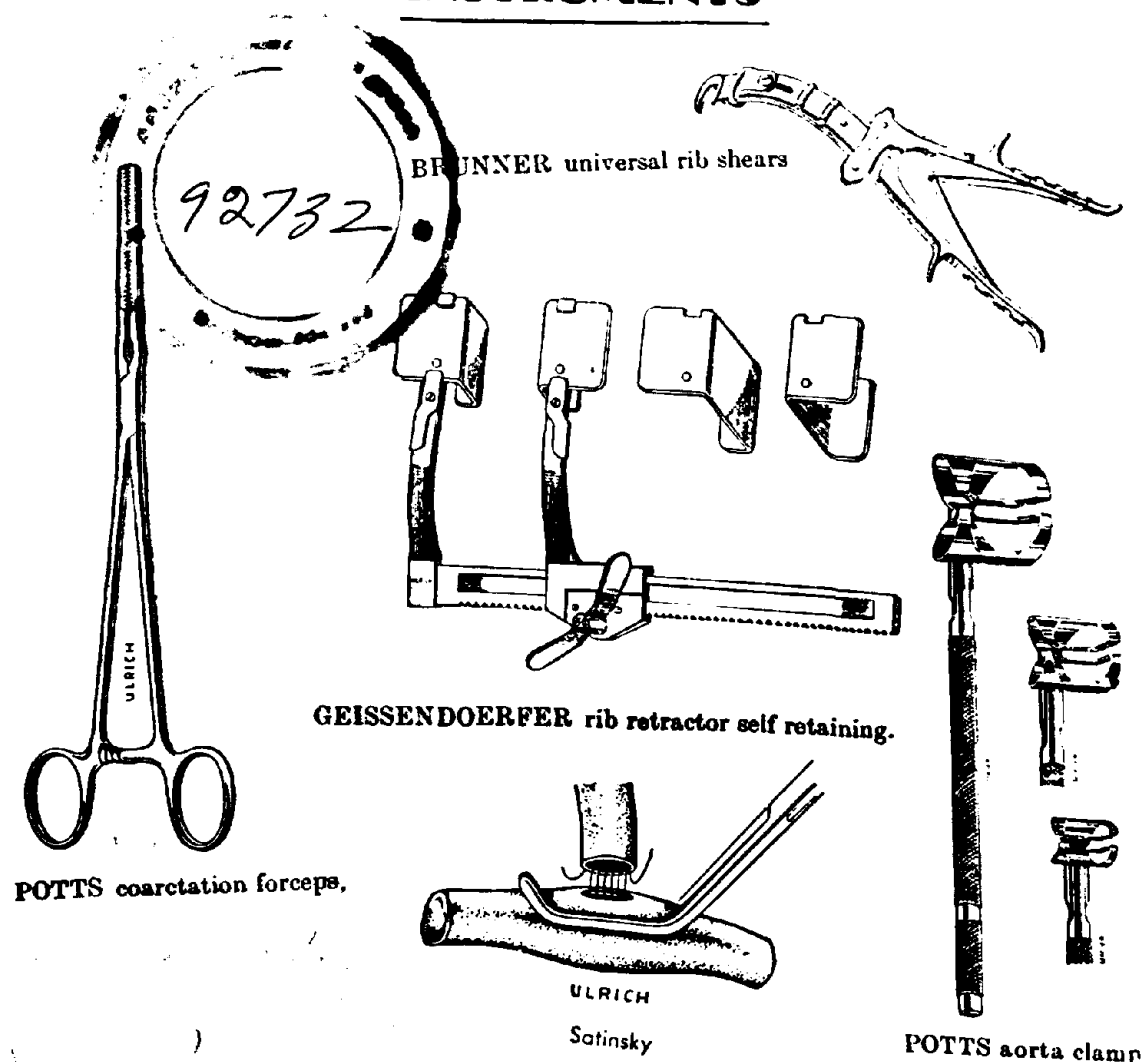
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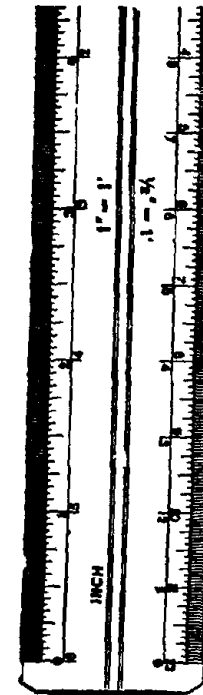
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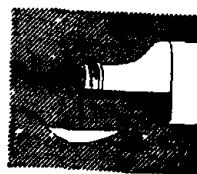
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**MICROSCOPIC PHAEOCHROMOCYTOMA
OF THE ADRENAL**

BY

P. B. DESAI, Bombay.

Phaeochromocytoma or "black-celled tumour" of the chromaffin tissues of the adrenal gland has aroused much interest since L'abbe and co-workers drew attention to the association of paroxysmal hypertension with adrenal tumours in 1922. In spite of its notoriety, phaeochromocytoma remains a relatively rare tumour, with only about 300 cases having been reported to-date². Probably the earliest report of a phaeochromocytoma was by Berdez in 1892.¹ He reported a medullary tumour of the right suprarenal gland. This tumour was vascular and encapsulated, and was probably a phaeochromocytoma. One year later, in 1893 Manasse² reported an adrenal medullary tumour which had the definite histologic characteristics of a chromaffin cell tumour, probably the first authentic case. It is of importance to realise that such tumours occur not only in the adrenal medulla but in any chromaffin tissues, e.g. in the carotid body, and the organ of Zuckerkandl on the aorta between the inferior mesenteric artery and the bifurcation. The term "Phaeochromocytoma" is usually reserved for tumours of the chromaffin tissue occurring in or near the adrenal gland. Tumours with histologic characteristics similar to those of phaeochromocytoma have been described in the brain, carotid body and the sympathetic chain, but

are generally classified as "Paragangliomas". Tumours in the extra-adrenal locations are more likely to be hormonally inactive but about two dozen examples are to be found in the literature of an extra-adrenal tumour exercising a vasospastic influence¹.

The incidence has been variously determined at 0.4% to 2% in all hypertensives³. Graham using his own and Smithwick's figures calculated that 600 to 800 people die yearly as a result of untreated phaeochromocytoma. This fact soon assumes significance when we realise that this group of patients represents potentially curable hypertensives, and failure to recognise and treat their disease is indeed lamentable. The diagnosis of phaeochromocytoma can only be made if the possibility of its existence is thought of.

Typically, a patient with phaeochromocytoma has *Intermittent* bouts of severe hypertension associated with headaches, extreme nervousness, a feeling of pressure or actual pain in the chest, rapid pulse, cold hands and feet with or without purple mottling of the skin, nausea, vomiting and tremor. These symptoms are often followed by profuse sweating. In short, the symptoms are those of an excessive dose of epinephrine

or norepinephrine. Unfortunately the symptoms are not always typical and phaeochromocytoma may imitate closely and be confused with essential hypertension, hyperthyroidism, anxiety state, psychoneurosis, diabetes mellitus, migraine etc. If any of the above syndromes or symptoms occur simultaneously with intermittent or sustained hypertension a presumptive diagnosis of phaeochromocytoma must be entertained and the condition excluded.

The search for confirmatory evidence of the presence of phaeochromocytoma should begin with the physical examination and serial recordings of the patients' blood pressure. An abdominal mass may rarely be palpable. More often, palpation over the site of the tumour will cause hypertension, tachycardia and symptoms even if the tumour itself is not felt. But even here the evidence may be misleading, as phaeochromocytomas have been found on the side opposite that indicated by palpation. Postural tachycardia, postural hypotension, and peculiar vasomotor phenomena such as blueness of the lips, nose and finger nails are not, unusual in this disease and their presence should be elicited. Assessment of the Renal Status is the next most logical step in evaluation for two reasons. (1) It may demonstrate the basis of hypertension. (2) It provides information that enables the surgeon to exercise intelligent judgement in dealing with the kidney during surgical exploration. A by-product of the investigation of renal function may well be the localisation of the tumour on the intravenous pyelograms. Laboratory examinations are usually directed at defining the degree of hypermetabolism. An elevated fasting blood sugar and elevated basal metabolic rates are common features.

The conclusive proof of the presence of phaeochromocytoma rests with the demonstration of elevated levels of circulating

epinephrine or norepinephrine and their excretion products in the urine. This is the ideal but as yet, an impractical test in most institutions. The indirect approach to the diagnosis of phaeochromocytoma was indicated by Roth and Kvale in 1945 when they devised the Histamine Provocative Test. A positive reaction is indicated when the pressure rise is 60/40 mm. of mercury above patients' basal values. There is a certain amount of hypotensive danger associated if this test is performed with a relatively low pressure to start with. This test is not diagnostic as false positives and false negatives do occur. A safer test is the use of a drug that blocks the effect of circulating vasopressor substances. Several drugs have been used but *Regitine* (Ciba) is considered to be the drug of choice and is said to give correct result in 96% of cases. An estimation of urinary catechol amines, the excretion products of medullary pressor substances, is replacing the indirect tests in most clinics.

Once the presence of a phaeochromocytoma has been established, the supplementary problem of localisation arises. Palpation usually affords minimal help. Retroperitoneal pneumography is considered to be of definite help, but there is, as yet, no diagnostic substitute for adequate exploration.

Case Report

A Hindu male, Aged 59, of stout and plethoric build presented himself with the following complaints on 13-1-1958.

1. Paroxysmal attacks of headache and a feeling of pressure in the head—duration 1 year; twice every day for the last 4 months.
2. Unstable blood pressure;—1 year.
3. Pigmentation of the face, particularly tip of nose—1 year.
4. Vomiting on and off—8 months.

Examination revealed the following:—

His blood pressure was 180/95 mm. Hg.

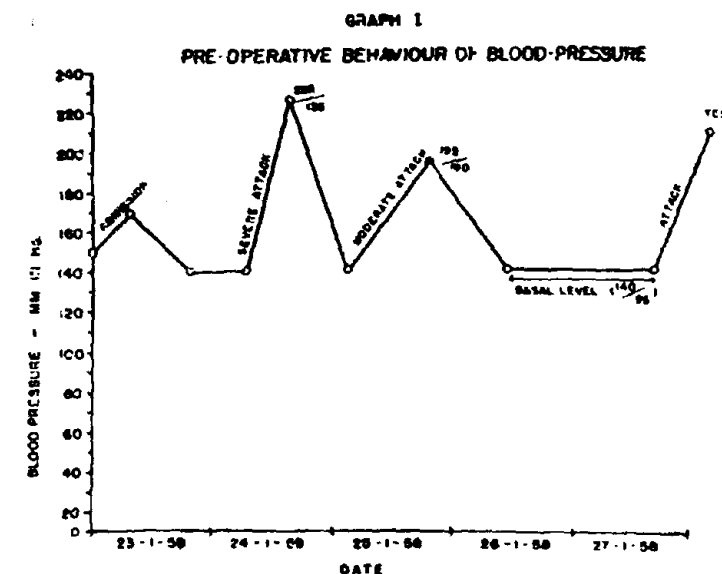
There was a dusky pigmentation at the tip of the nose and on the ear lobules.

Clinical examination of the abdomen, heart and lungs was negative.

A suspicion of phaeochromocytoma was entertained and the case was further investigated.

Intravenous Urogram showed good urinary function. A rounded opacity persisted above the left kidney.

Retroperitoneal Pneumography showed a very well rounded shadow, presumably the phaeochromocytoma, above the left kidney—(Fig. 1).



Graph No. I

Shows the pre-operative pressure values during the attack and intermission. The Regitine Test was performed at the height of a moderately severe attack as shown at o.

Routine Blood Pressure recordings were made and records during the attacks were kept. The blood pressure used to range from 225/135 mm. of mercury to 180/100 mm. of mercury during the attacks. His basal blood pressure was about 140/80 mm. of mercury. Attacks were frequent, twice or thrice every day (Graph No. I).

Routine Cardiographic and Pulmonary assessment showed only a mild coronary insufficiency.

Eye grounds showed mild changes of retinitis. His B. M. R. was + 9% and fasting blood sugar 90 mg. per cent.

Routine Haemograms, urine and stool examinations were normal.

The non-protein Nitrogen was 35 mgms. per cent and urea 56 mgms. per cent, slightly on the higher side of normal.

The 17-Ketosteroids and hydroxyketosteroids were normal.

An X-ray picture of the chest was normal.

A plain film of the abdomen showed an ill-defined round opacity above the left kidney shadow.

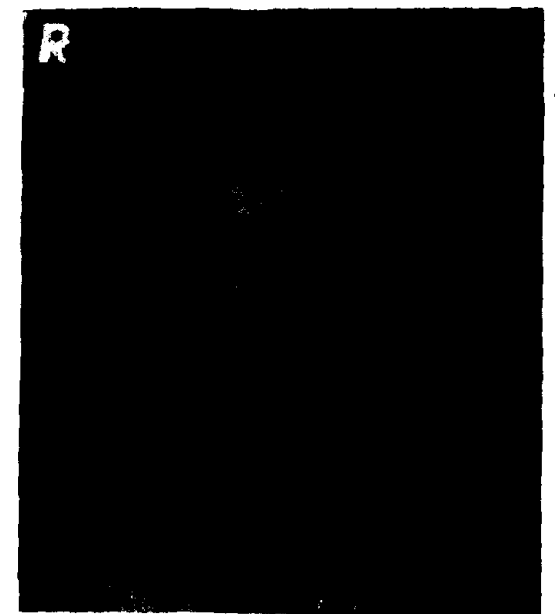


Fig. 1

Retroperitoneal Pneumography from the sacral region. This shows a well defined rounded opacity above the left kidney shadow. Presumably a Phaeochromocytoma.

Tomography following the Pneumography, however, showed the same mass separate from the left adrenal which can be distinctly seen in (Fig. 2). It was thought that this was probably a juxta-adrenal chromaffin mass giving rise to symptoms.

The Regitine test outlined in (Graph No. II), was strongly positive for the presence of a circulating

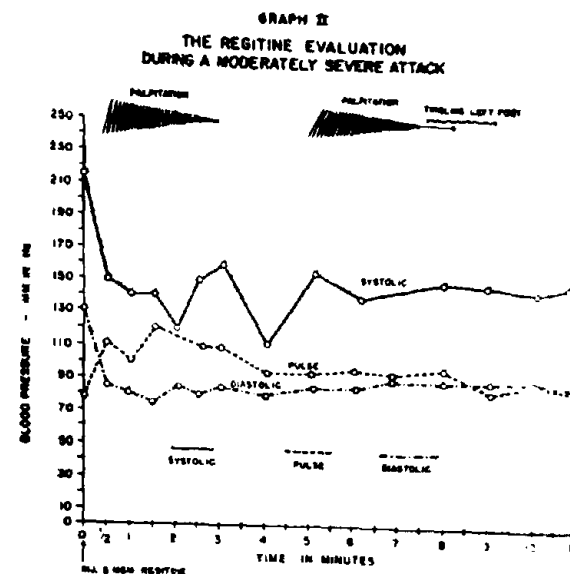
vaso-pressor substance, and gave confirmatory evidence of the highest importance.

With these investigations a presumptive diagnosis of a left sided phaeochromocytoma was made and the patient was taken up for exploration on 18—2—1958.



Fig. 2

Tomographic localisation after Air Insufflation. The left Adrenal is seen very clearly above the left kidney.



Graph No. II

"The Regitine Test"

Notable features are: A marked and sustained fall in Systolic as well as Diastolic pressure. The pulse rate is not appreciably altered.

Operative Findings

The patient was explored by a left sided thoraco-abdominal approach along the 11th rib.

There was no evidence of any tumour in the left adrenal or juxta-adrenal tissues. The left adrenal was quite normal in size and showed no surface irregularity or elevations. The left kidney showed the presence of a solitary minute cyst.

The incision was therefore extended further in the abdomen towards the right and the right adrenal visualised. It was quite normal in size and shape.

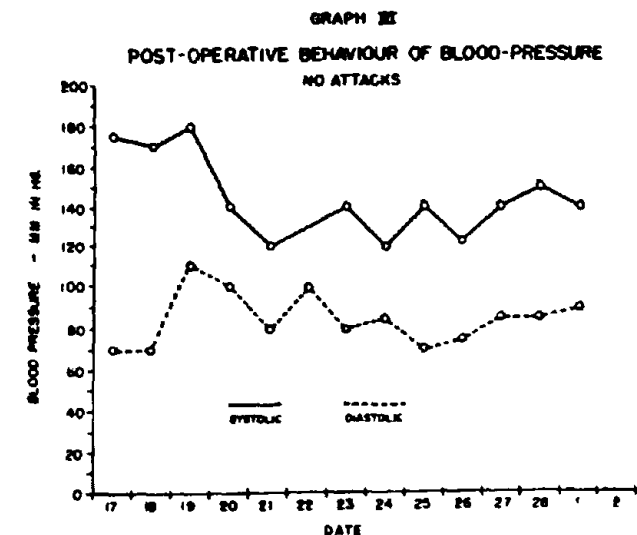
The retroperitoneal tissues in front of the aorta were explored by palpation to eliminate the presence of an extra adrenal chromaffin mass, with negative results.

However, the most important observation during this exploration was the recording of immediate elevations in blood pressure whenever the left

above the kidney region. It was only accidentally discovered that there was a cartilaginous patch of thickening on the pleural surface of the diaphragm which was responsible.

The post-operative recovery of the patient was uneventful.

The blood pressure showed a sustained fall (Graph No. III). It never rose above 140/90 mm. of mercury except one (150/80 mm. Hg). He has never had any more of those familiar attacks which used to come on twice or thrice every day with a pressure rise of over 210 mm. of mercury. His symptomatic improvement raised hopes that a microscopic phaeochromocytoma might have been removed. These hopes were happily confirmed when the histopathological sections were studied (Fig. 3a and b). The section in low and high power shows the distinct contrast between the normal and tumour tissue of the adrenal. The tumour cells are large with clear cytoplasm, multinucleated and arranged



Graph No. III

The post-operative behaviour of blood pressure. Since then the patient has no attack and the pressure has not gone above 160/95 mm. of Hg.

suprarenal area was palpated. From a basal level of 120 to 140 mm. of mercury Systolic (during anaesthesia) the pressure used to shoot upto 200 to 220 mm. of mercury Systolic. This was persistently observed. A similar manipulation of the right adrenal produced no change in the blood pressure.

This significant observation led to the decision to remove the left adrenal, although it appeared normal.

At exploration the most puzzling question was what had cast the shadow in the X-ray picture

in cords and sheets. This is typical of the so-called black celled tumour or the phaeochromocytoma. The clinical and pathological findings conform to a nitety.

The patient was discharged on 1—3—1958, 12 days after operation. Since then he is being regularly followed up to date. His attacks and symptoms have vanished. The follow-up period now amounts to 6 months. He has not had even a single attack. His blood pressure now varies between 140 to 160 mm. systolic and 80 to 90 mm. diastolic. He can, with sufficient reason be called *Cured*.



Fig. 3 (a)

Low Power Magnification $\times 110$. This histological photomicrograph shows the clear demarcation between the normal adrenal tissue on the top and tumour tissue below. The tumour cells are large with clear cytoplasm, multinucleated and arranged in cords and sheets. This is typical of the so-called black celled tumour or Phaeochromocytoma.

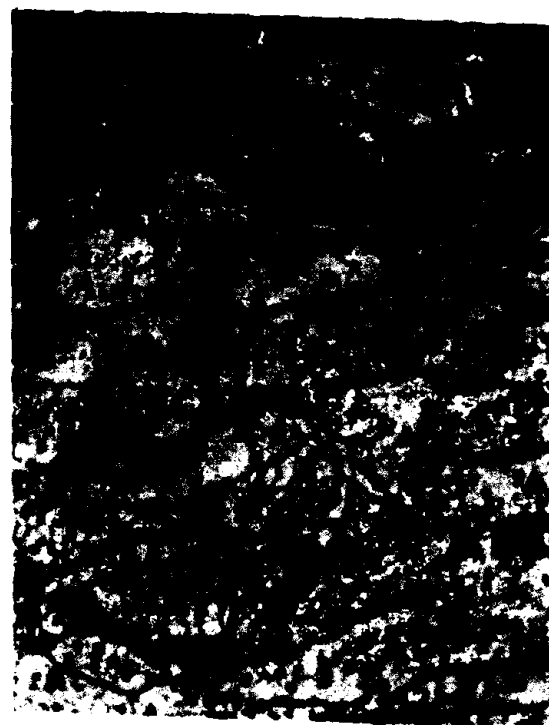


Fig. 3 (b)

Same field in high power $\times 220$.

Discussion

The incidence of a microscopic phaeochromocytoma is difficult to obtain from the literature. This might be one of the few cases if any recorded. Many phaeochromocytomas pass unnoticed and end fatally.

"If a definite clinical diagnosis of a phaeochromocytoma has been made and if palpation of an adrenal sends the blood pressure shooting up there is definite indication for removal of that adrenal".

Summary

Phaeochromocytoma is a rare tumour. The history is traced in brief. The frequent failure in diagnosing it, is stressed. A clinical and laboratory system of investigation to help in diagnosing this tumour has been dealt with at length. An interesting

case report of a microscopic phaeochromocytoma in a normal adrenal and its successful removal has been presented. The importance of sudden elevations of blood pressures, during manipulation of the adrenal concerned, in betraying an invisible phaeochromocytoma, within a seemingly normal and innocuous adrenal is emphasized. This is a definite indication for removal of that adrenal.

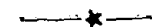
My thanks are due to my Chief, Dr. E. J. Borges, M.S., F.R.C.S. (Eng.), Surgeon, Tata Memorial Hospital, for valuable suggestions and guidance.

My thanks are also due to Dr. J. C. Paymaster, F.R.C.S.E., D.C.O.G., Chief Surgeon and Superintendent, Tata Memorial Hospital, for permission to use hospital records.

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—Received for publication on 1-8-1958.



KRUKENBERG AMPUTATION IN FOREARM STUMPS*

BY

BINOY CHAKRAVORTY, Calcutta.

Krukenberg operation in forearm amputation stumps is a German method developed during the First World War. The object of this operation is to convert the radius and ulna into the two jaws of a 'crocodile' forceps so that the resulting stump can be used as 'lobster claws'. This 'forcepisation' of the forearm stumps with full preservation of the cutaneous sensibility enables the subject to grasp things with considerable strength and can be used even for finer movements. The two forearm 'fingers' can be used as it is, usually a prosthesis is not used but an ordinary rotational prosthesis is an excellent help, only the grasping cuff of the prosthesis has to be changed into a double cuff to fit and to cover the two antibrachial 'fingers'. With each pronation and supination movement the two jaws open and close. The fingers of the prosthesis when it is fitted can be worked by the same movements. The advantage of two 'fingers' with perfect tactile sensibility helps considerably in finer discrete movements.

Technique of the Operation

A 'U' shaped incision is made starting on the Volar surface of the forearm from a point 7 cm. distal to the bend of the elbow to the same point on the dorsal aspect. The flexor digitorum sublimis is separated into a radial and ulnar moiety. The median and ulnar nerves are cut short taking care to preserve the nerves of supply. The bulk

of the jaws are minimised by the complete resection of the flexor pollicis longus and flexor digitorum profundus. The Interosseous membrane is divided to the same extent as the skin incision. The interosseous arteries are spared. The radial division of the flexor digitorum sublimis is sutured to the flexor carpi radialis and the ulnar part to the ulnar flexors. On the dorsal aspect the extensor are similarly divided into radial and ulnar heads. The ends of the two forearm bones are grooved.

The flexors and extensors on the radial and ulnar sides are joined in such a way that the junctions of the flexors and extensors lie in the grooves at the end of their respective bones. The skin flap is closed so that the radial limb is completely covered and the raw area lies on the lateral aspect of the ulnar limb which is subsequently treated by Thiersch or pedicle grafting.

Movements are begun as soon as healing is complete, massage or electrical treatment may be helpful. The abductors of the radial limb are the brachioradialis and the radial extensors, while the adductors are the pronator teres, flexor carpi radialis and half of the flexor digitorum sublimis.

Difference of opinion exists regarding the length of the jaw limbs. Krukenberg in his original paper (1917) advocated a length of 12 cm. of each limb, Putti (1920) reduced

the length of the limbs to 5-7 c.m. Zanoli (May, 1957) after having experimented with forcepisation of different lengths from 4 to 7 cm. concluded that the optimum length is 6-6½ cm. This gives a sufficient spread with greatest strength of prehension; a shorter stump gives greater strength with limited spread and less chance of direct use. The longer fingers gives the opposite effect. The following case has a stump length of 6 cm. and shows gratifying results.

Case Report

The patient A. M. a Muslim male aged 32, a worker in a rubber factory suffered an injury in a roller machine in his left hand resulting in traumatic loss of the limb upto a length of one inch above the wrist joint. With this injury he was admitted into the hospital on the 3rd August, 1956. The wound was attended to at once, the part was cleaned, dead tissues were excised and a forearm stump was left. Although it was in mind at that time to make a Krukenberg claw still we deferred it to a later date, for the patient was in shock and we thought that there might be chances of infection. The amputation stump healed primarily. The patient wanted to go home he was therefore, discharged and advised to get readmitted for the Krukenberg operation at a later date. He got admitted in March 1959 and was operated on the 17th of March. A classical Krukenberg - Putti operation with 6 cm. Stump was performed. The radius could be covered with the skin flap but the radial side of the ulna needed subsequent Thiersch grafting. Rehabilitating measures were started since the day the stitches were removed. The patient was discharged on 9th July, 1957.

The present state (27-8-57) of the patient is after one and half months from the date of discharge. He can actively

grasp things with the two antibrachial fingers, and can use them even for finer movements (Figs. 1, 2, 3 and 4).

The presented case shows promising results within 6 weeks of his discharge from the hospital. In this particular case regular massage or electrical treatment was not carried out: yet the grasping power of the stumps is considerable.

In earlier days this operation was advocated only for bilateral forearm amputees and/or blind subjects who cannot learn the use of prostheses. The blind subjects get the advantage of sensation and can read Braille. Kineplasty of amputation stumps (Vanghetti 1899) can give the faculty of prehension but not that of cutaneous sensibility. In spite of the theoretical attractiveness this method has gradually disappeared owing to the development of complications as eczemas, ulcerations etc. and prosthetic difficulties. The present day prosthesis is usually costly and facilities not easily available. Most people may not afford prostheses and, if they can manage to have one, may not be able to keep them in working condition. The alternative to a prosthesis is a useless forearm stump. The only disadvantage of the operation is an unsightly stump, but the advantages derived out of it greatly outweigh it. In a country like India where the population consists mostly of the poorer working class we hope the Krukenberg operation has a definite place in amputation surgery even in unilateral amputees.

Summary

1. Krukenberg operation with Putti's modification has been discussed.

2. A case on which Krukenberg - Putti amputation plasty has been done is recorded.

*This case was presented at the local sitting of the Association of Surgeons of India, Calcutta on 27-8-57. An operation of this nature has not been previously reported in India.



Fig. 1.
The forearm stumps in full abduction.



Fig. 2.
The patient smoking a cigarette which is held by the amputation stump.



Fig. 3.
The patient can use the stumps to grasp even a flat thing as a dinner fork.



Fig. 4.
Turning of pages of a book with the stumps is also not difficult.

Acknowledgement permission to operate on this case and to my sincere thanks are due to Dr. M. K. Dr. D. Bhattacharya and Miss. J. Gupta ha, Professor of Surgery, Nilratan Sircar for their valuable help rendered in this medical College, Calcutta for his kind connection.

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HYDROCEPHALUS—Experimental Observations*

BY

R. NIGAM & S. L. SINGHAL.

Introduction

Though hydrocephalus as a disease entity belongs to antiquity, having been known since the times of Hippocrates, for centuries its pathogenesis remained obscure. Blackfan, in 1913 produced hydrocephalus by obstructing the aqueduct of Sylvius by means of a tiny foreign-body, thereby, for the first time, bringing the disease within the realm of experimentation. His observations led to the monumental work of Dandy et al between 1913 and 1922, which clarified one aspect of its pathogenesis namely that the obstruction to the outflow of C. S. F. somewhere in its course is directly responsible for the enlargement of the ventricles. Since then various procedures have been employed, such as intrathecal injection of Indian-ink (Dandy, 1914; De, 1950), wrapping the midbrain by a gauze piece (Dandy, 1914), aleuronate granules (Thomas, 1914) fibrinogen, thrombin, suspensions of rat carcinoma and of mycobacterium tuberculosis (De, 1950) and sterile paraffin (Lashley et al, 1933). In contrast to Dandy's observation Bedford and Schlesinger failed to produce hydrocephalus by ligature of the vein of Galen. Millen et al (1953) pointed out the causal relationship between aqueductal stenosis with consequent hydrocephalus and vitamin A deficiency.

The present work has been undertaken to study and evaluate various procedures

employed for experimental production of hydrocephalus in common laboratory animals and to study the macroscopic and microscopic changes produced thereby and to investigate the possible causal relationship of these changes to those seen in clinical work.

Two common laboratory animals viz. the albino rat and the dog were used in the present study because of their easy availability and simple upkeep. The procedure adopted was intrathecal injection of suspensions of (a) Indian-ink 40% and 50%, (b) kaolin 20%, (c) twelve weeks' culture of bovine strain of mycobacterium tuberculosis on Lowenstein's medium. The technique of injection employed in the case of the rat was essentially similar to the one described by De, 1950. A tuberculin syringe was used for easy and accurate measurements. The technique was much simpler in the case of the dog in contrast to the rat, a definite flow of C.S.F. being obtained indicating the correct position of the needle. In the rat, however, the only guiding factor was the sudden loss of resistance encountered by the needle on puncturing the occipito-atlantoid membrane. Some animals died immediately after the injection, probably as a result of trauma to the medulla. The animals that died or those sacrificed, were immediately preserved in 10% formal-saline after the skull cap had been split

anteroposteriorly. The brain, the meninges and the proximal portion of the spinal cord were subsequently dissected out and studied for gross and microscopic changes. In some animals, to demonstrate the site of obstruction to the flow of C. S. F. the Prussian blue test was employed.

Observations

I. Induction of hydrocephalus by Indian-ink.—Twenty - three adult albino rats weighing between 150 g. and 210 g. and five stray dogs were used for these experiments. The animals were divided into two groups (Table-I) :

The interval between the first and subsequent injections was 3 and 6 weeks in the case of the rat and 4 weeks in the case of the dog.

Successfully injected animals developed signs of meningeal irritation. They all looked ill and lethargic and showed apathy towards food for two to three weeks after the injection. They all had pyrexial reaction varying between 0.5°F to 1.5°F for 3 to 5 days. Head retraction, skew deviation of the eyes and loss of weight between 5 g. and 10 g. were observed in the case of rats. Subsequently they all recovered regaining their weight. One of the dogs (No. 3)

Table I

Animal	Dose given.	Single Injection.	Repeated Injection.	
			Twice.	Thrice.
Albino rat ...	0.2 mls. 40%	14	4	5
Dog ...	2 mls. 50%	3	2	—

A.—Those receiving single injection.

B.—Those receiving repeated injections upto a maximum of three injections.

had quadruplegia which gradually recovered during three weeks' time. The other dog (No. 2) was a young puppy who showed external signs of cranial enlargement. The results are summarised in Tables-II and III.

Table II

Particulars.	Animal.	Total No. used.	Immediate mortality.	Animals still alive.	No change.	Meningitis.	Hydrocephalus.		
							Gross.	Mod.	Total.
Single Injection ...	Rat	13	3	1	3	4	1	4	5
... ..	Dog	3	1	—	—	3	2	1	3
Two Injections ...	Rat	4	—	—	2	2	1	1	2
... ..	Dog	2	—	—	—	2	2	—	2
Three Injections ...	Rat	5	—	—	1	4	1	2	3
... ..	Dog	—	—	—	—	—	—	—	—

*I.C.M.R. Inquiry at Medical College, Nagpur.
From the Department of Surgery, Medical College, Nagpur.

Table III

Duration.	Animal.	Total No.	No Changes.			Meningitis.			Hydrocephalus.		
			1 Inj.	2 Inj.	3 Inj.	1 Inj.	2 Inj.	3 Inj.	1 Inj.	2 Inj.	3 Inj.
0-4 Weeks	Rat	7	3	—	—	1	—	—	4	—	—
	Dog	1	—	—	—	1	—	—	1	—	—
5-8 Weeks	Rat	3	—	1	—	—	2	—	—	1	—
	Dog	2	—	—	—	1	1	—	1	1	—
9-16 Weeks	Rat	3	—	—	—	—	2	—	—	1	—
	Dog	1	—	—	—	—	1	—	—	1	—
17 weeks & above	Rat	6	—	—	2	—	—	3	—	—	2
	Dog	—	—	—	—	—	—	—	—	—	—

The immediate mortality in the present series was 13% in rats. Indian-ink was found distributed in the sub-arachnoid space mainly in the meninges—the maximum deposition being in the basal cisternae and along the vessels in the sulci of the cerebral and cerebellar hemispheres. Excepting at the site of injection, the dura was devoid of ink. The subjacent pia-arachnoid was studded with ink along the meningeal vessels in the

form of a beautiful filigree pattern, most marked in the region of the medulla and proximal portion of the spinal cord, particularly in the case of dog (Fig. 1). In some specimens the ink was observed in the superior sagittal sinuses and in two specimens from dogs the arachnoid granulations were stained black. The dilated ventricles of the rats, in contrast to those of the dogs were found to contain ink which had entered



Fig. 1
Showing thickening of Meninges at the site of injection and distribution of Indian-ink along meningeal vessels.



Fig. 2
Showing dilated ventricles of the rat with Indian-ink inside the ventricular cavities.

them in retrograde fashion (Fig. 2). In about 50% of the specimens from the rats and in all the four specimens from the dogs, the meninges at the site of injection and in the basal region were grossly thickened and adherent (Fig. 3). The pia-arachnoids were glued together and could not be separated off from each other as opposed to the dura, which could easily be stripped off. The brain substance proper was completely devoid of ink.

Dilatation of ventricles was noted in about 50% of the rats. Three of the four specimens from the dogs showed symmetrical dilatation of the ventricles (Fig. 4). In both these animals the anterior horns of the lateral ventricles were maximally affected. The third and the fourth ventricles were also dilated and so was the aqueduct of Sylvius (Fig. 5). Intra-ventricular foramina were widely patent. In the fourth specimen (dog No. 5) only unilateral dilatation of the anterior horn of the lateral ventricle was observed—no other ventricles being affected. The cerebral cortex as compared to the normal brain was atrophic.



Fig. 3
Showing inferior surface of the brain; deposition of the ink at the base.

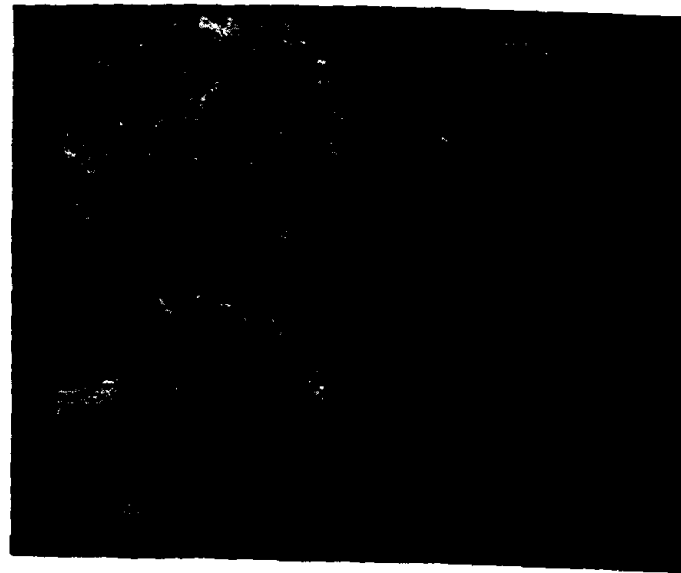


Fig. 4
Showing bilateral dilatation of
ventricles in the dog.



Fig. 5
Showing grossly dilated
ventricles of the rat.

Microscopic examination revealed Indian-ink taken up by the lining cells of the arachnoid with leucocytic infiltration. There was perivascular deposition of ink along Virchow-Robin spaces. In some sections ink was found in the arachnoid villi along the superior sagittal sinus. In hydrocephalic brains, atrophy of the periventricular

structures, especially the basal ganglia and corpus callosum, with oedema of the nerve cells was evident. Ependymal flattening together with oedema of sub-ependymal structures was also observed. The choroid plexus, however, did not show any pathological changes and was found to be normal (Figs. 6 and 7).



Fig. 6
Microphotograph showing
sub-ependymal oedema and irregular
swelling of nerve fibres in the
ventricular margin of the
hydrocephalic rat.



Fig. 7
Microphotograph showing normal
choroid plexus. Oedema of the
nerve cells in the sub-ependymal
structures.

II. *Induction of Hydrocephalus by Mycobacterium tuberculosis.*—Eighteen adult albino rats were used. They were equally divided in two groups. The first group was given intrathecal injection of a suspension of tubercle bacillus without prior sensitisation. In the second group, the animals were first sensitised by giving a subcutaneous injection of dead tubercle bacilli followed by intrathecal injection of living bacilli, three weeks later. There was no immediate mortality.

All the animals were given repeated injections at an interval of 4 and 8 weeks upto a maximum of 3 injections. A few of the animals were followed upto 35 weeks after the first dose. Only two of the unsensitised and one of the sensitised animals showed definite hydrocephalic changes. About 40% of the animals showed evidence of meningeal irritation but the reaction seen was less intense than the one seen with Indian-ink injections (Table IV). In two animals

Table IV

Particulars.	Total No.	Immediate mortality.	Animals still alive.	No changes.	Meningitis.	Hydrocephalus.
Unsensitised animals ...	9	—	2	2	3	2
Sensitised animals ...	9	—	—	4	4	1

(Nos. 18 and 20) intense congestion of meningeal vessels was observed. In four specimens (Nos. 18, 20, 25 and 29) intraventricular clots of blood was found. Microscopically slight inflammatory changes in the meninges with leucocytic infiltration was observed. No bacilli were detected in the smears prepared from the exudates at the site of injection. One specimen (No. 17) showed a cystic dilatation in the region of the medulla and pons (Fig. 8). It was probably an arachnoidal cyst resulting from

chronic meningeal irritation. The lining of the cyst was quite smooth and regular and its cavity filled by fibrin clot.

III. *Induction of hydrocephalus by Kaolin suspension.*—Thirteen white adult rats were used. 0.2 mls. of a 20% sterile kaolin suspension was given intrathecally. The immediate mortality in this series was high being 54%. The animals were followed upto a maximum of 23 weeks. Of the six surviving animal only two showed evidence of meningeal irritation and ventricular dilatation (Table V). Others showed no pathological changes. In one of the animals (No. 45) again a cystic dilatation was observed—an arachnoidal cyst similar to the one observed in animal No. 17.

Table V

1. Total No. of animals	...	13
2. Immediate mortality	...	7
3. No changes	...	3
4. Meningitis and ventricular dilatation...	...	2
5. Cystic dilatation	...	1

Discussion

Dandy's illustrative experiments have clearly shown, that an effective block at any point in the course of the circulation of the C. S. F. will, without exception, cause hydrocephalus. In the present study such an

obstruction has been produced in the sub-arachnoid space at the base of the brain by introducing mild irritants like Indian-ink, in the cisterna magna. Intra-cisternal injection was found to be an easy procedure—more so in the case of the dog. Of the three agents viz. Indian-ink, myco-bacterium tuberculosis and kaolin thus investigated, Indian-ink was found to be the most suitable agent as far as chronic meningeal irritation is concerned. The immediate mortality as reported by De (1950) was 50% whereas in the present series it was only 13%. Positive results in the form of meningeal irritation and dilatation of ventricles were observed in about 50% of the animals. In contrast to the observations of Griffith et al (1936) kaolin, in our opinion, is not so suitable a substance for such work. The immediate mortality with kaolin was more than 50% and the results obtained were poor. Similarly, mycobacterium tuberculosis is not quite as effective. The rat is naturally resistant to tubercular infection. The incidence of meningeal irritation, even after prior sensitisation was quite low—in the region of about 15%. Possibly the mild form of irritation produced by the bacillus acting as a foreign body is insufficient to produce an effective block. The dog shows a much higher incidence of hydrocephalus as compared to the albino rat employing the identical procedures in both these animals.

The most frequent site of dilatation was the anterior horn of the lateral ventricle. In some specimens unilateral dilatation of only the anterior horns was observed (e.g. Dog No. 5). We thereby conclude that this part of the ventricular system is first to be affected and other parts follow later on, depending upon the severity of the block. Dilatation of ventricles, however, was neither related to the interval since the first injection nor to the number of injections.

Actually the animal (No. 6) followed up maximally (38 weeks) and injected thrice did not show any pathological changes, whereas the one injected only once and which died after 11 days (No. 50) showed definite dilatation of the ventricles. The mechanism of the dilatation becomes obvious in the light of the Monro-Kelly doctrine which postulates that the total volume of intracranial contents, after the fusion of cranial sutures, must remain constant. If an effective block has been produced in the sub-arachnoid villi the absorption of C.S.F. from the arachnoid villi ceases, allowing the fluid to accumulate in the ventricles under tension. To accommodate the extra fluid the ventricles dilate at the cost of the periventricular structures which undergo a pressure atrophy. The hydrocephalus thus produced is of a communicating variety as evidenced by the prussian blue test. Similar inferences were drawn by De (1950). Perhaps the non-communicating hydrocephalus seen clinically is due to congenital malformations and neoplasms.

We did not come across any reference in the literature reviewed, regarding the development of arachnoidal cysts in such experimental work. In our opinion such cysts are produced by chronic meningeal irritation. The same aetiological factor may be applicable to clinical material.

Summary and conclusions

(1) Experimental production of hydrocephalus was carried out in 57 adult white rats and in 5 dogs, by intrathecal injections of Indian-ink suspension, kaolin suspension and a suspension of mycobacterium tuberculosis.

(2) The incidence of hydrocephalus in rats was 50% in case of Indian-ink and about 15% in cases of both—kaolin and

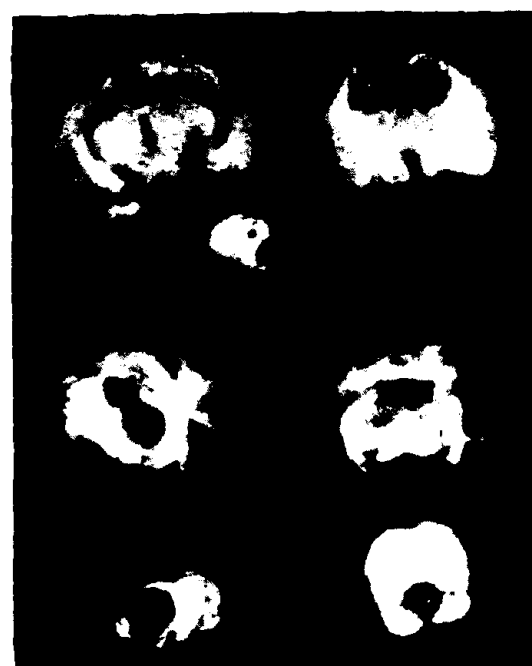


Fig. 8
Showing arachnoidal cyst.

tubercle bacillus. All the four successfully injected dogs showed hydrocephalus.

(3) Indian-ink was found to be the most suitable agent in the present study.

(4) Hydrocephalus thus produced was of a communicating variety, the pathogenesis being obstruction to the flow of C.S.F. in the sub-arachnoid space at the base of the brain.

(5) Observations were better in the dog than in the rat.

(6) Arachnoidal cysts were observed in two specimens. The development of these cysts is due to chronic meningeal irritation.

(7) The salient histopathological findings were as follows:—Indian-ink taken up by the lining cells of arachnoid, perivascular deposition of ink, pressure atrophy of periventricular structures, oedema of the nerve cells, ependymal flattening and oedema of sub-ependymal structures. The choroid plexus was found to be normal.

Acknowledgement

We are grateful to the Indian Council of Medical Research for financial help for this scheme. Our thanks are due to the Dean and to the Professor of Pathology, Medical College, Nagpur for the facilities given to us to carry out the present work.

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HYDROCORTISONE IN OSTEOARTHRITIS

BY

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Hench* administered parenteral cortisone to a case of Leukaemia in 1951 and accidentally noticed alleviation of symptoms in the osteoarthritic joint of the case. Thorn,¹³ Dale⁴ and Boots¹ tried the therapy in many more cases and found encouraging results. Hollander⁸ and Brown,³ however, found no relief in 6 out of 8 cases treated particularly. One discouraging factor noticed by all authors, apart from the cost of treatment, was the unavoidable unpleasant side effects of parenteral therapy. The latter disadvantage was obviated by Hollander⁸ and others in America and Kersely¹⁰ in England by local use of cortisone in the affected joint. Thus they achieved highest concentration at the desired site and avoided the general undesirable side-reactions. Both the authors found far superior clinical improvement with hydrocortisone than with cortisone. The present communication includes observation on 80 cases (with 98 joints) of Osteoarthritis treated with intra-articular hydrocortisone therapy and followed for varying periods upto a year.

The type of cases included in the study are shown in table I.

This distribution of cases does not necessarily represent the frequency distribution of osteoarthritis in the cross-section of patients. All cases of osteoarthritis who reported to the department were not treated by this procedure. In view of the heavy cost of treatment, only cases which could easily be followed up were selected. In most cases conventional means of therapy like massage,

Table I

Showing the distribution of the cases studied.

S. No.	Joint Treated	Number of Cases	%
1	Knee ...	45 (Unilateral 27) (Bilateral 18)	56.25
2	Ankle ...	10	12.50
3	Wrist ...	8	10.00
4	Shoulders ...	8	10.00
5	Hips ...	3	3.75
6	Inter phalangeal	6	7.50
Total ...		80	100.00

radiant heat, local Scotts' dressings, administration of salicylates and allied drugs had either not given appreciable relief or the relief was too short lived. 16 cases of knee involvement had courses of deep X-ray therapy, 13 with and 3 without relief. It was considered inadvisable to expose the cases to repeated exposures of deep X-rays and these were treated by hydrocortisone therapy. The absence in this series of osteoarthritis of the spine which is so commonly encountered in practice is striking. The large number of knee cases included is due not only to the frequency with which this joint is involved with disabling symptoms but also to the ease with which it can be injected. The so called 'Mallum Coxae Senilis' with disabling symptoms, is rare in our country. Probably our country men do not live to that age.

*. From the Department of Surgery, G. R. Medical College and J. A. Group of Hospitals, Gwalior).

Method of Injection

The joints were approached from the most superficial point from which the needle could enter the synovial cavity by the shortest route and without endangering any important structures. For example, the knee was approached by the side of patellar tendon. The usual aseptic precautions used for aspiration were adopted as a routine. Aspirating even a drop of fluid confirmed the position of the needle in the joint. The hydrocortisone used contained 25 mgms. to a c.c. After injection the joint was moved gently through its full range of movement and a firm bandage or preferably a crepe bandage was applied for 24 hours. The latter precaution diminished the chances of reactionary effusion and post-injection pain.

The amount of hydrocortisone used for each joint was determined arbitrarily. Hollander⁹ and Kersley¹⁰ have also used similar doses and found them effective. The doses employed are shown in table II. The injections were repeated after the return of symptoms or after 48 hours if no relief followed the first injection.

Table II

Showing dose schedule of hydrocortisone for each joint.

S. No.	Joint Injected	Amount used in single injection
1	Hip	50 mgm.
2	Knee	25 mgm.
3	Shoulder	25 mgm.
4	Ankle	12½ mgm.
5	Wrist	12½ mgm.
6	Inter phalangeal joint	5 mgm.

The cases were followed up and the results categorised as good, fair or poor. The result was considered good when there occurred a complete subjective relief of symptoms and demonstrable improvement in the clinical picture such as increase in the range of movement and absence of tenderness. The result was considered fair when there was partial but definite relief in symptoms and some improvement in the range of movement. In the rest of the cases the result was graded as poor. In regions where accuracy of injection was doubted, as in the case of hip joints, the results were graded as poor only after two successive attempts had failed.

As a rule the relief was appreciated 24 hours after injection. Often there was pain, sometimes even a little effusion a few hours after the injection. No relief was expected if it did not occur within 48 hours.

The period of relief, however, was very variable. It varied from one week to more than 1 year. In the majority of cases, the relief remained for 3–6 weeks. The period also seemed to depend on the amount of activity of the patient. An early recurrence of pain was noticed when patients abused their limbs or indulged in excessive use of the joint. The relationship was so evident that the patients often forecasted a recurrence of pain before a possible bout of excessive activity. This relationship of occurrence of pain and excessive activity was noticed by Hollander⁹ and others also. There seemed to be no tolerance to the drug. Each time the same dose gave relief for similar periods, if the limb was not abused in between.

There appears to be an optimum quantity of drug required to produce clinical relief in each individual joint; and an increase in dose beyond this does not increase the period and/or amount of relief.

Table III-A

Showing results after intra-articular Hydrocortisone Therapy.

S. No.	Joint affected	Total No.	Good	Fair	Poor
			No. %	No. %	No. %
1	Knee	63 (Bilateral 18) (Unilateral 27)	46 (73)	11 (19)	6 (7)
2	Ankles	10	6 (60)	1 (10)	3 (30)
3	Shoulders	8	4 (50)	2 (25)	1 (25)
4	Wrist	8	6 (75)	1 (12.5)	1 (12.5)
5	Hips	3	2 (66)	0 (0)	1 (33)
6	Inter phalangeal	6	3 (50)	1 (16)	2 (33)
	Total	98	67 (68.3)	16 (16.3)	15 (15.4)

Table III-B

Showing period of relief after intra-articular Hydrocortisone Therapy

S. No.	Joint	Period of relief
1	Knee	Minimum — 10 days Maximum — Over a year Average — 8 weeks.
2	Ankle	Minimum — 8 days Maximum — 3 days Average — 3 weeks.
3	Shoulder	Minimum — 1 week Maximum — 4 months Average — 3 weeks.
4	Wrist	Minimum — 2 weeks Maximum — About a year Average — 3 months.
5	Hip	Minimum — 1 week Maximum — 5 weeks Average — 3 weeks.
6	Inter phalangeal joint	Minimum — 2 weeks Maximum — 4 weeks Average — 3 weeks.

10 cases of knee joint disease which showed relief after the 1st injection were injected weekly with 25 mgms. of hydrocortisone for 6 weeks. The period of relief that occurred is shown in table IV. It varied from 3 weeks to over 6 months. This would suggest that a weekly prolonged therapy is not likely to produce more lasting results.

Table IV

Period of relief after 6 weekly Intra-articular injections of hydrocortisone in 10 knees.

Period of relief	No. of cases	%
3 – 6 weeks	2	20%
6 – 12 weeks	2	20%
12 – 24 weeks	3	30%
over 6 months	3	30%

There appears to be no relationship between the severity of the radiological findings and the amount of relief that followed intra articular therapy. X-rays were taken every 3 months in cases which could be kept symptom free either by one or repeated injections. 32 cases after 3 months, 18 cases after 6 months and 3 cases after 12 months showed no radiological improvement. In two cases there was an increase in the severity of radiological findings even though the joints were comparatively symptom free. Hydrocortisone does not reverse the process or rejuvenate the attritioned cartilage. It may however arrest the process as suggested by the absence of increase in radiological signs in the majority of cases. This point needs further follow up and investigation.

It is interesting to note that out of 13 cases of knee joint disease, which were benefitted by exposure to deep X-rays 12 gave good results and one fair. Out of 3 cases who did not show appreciable relief with deep X-rays, one showed good result and two did not respond. There may appear a similarity in results obtained in the two types of therapy.

Complications

Increase in local pain, sometimes very disturbing to the patients, was noticed 8-10 hours after injection in a great majority of cases (52). This was accompanied by warmth and local tenderness in 34 cases and with small, though definite, effusion in 9 cases. In cases where the therapy succeeded this pain subsided within 24 hours and was followed by demonstrable improvement in symptoms and signs as compared to the preinjection state. In cases where the drug failed and this pain occurred, it gradually returned to the preinjection state within 24 hours. There seemed to be no relationship of this increase in pain to possible success of

therapy in the cases. Successive injections in the same joint usually produced lesser reaction.

Table V
Showing complications of Intra-articular hydro-cortisone therapy.

S. No.	Complication	No. of joints	%
1	Local pain for 24 hours ...	52	53%
2	Swelling with tenderness for 24 hours ...	34	35%
3	Slight effusion for 24 hours to 48 hours ...	9	12%
	Total ...	98	100%

This increase in symptoms was appreciably less if a firm support to the joint was given for 24 hours. The pain was treated with aspirin and allied drugs. The above complications pertain probably more to a joint puncture than a reaction to the drug. Sepsis was not encountered in any case in over 250 injections that were given to these cases.

No side effects of the drug in any other joint or any other part of the body were encountered. Kersley¹⁰ and Hollander⁹ noted similar freedom from side reactions, which makes the drug superior to other corticoids.

Discussion

Osteoarthritis is generally thought to be primarily a mechanical disorder caused by wearing out of the joint because of lack of congruity of the joint surfaces. The process of incongruity starts with attrition of the joint cartilage dependent on the so-well-known factors of age, senescence, trauma, diseases, and other factors. In Boyd's² inimitable words 'stealthy hours are continually

stealing away qualities of tissues'. In a joint the first change is in the chondroitin sulphate. The collagen fibres are left unsupported so that they are vulnerable to the mechanical effects of trauma, wear and tear. The cartilage can only respond to changing mechanical conditions by degeneration and destruction but the bone responds by regeneration and reconstruction. Since no cartilage is formed, harmony between form and function is never re-established. Every thing that follows thereafter can be explained by the changing form due to destruction of the cartilage and regeneration of bone to regain the loss, thus producing disharmony with function.

When abnormal pressure and attrition is talked about so lightly, recent studies of Harrison, Schajowicz and Trueta⁷ are illuminating. While agreeing with most modern writers that osteoarthritis begins in the attrition of articular cartilage, the authors, surprisingly, find that cartilage changes occur in the non-pressure areas earlier. They conclude that if excess of joint pressure is deleterious to hyaline cartilage, the lack of pressure is even more the compelling cause of its degeneration. This may explain the hitherto unexplained involvement of the patella and the acromioclavicular joint in the process. The cartilage damage is the main stimulus to vessel growth which ultimately lays down the osteophytes and completes the vicious circle. 'What is so damaging in osteoarthritis,' they write, 'seems to be not the degeneration of cartilage but the vigorous and persistent attempts at repair; an attempt to transform a decaying joint into a youthful one and for this, as in the miraculous rejuvenation depicted in Goethe's Faust, a high price must ultimately be paid'.

Discussing the treatment Philip Wiles¹⁶ has emphasized that osteoarthritis is a local

disease as compared to other joint diseases and, therefore, the treatment should be directed to the affected joint mainly except in cases where superimposition of other diseases is suspected, which would need investigation and treatment. If we add to this Trueta's findings that symptoms are worse not so much because of the disease as because of the 'persistent attempt at repair' we may inhibit this 'attempt at repair' with benefit.

It is exactly this function which is performed better by hydrocortisone injection in osteoarthritic joint than by any other drug. Selye had concluded that the effect of the adrenal steroids is to inhibit the capacity of the tissue to respond to a noxious stimulus by inflammatory reaction. Ramsey and Key¹⁴, after extensive experimentation concluded that of all the corticosteroids hydrocortisone inhibits inflammatory reaction most effectively without producing undesirable general reactions. They logically conclude that hydrocortisone would be most useful in those pathological conditions which are inherently localised and self limited, in which the symptoms are largely due to inflammatory response per-se.

The superiority of hydrocortisone over other steroids may be inherent in the difference in solubility. Hollander⁹ points out that hydrocortisone is more soluble in water and synovial fluid and less soluble in blood serum as compared to other steroids thus keeping intra articular concentration for a longer time. Also the anti-inflammatory property of hydrocortisone is higher than others. As hydrocortisone only inhibits the reaction, it cannot be expected to effect a cure or produce reversal of the processes in osteoarthritis. Where no cure is available a drug promising greater and more prolonged alleviation is welcome.

Summary

Results of ninety osteoarthritic joints treated with intra-articular hydrocortisone have been analysed. Gratifying relief was observed in the majority of cases. Repeated injections have been found to be equally effective. No side reactions or serious complications were observed. The pathological basis of the improvement in symptoms produced by the drug has been discussed.

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**ACUTE HEAD INJURY**

(A clinico-pathological Study)

BY

R. NIGAM and V. V. KULKARNI.

Acute injury of the head is a serious problem in the modern world of mechanization in industry and speedy transport. It was a serious problem in the recent world war and the knowledge and experience gained therein, has considerably changed the concept of head injuries. Fractures of the skull have lost the importance they once enjoyed, and now more and more attention is being paid to injuries of the brain, the severity of which determines the ultimate result. Even under peace time conditions, quite a few cases are admitted in the hospital for treatment and this paper is based on the experience gained in 50 cases of acute head injury admitted in the Medical College Hospital, Nagpur during a period of two years. For medico-legal reasons, autopsy was carried out on patients dying of head injury, and this opportunity was seized to follow the cases to the post-mortem room. In 50 cases, there were 15 deaths, of which 12 were available for autopsy, and this paper is confined to the observations made on them.

Subepicranial Haemorrhage

Out of 12 cases, subepicranial haemorrhage was observed in 5 cases, 3 of which were of a massive type. The clots were bilateral and symmetrical, and were found to extend beyond the temporal lines (Fig. 1). The clots were of uniform thickness and gave no external indication of their extent. All the cases had an intact scalp, and it was observed that with large gaping

wounds of the scalp subepicranial haemorrhage was minimal. The association of subepicranial haemorrhage and brain injury is very close. All the three cases with massive clots also exhibited severe injuries of brain. The presence of subepicranial haemorrhage indicates that the violence had been of a severe type and that the brain is likely to have been extensively damaged. Milroy Paul² considers massive sub-epicranial

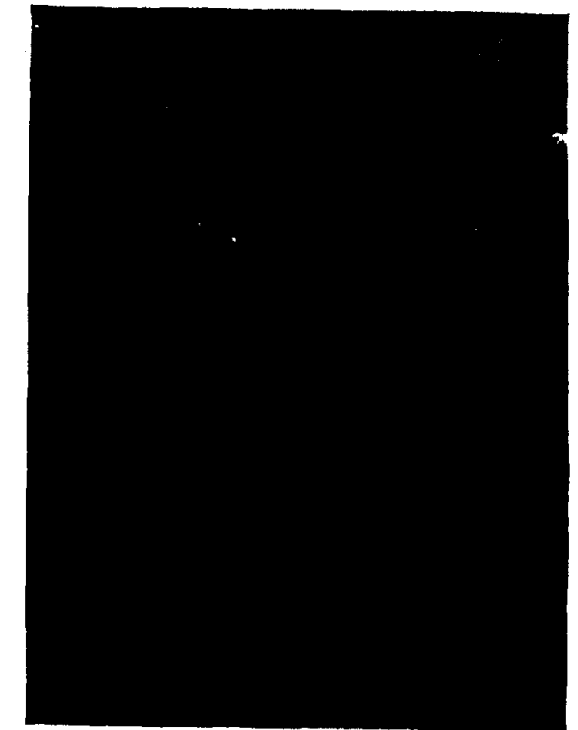


Fig. 1
Subepicranial haemorrhage and haemorrhage in the temporalis muscle. Depressed fracture with underlying extra-dural haemorrhage is also seen.

haemorrhage as an almost certain indication of severe brain injury.

Extradural Haemorrhage

Extradural haemorrhage was encountered in 5 cases and in 3 of these it was of the massive type. Common sources of bleeding are the venous sinuses and middle meningeal vessels, especially the middle meningeal venous sinuses which are most liable to injury. Bleeding in extradural haemorrhage is more a slow and continuous ooze, than a spurting arterial haemorrhage. Further, it is known that the clot has to attain a fairly large size before clinical manifestations appear. This takes anywhere between 6 to 12 hours or more. These facts indicate that it is the venous bleeding which is slow and continuous and that is responsible for the formation of large clots. Out of 3 cases, 2 showed clots overlying the middle meningeal vessels (Figs. 2 & 3), though only in one of them a tear in the artery and vein was observed. It is essential to realize that in every case of extradural haemorrhage, brain injury very often coexists, and later on plays an important role in the determination of the prognosis. Of the 3 cases of massive haemorrhage 2 had associated severe injury of the brain. In retrospect it becomes apparent that the patients could not have survived in the face of such extensive injury to the brain (Fig. 6). Evacuation of the extradural clot is essential, as such a procedure provides better chances for the brain to recover, but it would be irrational to expect a miraculous recovery in every case following an operation.

Injuries of the brain

Injuries of the brain are manifested as contusions, lacerations, and intracerebral haemorrhage of traumatic origin. These lesions may be single or multiple. Multiple

contusions of the brain was a common observation—these lesions being present in 4 out of 12 cases. All these patients died within 12 hours of the injury. The lesions were superficial and covered by subpial haemorrhages (Fig. 7). They were distributed evenly over the surface of the cerebral hemispheres. The lesions were not severe at the site of impact but were of a generalised type indicating that such injuries are due to a generalised deformation of the brain. Histologically, sheets of haemorrhages were seen in the superficial areas of the cortex. Deeper sections showed patches of peri or paravascular haemorrhages (Fig. 8). The histological picture was uniform throughout and provided no explanation for the various clinical manifestations of the head injury. Clinically, unconsciousness following head injury is a serious condition and, as long as it is present, the patient's life is in the balance. Though it has no pathological counterpart, unconsciousness is a fairly good guide in assessing the severity of the brain injury. Patients who receive a severe injury to the brain die within 12 hours of the injury (Table II). On the other hand the majority of cases of head injury who survive, regain consciousness within the first 12 hours. A small percentage of cases, who remain unconscious for more than 12 hours, should be observed carefully because these are the patients who are likely to survive the brain injury provided factors like extradural or subdural haemorrhages or depressed fractures, if present, are adequately treated. There is one important exception to these generalisations, and that is the phenomenon of a lucid interval. In addition to the well recognised middle meningeal syndrome, intracerebral haemorrhage of traumatic origin is capable of showing a lucid interval and other signs and symptoms which mimic the middle meningeal syndrome. The following case report illustrates this fact.



Fig. 2
Massive extradural clot.

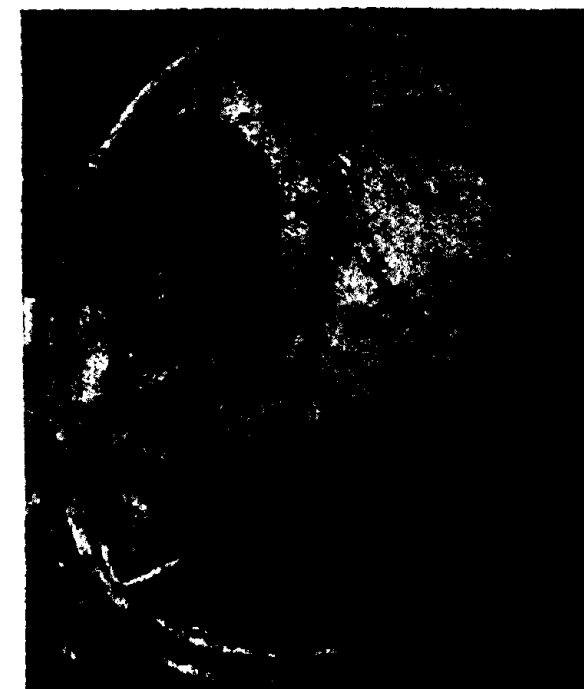


Fig. 4
Deep indentation of the dura due to clot shown in Fig. 3.



Fig. 3
Massive extradural clot.



Fig. 5
Flattening of the cortex due to clot shown in Fig. 3.



Fig. 6
Associated brain injury in a case of extradural haemorrhage shown in Fig. 3.



Fig. 7
Extensive surface haemorrhages and contusions.



Fig. 8
Photomicrograph showing a large paravascular haemorrhage.

Table No. I

Summary of the observations at autopsy
Total number of cases - 12

S. No.	Lesion	No. of cases	Percentage
1	Laceration — Superficial	1	8.3
	— Deep	5	41.5
2	Contusions — Single	2	16.6
	— Multiple	4	33.2
3	Intracerebral haemorrhage — Petechiae	2	16.6
	— Massive	2	16.6
4	Subarachnoid Haemorrhage — Slight	2	16.6
	— Massive	3	24.9
5	Subdural Haemorrhage — Slight	2	16.6
	— Profuse	2	16.6
6	Extradural Haemorrhage — Thin	2	16.6
	— Thick	3	24.9
7	Fracture of Skull — Vault	1	8.3
	— Base	2	16.6
	— Both	3	24.9
	— Neither	3	24.9
8	Associated severe injuries — Lungs — Surface haemorrhage	7	58.1
	— Rupture	1	8.3
	— Liver — Large Tear	1	8.3

Table No. II

Analysis of degree and period of unconsciousness (50 cases)

Degree of unconsciousness.	On Admission.	Post-traumatic period.								
		Hours.		Days						
		12	24	2	3	4	5	6	7	8
Dead	...	2	10	11	12	13	14	14	15	15
Coma	...	18	7	6	4	2	1	1	1	1
Semi-coma	...	9	6	4	4	2	1	1	—	—
Confusion—Severe	...	3	3	2	2	4	2	1	1	—
—Moderate	...	5	1	1	—	1	3	1	1	—
—Mild	...	3	1	1	1	1	2	—	1	—
Intellectual impairment	...	4	2	1	2	1	1	3	3	1
Normality	...	6	18	24	25	26	27	27	30	31

Case Report

(Fig. 9) K. G. 45 H. M. admitted on 26-1-57 at 10 a.m. with a history of fall from a running bullock cart 24 hours before admission. He was reported to have been unconscious for about half an hour following injury and had bleeding from the left ear. On admission he was in a state of moderate confusion and was bleeding from the left ear, which subsequently ceased. There were no signs of injury to the scalp. *Neurological examination* was normal. *Skiagram skull*—A.P. and lateral views—normal. *Lumbar puncture*—C.S.F. 90 drops per minute—blood stained. R.B.C. one mill. per c.mm. The patient was observed for 4 days in the ward. During this period confusion cleared up but the patient continued to complain of frontal headache throughout. Discharged on 31-1-57. *Readmitted* on 1-2-57 at 12 noon in an unconscious state. Lumbar puncture showed frank haemorrhage. He died 6 hours after admission. *Autopsy*: (1) Fracture of the left petrous temporal bone

and corresponding contusion over the under surface of the left temporal lobe—coup injury (Fig. 10). (2) A large intracerebral haematoma in the right frontal pole of the cerebrum (Fig. 10). This was found to have ruptured into the lateral ventricle (Fig. 11).

Discussion

This case is of interest because of several reasons. The trauma to the brain was minimal in comparison to the severity of the injury. The typical contre coup injury observed was more severe than the one due to direct impact. Friedman² considers contre-coup mechanism as an important factor in the genesis of intracerebral haemorrhage. The lucid interval of 6 days is interesting and the occult nature of the lesion is explained by its situation in the silent area of the brain. Holburn⁴ observed that there was always a concentration of shearing forces in the frontal poles of the hemispheres, especially in injuries due to the



Fig. 9
A clinical record.



Fig. 10
Coup and contre-coup lesions.
Coup injury is on the right and contre-coup on the left.



Fig. 11
Intracerebral haematoma which had ruptured
into the lateral ventricle.

forward rotation of the head. Death was due to rupture of the progressively enlarging haematoma into the ventricle, resulting in profuse intraventricular haemorrhage (Fig. 11). Naffziger and Jones² describe two similar cases operated on under a mistaken diagnosis of middle meningeal haemorrhage. The condition was first described by Bollinger in 1891 as delayed post-traumatic apoplexy. In the absence of physical signs, the diagnosis is difficult, but the possibility of intracerebral haemorrhage should be considered in the presence of neurological signs like hemiplegia and deteriorating general condition after an initial improvement. Definite diagnosis can be established by cerebral angiography which would show pooling of the dye at the site of the haematoma. Treatment in the cases diagnosed preoperatively or at the time of the operation is formidable. Bowder and Turney¹ strongly advise surgical removal of these haematomas. Symonds³ believes that the post-traumatic apoplexy occurring a few days after the injury is due to the lesion in the vessel wall, whereas Herbitz⁴ considers that pre-existing atherosclerosis or syphilitic arteritis is the commoner cause of this condition.

Cerebral lacerations are usually due to an injury produced by spicules of the bone from the overlying fracture of the skull (Fig. 12). Penetrating injuries of the head cause extensive lacerations of the brain (Fig. 13) though the cases are not necessarily fatal instantaneously. For example the patient whose brain is shown in (Fig. 13) died 8 hours after the injury. Cerebral injuries, howsoever extensive, do not cause death by themselves, a fact which is supported by surgical ablation of a cerebral hemisphere, which is quite compatible with life. In head injury it is trauma to the brain-stem which is a great danger to life and causes immediate death.

The reaction to brain injury is cerebral oedema (Fig. 14) which leads to a train of intracranial events. The intracranial pressure rises, followed by tentorial herniation leading on to hydrocephalus of the communicating type initially, and of the internal type later. Intracranial pressure, as recorded by lumbar puncture, depends on the presence or absence of C.S.F. leakage, the stage of tentorial herniation, and the state of the peripheral and cerebral circulations. The patient with peripheral circulatory failure has a low pressure in the cerebral vessels and hence spinal pressure is normal or subnormal inspite of severe brain injury and cerebral oedema. Rowbotham⁵ considers deep coma, associated with normal or subnormal pressure, to be a sign of bad omen but patients in moderate or mild confusion with high C.S.F. pressure have their lives still in the balance and surgical treatment is life saving in these cases.

In every case of head injury the associated injury to the other parts of the body are likely to be ignored especially when they involve the abdominal or thoracic viscera. Special mention should be made of injuries to the lungs which were observed by us in 8 out of 12 cases submitted to autopsy. Lesions were in the form of multiple haemorrhages and pulmonary oedema. Reddy⁶ has emphasised the importance of realising these facts in a case of head injury. Pulmonary oedema is a real danger resulting from these facts and adequate oxygenation, if necessary by tracheostomy, should be obtained.

Summary and Conclusions

In a series of 50 cases of head injury, autopsy was done on 12 out of 15 fatal cases. An attempt is made to correlate the clinical and post-mortem findings. An interesting



Fig. 12
Isolated cerebral laceration due to fracture of the underlying petrous temporal bone.



Fig. 13
Extensive cerebral lacerations due to penetrating injury of the head. A large irregular stick had perforated the head.



Fig. 14
Cerebral oedema and cerebral contusion. Brain matter had prolapsed out through a crucial incision made in the dura at the time of operations.

case of delayed post-traumatic apoplexy due to rupture of intracerebral haematoma into the ventricle is reported.

In every case of head injury, injury to the brain is of prime importance, and depending upon its severity, the ultimate prognosis is determined.

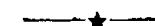
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EVALUATION OF LOSS OF VENTILATORY FUNCTIONS FOLLOWING THORACOPLASTY FOR PULMONARY TUBERCULOSIS*

BY

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Thoracoplasty is an established procedure in the treatment of Pulmonary Tuberculosis. The value of Thoracoplasty in arresting the disease process is well known. Diminution in the size of the thoracic cavity in relation to the underlying lung lesion is the primary object of this operation. The effect is, however, not limited to the healing of cavities. Depending on the extent of operation it has a deleterious effect on the adjoining lung tissue as well. The thoracic cage on the operated side becomes relatively rigid and immobile and thereby the respiratory excursions and ventilatory functions are further diminished. The deformity of the spine that occurs after thoracoplasty adds to the ventilatory loss. The present investigations were undertaken to find out the effect of thoracoplasty on lung functions.

Baldwin, Cournard and Richards² presented a classification of Pulmonary insufficiency and described simple tests for evaluating lung functions. Cournard has divided pulmonary functions into two broad categories—(i) ventilatory function and (ii) respiratory gas exchange. Estimation of respiratory gas exchange requires a complicated apparatus. Study of ventilatory functions reflects on the ability with which a person can replace air from the outside atmosphere. It is important to remember that any single test of pulmonary function is inconclusive.

Various ventilatory function tests interpreted in relation to each other give a more reliable information about the respiratory capacity of an individual. In this article an attempt has been made to evaluate the extent of loss in ventilatory function occurring after thoracoplasty and to suggest some measures to minimise this loss with adequate arrest of disease.

Methods, Material and Observations

Pulmonary function was estimated before, and after three months of thoracoplasty, in twelve cases (Table I & II). Two of these cases were females and the remaining were males. The number of female patients is small because the co-operation necessary for the tests, could not be easily obtained from them. In addition to a careful clinical examination and fluoroscopy of the chest, the following pulmonary function tests were undertaken:

1. *Vital capacity*.—Vital capacity is influenced by so many factors that it could not be used as a reliable test. Timed vital capacity is a more reliable test of ventilatory function. This, however, could not be estimated because of the non-availability of a rapidly moving recording drum. Arnett³ found that successive readings of vital capacity in a case gave constant values, but had little resemblance to the

Table No. I

Ventilatory function studies in cases submitted to thoracoplasty

Case No.	Extent of operation	Vital Capacity		Maxim. breathing capacity			Loss due to operation (per cent)	Walking Dyspnoea Index	
		Before operation	After operation	Before Operation		After operation (litres)			
				Actual value (litres)	% of Predicted MBC				
1. Mr. M.T. ...	5 ribs (Left)	2400 c.c.	1780	70	75.2	55	21.4	0.40	0.45
2. Mr. Ch.P. ...	6 ribs (Right)	3100	2400	78	78.3	62	20.5	0.38	0.42
3. Mr. L. S. ...	" "	2650	2050	110	62.6	84	23.6	0.26	0.32
4. Mrs. N. T. ...	" (Left)	2350	1600	86	69.8	64	25.5	0.38	0.42
5. Mr. S. S. ...	" (Right)	1920	1250	60	55	45	25	0.45	0.58
6. Mr. N. D. ...	" (Right)	2850	2160	115	79.3	82	28.6	0.28	0.35
7. Mr. T. P. ...	" (Left)	3400	2850	120	77.6	86	28.3	0.3	0.34
8. Mr. B. D. ...	" (Right)	3750	3060	130	81.8	96	26.1	0.24	0.30
9. Mr. P. V. ...	8 ribs (Right)	3250	1950	105	78	74	29.5	0.18	0.38
10. Mr. B. P. ...	9 ribs (Right)	3050	1760	96	71.6	54	43.7	0.3	0.44
11. Mr. R. A. ...	" (Left)	2850	1600	110	81.9	70	36.3	0.26	0.35
12. Mrs. S. C. ...	" (Right)	2600	1410	75	68.2	42	46.6	0.43	0.56

Table No. II

Bronchspirometry findings

Case No.	Extent of operation	Vital Capacity			
		Right		Left	
		Before Operation	After Operation	Before Operation	After Operation
1. Mr. M. T. ...	5 ribs (Left)	1250	930	950	540
2. Mr. Ch. P. ...	6 ribs (Right)	1330	630	1880	1670
3. Mr. L. S. ...	" "	1740	1560	1760	1500
4. Mrs. N. T. ...	" (Left)	1400	1150	950	440
5. Mr. S. S. ...	" (Right)	850	440	1100	820
6. Mr. N. D. ...	" "	1060	750	1700	1380
7. Mr. T. P. ...	" (Left)	1870	1650	1475	890
8. Mr. B. D. ...	" (Right)	1580	970	2670	1980
9. Mr. P. V. ...	8 ribs (Right)	1240	680	1860	1210
10. Mr. B. P. ...	9 ribs (Right)	1080	470	1670	1280
11. Mr. R. A. ...	" (Left)	1760	1070	950	480
12. Mrs. S. C. ...	" (Right)	1670	1380	880	420

*This paper was read at the 19th Annual Conference of the Association of Surgeons of India held at Nagpur in December, 1957.

theoretical values based on surface area, weight etc. Bieger⁷ also noted that, despite lowered vital capacity, the working ability of many patients was little below normal.

Vital capacity was uniformly lowered after thoracoplasty. Case No. 5 (Table I) which had a vital capacity of 1920 c.c. before operation developed a great disability after it. No case where vital capacity was below 2000 c.c. was accepted for operative treatment.

2. *Maximum Breathing capacity (M.B.C.).*—It is an index of the maximum volume of air that a person can ventilate in one minute. The patient was given an explanation of the whole procedure as also a personal demonstration before performing this test, and emphasis was laid on rapid and deep breathing. Expired air was collected over a period of 15 seconds by connecting the patient to a Tissot's Spirometer with an open circuit. This test was repeated after half an hour and the higher of the two readings was recorded as M.B.C. The predicted M.B.C. for an individual was calculated by using the regression formula of Cournard.

Males—Predicted M.B.C. = $86.5 - (0.522 \times \text{age in years}) \times \text{B.S.A. in sq. Inch.}$

Females—Predicted M.B.C. = $71.3 - (0.474 \times \text{age in years}) \times \text{B.S.A. in Sq. Inch.}$

It has been observed by Thomson Wells¹⁰ that the regression formula of Cournard gave too low a figure for Indian patients. He reported that predicted M.B.C. was 122.5% and 111.3% of the above values in men and women respectively. The number of cases investigated in our series is too small to corroborate the above findings. Maximum Breathing Capacity as a test of pulmonary function was first studied by Hermensen in 1933. The efficiency of physical activity of an individual was more closely related to his M.B.C. than to the static lung volumes.

Maximum Breathing Capacity measured the volume defect and the resistance to air passages. This is a volume on which an individual can call upon in circumstances demanding extra ventilation. Due to variations in the valves, diameters of the tubing and the apparatus, it is difficult to compare the data obtained by various workers. The average normal M.B.C. for males is 150 litres and for females 100 litres.

It was observed that M.B.C. below 50 litres or below 40% of the predicted M.B.C. was not sufficient for the daily requirements. After thoracoplasty there was a reduction in M.B.C. to 42 litres and 45 litres in two cases (Nos. 5, 12 in table I). These cases were more or less respiratory cripples. Cases Nos. 1 and 10 whose M.B.C. came down to 55 litres, became dyspnoeic after walking or on sight exertion. Six cases had M.B.C. nearing 100 litres before the operation. These cases still have good ventilatory capacity after the operation and do not show any symptoms of post-operative pulmonary insufficiency.

3. *Walking ventilation.*—This shows the ventilatory requirements of patients during moderate exercise performed over a fixed period of time. Through a one way valve and an open circuit, the patient was connected to an empty Douglas's bag which was strapped to his back. A nose clip was fixed in position and the patient was asked to walk, with the observer, for a distance of 180 ft. in one minute's time. At the end of the test, the expired air, collected in the Douglas's bag, was measured. Subjective dyspnoea, if present, was also noted. Walking Dyspnoea Index was calculated by the formula of Waring $\frac{\text{Walking ventilation}}{\text{M. B. C.}} \times 100$. The walking dyspnoea index is important for assessing the morbidity of a case and the degree of pulmonary insufficiency.

The ratio is normally below 0.3 or 30%. If this goes above 0.5 or 50% the patient is a respiratory cripple. Walking dyspnoea index below 0.35 or 35% keeps the patient in good respiratory reserve. Table I shows that two cases (Nos. 5, 12) developed walking dyspnoea index of over 0.5%. These were respiratory cripples after thoracoplasty. Five cases (Nos. 6, 7, 8, 9, 11) had walking dyspnoea index of 0.35 and below. These cases have no symptoms of pulmonary insufficiency. The remaining 5 cases whose walking dyspnoea index is between 0.35 and 0.5 had restriction of working capacity after the operation.

4. *Broncho-spirometry.*—Broncho-spirometry was carried out to find out the relative contribution of each lung in respiratory effort. Broncho-spirometry, originally described by Jacobus, Frankner and Bjorkman in 1932 has the additional advantage of estimating the lung function of each side separately. Bronchoscopy was done one week before broncho-spirometry, to exclude stenosis of left bronchus and tracheobronchitis. The patient was made acquainted with the procedure and his fears allayed by showing him the test being performed on another patient. Under sedation, local anethaine spray and intratracheal anethaine injection, Carlen's double lumen catheter was passed into the trachea by direct laryngoscopy (Fig. 1 & 2). The two cuffs were distended by a few c.c. of air. Correct placement of the tube was confirmed by auscultation of the chest. The patient was propped up, and was allowed to get accustomed to breathing through the catheter. When he was found to have settled down the spirometer and the recording drum was connected to one lung at a time—as only one set of spirometers and drum was available. Normal tracings followed by vital capacity was recorded for each lung separately (Figs. 3 & 4).



Fig. 1

Set up used for passing Carlen's double lumen catheter.



Fig. 2

Showing the spirometer and recording drum connected to Carlen's catheter.

Tracings of one lung could only be recorded at a time.



Fig. 3
Showing Broncho-spirometry tracing of definite value in deciding therapy. It shows good lung function on left side.

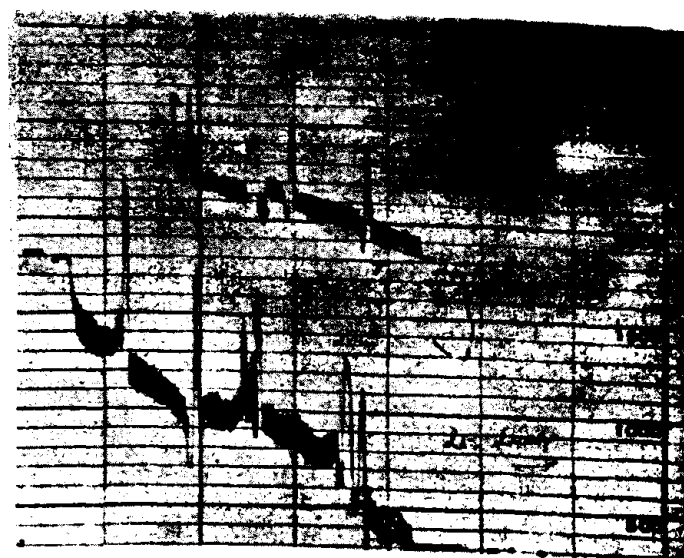


Fig. 4
Showing unsatisfactory broncho-spirometry tracing. The treatment should not be guided on such tracing.

It was observed, that the isolated function of each lung was quite different from that assessed by clinical examination. It is, however, important to realise that the patient undergoing this investigation under the effect of sedatives, atropine, local anesthesia and with the presence of a catheter in the respiratory passage, can no longer be considered normal. However, broncho-spirometry provides a useful method of determining the function of one lung in relation to the other lung.

Table No. II shows the effect of thoracoplasty on individual lung function. In case Nos. 4 and 5 (table II) the contribution from the relatively healthy lung was inadequate which resulted in lowering the pulmonary functions to a marked extent. It also shows that the loss of pulmonary function is proportional to the extent of the operation. An important decision has to be taken in considering this operation when the pulmonary function on the healthy side is also subnormal. The right lung normally

contributes 55% and the left lung 45% of the total ventilation. It is in relation to this ratio that the function on each side should be assessed before and after operation. Loss of lung function on the operated side could be well compensated if the healthy side contributed adequately.

Discussion

It should be emphasised that information obtained from the above mentioned laboratory studies can only help but cannot be the deciding factor in planning the treatment for pulmonary tuberculosis. Careful history taking, physical examination, and roentgenologic studies form an important basis. These tests can afford a quantitative and objective means of following the progress of a case. They have an important place in patients who are to be submitted to irreversible collapse measures. Screening of the respiratory status rather than its complete evaluation is the aim of these investigations. Gaensler, Cugell and Lindren (1955) have recently discussed the role of the initial pulmonary function in the mortality and morbidity following surgery for pulmonary tuberculosis. In the immediate post-operative period there is a steep fall in the lung function. Respiratory failure is likely to occur due to paradoxical respiration, retained secretions, pneumonitis, and impaired chest movements. Cases with borderline lung function have, therefore, a stormy period of convalescence. The loss of pulmonary function that occurred three months after six rib thoracoplasty was about 25-30% and after nine rib thoracoplasty this loss mounted upto 40-45%. This observation helped us to assess before hand, the ventilatory loss that would occur after the operation and, in three cases the operation was not done because of these reasons. It will be observed that in view of the fact that there is loss of ventilatory function after the

operation, thoracoplasty is likely to be regarded as an unsound procedure. Its merits, however, have to be calculated on the pulmonary function that would be available after the operation to carry on the normal life. If the operation is likely to lead to respiratory disability this operation should not be undertaken.

It is an important problem to consider whether the pulmonary functions could be improved and whether its loss, after operation could be minimised. The patients to be submitted to thoracoplasty were taught to increase their breathing reserve by properly guided breathing exercises. They were given instructions in localised breathing exercises, especially diaphragmatic breathing, and breathing through the lower part of chest, while simultaneously relaxing the upper part. The breathing exercise programme that was followed was on the lines advocated by Jocelyn Reed^o of Brompton Chest Hospital, London. Breathing exercises not only helped in preserving the pulmonary functions but also helped in the prevention of post-operative complications. After thoracoplasty the lower lobe is the only part of the lung functioning on that side and proper breathing exercises assist the patient in maintaining this function. Physiotherapy and exercises of the muscles of the shoulder and the back were employed to prevent scoliosis and deformity of the shoulder. These are important procedures in preserving pulmonary function and in maintaining the working capacity of an individual.

Summary

In pulmonary tuberculosis, where irreversible collapse measures are planned, it is important to know the pre-operative ventilatory capacity of a patient so that the anticipated effect of operation on the pulmonary functions can be given a forethought in

deciding the advisability of the operation, and its extent. Screening of cases rather than complete evaluation was the aim of these investigations. Although the number of cases investigated is small, yet we feel that these tests should form an integral part of the investigations in thoracic surgery. No attempt has been made to evaluate the effects of different types of collapse therapy. By proper physiotherapy and breathing exercises it is possible to train the patient to make the best use of the available pulmonary functioning tissue after the operation.

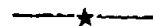
Acknowledgement

We are grateful to the Dean, Medical College and Hospital, Nagpur for granting permission to use the hospital records of these cases. To Drs. S. S. Khandare and R. D. Shukla of the Physiology Department, Medical College, Nagpur our thanks are due for the help they rendered in carrying out these investigations in their laboratory. We are indebted to Dr. S. S. Mujumdar, in-charge Anti-Tuberculosis Centre, Medical College, Nagpur for the co-operation given during the management of these cases.

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THE SIGNIFICANCE OF THE RADIOLOGICAL SIGNS IN THE TREATMENT OF PSOAS ABSCESES

BY

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Tuberculous processes in the vertebral column are generally accompanied by abscesses. The recognition of the abscess and the determination of its size influence the treatment of the patient. If the lumbar column and, because of the origin of the psoas muscle-fibres, the D XI-XII vertebrae are attacked by tuberculosis, one may frequently notice abscesses in connection with the psoas muscle.

The abscess is generally called a "psoas abscess". Yet the terminology is not exact as the pus remains only for a certain time between the fibres of the psoas muscle. Because of the small resistance it may gravitate towards the thigh and sometimes it happens that the abscess, spreading backwards, appears above the region of the gluteal muscle. In some cases we have observed—and others have also referred to it—that the pus may burst into the free cavity of the abdomen, causing severe abdominal symptoms, even death.

Because of the anatomical conditions, the pus does not closely surround the vertebral column and thus, the radiological demonstration of the abscess is difficult. Many do not attribute much importance to the roentgenograms, as 'palpability' conditions in the abdomen are favourable. Doubtless, palpation is the oldest and most common method of examination to diagnose an abdominal abscess. In the past years, however, we have extirpated many lumbar abscesses and vertebral lesions and during the operations we have noticed that the

palpation findings are not always reliable. Mostly only those abscesses are palpable, which extend below the Crista iliaca line, furthermore, pain, adiposity and swollen intestines make palpability difficult. As long as the treatment of the psoas abscess consisted of puncture and incision of the abscess pointing towards the surface, early recognition perceptibility had no significance. Nowadays, however, it is a necessity. In accordance with the present therapeutic conception it is not sufficient if the abscess is diagnosed only when its volume is significant or when it is about to burst. The calcified abscesses, frequently seen in children, situated high and of the size of a small apple or egg, are not always palpable and only the roentgenograms make them visible. Since the extirpation of the lumbar vertebral lesion has become frequent, the early recognition of the abscess has an important influence on the intervention.

Therefore we found it necessary to re-examine from the point of view of radiology, those patients in whom during the operation we had made certain of the presence of an abscess in the psoas area and to look for such manifestations, which give indications of the abscess in the psoas and its therapy.

The radiological changes in the psoas muscle are not only in connection with tuberculous spondylitis. According to *Wichl* the causes of the enlargement of this muscle or of the disappearance to its contours are, frequently, the abscesses of the muscle itself,

haematoma due to a fracture in the vertebrae or in their transverse processes, perforation of paranephritic abscesses into the psoas muscle-fibres or perforation of abscesses from the appendix region (Fig. 1-2); rarely:

the help of the roentgenograms, as the lower parts are well palpable. On the roentgenograms, made with adequate technique and in adequately large size, the muscle-borders can be seen clearly.

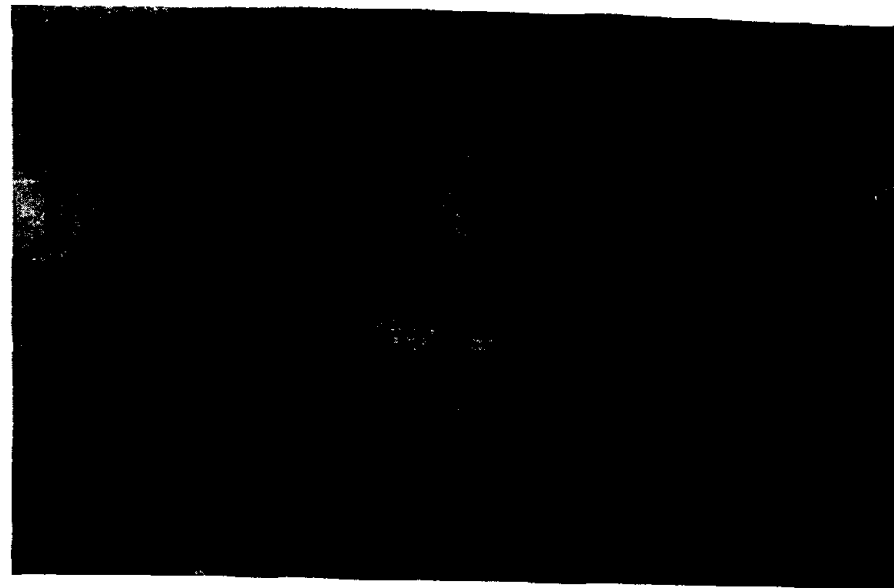


Fig. 1-2.

34 years old man; the psoas muscle on the right side—in the region marked with the → is most likely enlarged, though because of gas-formation it is impossible to define the muscle-border. At operation the bursting of a periappendicular abscess towards the psoas muscle, was proved. Several weeks after the operation the muscle-contours are normal.

primary tumours, lymphogranulomatosis, myeloma, sarcoma. Brocher, however, believes that alterations of the psoas shadows are a consequence of tuberculous spondylitis. Malluche draws attention to the fact, that enlargement or disappearance of the muscle-shadow may occur also after major abdominal or kidney operations.

For the roentgenological examination only the suprapelvic part of the psoas contour is accessible. Actually only here lies the significance of the diagnosis, made with

For the radiologist the most important question is: what is the normal breadth of the psoas muscle, as the judgement of the protuberance decides the presence of the abscess. Brocher says, that if we extend in a cranial direction the line of the ilio-sacral synchondrosis, the border of the psoas muscle should not exceed the crista by more than 2-3 centimetres. If this occurs, one has to consider it as a suspicious circumstance and further examination is necessary. The presence of an abscess is also probable if the muscle-border shows somewhere a

protuberance. Sometimes it is a very difficult task to judge the muscle-borders. If the patient is very corpulent, the gas-formation is great (it occurs very frequently in patients with tuberculous spondylitis, lying in bed) the interpretation of the roentgenograms is very difficult. To eliminate the difficulties Pitzen advises a special lying position. In such cases we had very good results with tomograms. Among the methods to demonstrate the abscess there is the air-filling of the retroperitoneal area, the pneumoperitoneum.

We examined 30 patients, who later underwent retroperitoneal exploration and at the operation also we found the abscesses. There were 40—500 cub. centimetres of pus, or calcified, caseous debris. We made retroperitoneal exploration on both sides in 5 and on one side in 25 patients, the total number of operations being 35.

We have referred above to the fact that the palpation findings may bring some surprises. There were observed to be negative in 11 cases out of 30; all patients were examined thoroughly, in some cases under narcosis. At operations in all these 11 patients we found abscesses—on both sides in 4 cases and in 7 instances on one side. If we consider that there were many among these patients who had calcified abscesses of the size of an egg or smaller in the region of LI & LII it is more comprehensible why the palpability failed us so many times.

In 6 cases the preoperative roentgenograms showed abscesses on both sides and in 18 cases on one side. It was negative in 4 cases and because of gaseous intestine-shadow it was not possible to judge in 2 cases. As we mentioned before, during the operation we found in every patient an abscess and thus it is evident—and we wish to emphasize this—that the roentgenogram is not always a sure diagnostic method. In

most of our cases we assume the presence of the abscess on the basis of muscle—enlargement and sometimes because of the disappearance of the muscle-border.

Out of the 30 cases we found in 6 an abscess filled with calcified debris. All but one patient were 4—11 years old children and the only 31 years old patient had the first symptoms when he was 14 years old. We should like to point out once more, that such abscesses filled with calcified debris give the radiologist the opportunity to define the duration of the process also, because, as our experience till now shows, the on set of the process presents itself without exception in or during childhood. (Fig. 3-4).

In most cases it is the radiologist who discovers the abscess filled with calcified debris, as because of their small size, there are no palpation findings. Many consider such abscesses—because of their calcified fillings—as characteristic of a quiescent process. Our opinion is that these lesions are dangerous and the best proof for that is that in 3 cases out of 6: Koch-bacilli were demonstrated, in 5 cases histologically proved tuberculosis. Tuberculosis could not be proved only in one case, as the examined material was muscle-fibre. The patients who had abscesses with calcified, debris, were grouped separately to prove that the radiologist has no right to speak about the process being quiescent or benevolent if there are calcified debris present.

Among the other 24 patients the culture was positive in 19 cases and the histological examination proved tuberculosis in 23 cases.

We are of the opinion that our results justify the necessity of endeavouring to make possible the healing of the psoas abscess as early as possible with all means, particularly with the help of radiological means.



Fig. 3-4.

9 years old girl; with negative palpation finding, a calcified abscess of the size of a small apple is to be seen at the right side of L II—III. After extirpating the abscess and the lesion a drain-catheter is introduced into the lesion. Culture: Koch pos.; histologically: tuberculosis.



Fig. 5-6.

35 years old man, the psoas-shadow on the right side is considerably protuberant. On the left side it is partly protuberant and partly—in the lower section—disappeared. After extirpating the psoas abscess the psoas contours are normal. Histologically: tuberculosis.

Furthermore it was interesting to observe the behaviour of the psoas contour after the operation in such cases where on the basis of the preoperative roentgenograms abscess was to be suspected. This could be followed only in 15 patients, as in the others the lack of time or technical motives made an objective judgement impossible. The psoas shadow became normal in 11 cases and remained unaltered in 4 cases (Fig. 5-6). In some cases where the psoas contour remained unaltered, we tried puncture, but without result. Therefore the cause of the convexity was not pus, but organising haematoma or cicatrix.

Thus, we may conclude that roentgenograms, made with adequate technique, give, if not infallible, at least valuable help in

recognising the unpalpable psoas abscess. This help is indispensable for the physician who works with modern therapeutic means.

Conclusions

Re-examining the roentgenograms of 30 cases, where the operation proved the presence of psoas-abscess, the writers point out that the roentgenograms give valuable information just in that period, when the palpation findings are negative or doubtful. They emphasise the dangerous nature of the abscesses filled with calcified, caseous debris, which occur in childhood and in the adult age. In the recognition of these, the roentgenograms have a leading role. Finally they describe the postoperative behaviour of the psoas contour.

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SEGMENTAL GIANT HYDRONEPHROSIS IN A PYELON DUPLEX*

BY

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Giant hydronephrosis is relatively uncommon and represents only about 3% of all the reported cases of hydronephrosis (Smart¹). By definition any hydronephrosis containing 1000 cc. or more of fluid has been generally considered a giant hydronephrosis.

Giant hydronephrosis occurring in one portion of a *pyelon duplex* seems to be rarer still and this case appears to be the first in recent available literature.

Case Report

Sri. S. Male, aged 47 years, robust and athletic in appearance was admitted on 17—1—57 complaining of a distension of the upper abdomen. He stated that this distension which was first noticed by him nearly six months ago, had progressively increased in size. Apart from a mild degree of discomfort, he had no pain at any time. Though he was easily fatigued on physical exertion, his appetite, his bowels and his micturition were all normal.

On examination there was a marked, uniform fullness of the upper abdomen. The fullness appeared to be more on the right side, and the right loin was full. The left loin was normal. Palpation revealed a large, cystic intra-abdominal spherical mass occupying the entire right half of the abdomen, except a small portion of the iliac region. The mass was crossing the mid-line and occupying varying portions of the left hypochondriac and lumbar regions. Its surface was smooth and the borders were definite. There was no movement on respiration. It was dull on percussion, and the dullness was continuous with the liver dullness. The rest of the abdomen and the genitals were normal. His urine, faeces, and blood were normal.

Intra-venous pyelogram revealed

(i) A normally functioning and normally situated left kidney, with an incomplete double ureter and double pelvis (Fig. 1). The lower segment of this double pelvis and the corresponding ureter was smaller than the upper pelvis and ureter. The double ureters appeared to fuse at the level of the sacro-iliac joint.

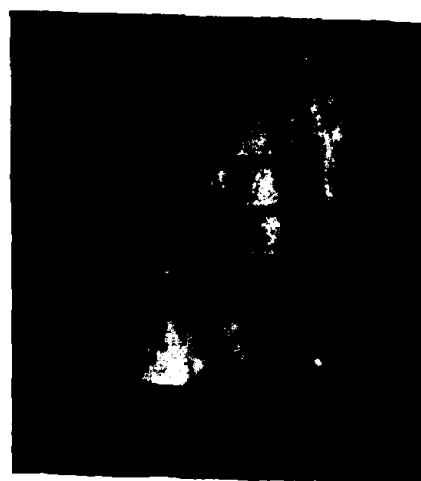


Fig. 1

Intravenous pyelogram (7 mins. after)
Shows the bifid ureter and bifid pelvis (Lt.).

Note that the upper segment is longer and bigger than the lower one.

(ii) The right kidney was slightly hydronephrotic. It was displaced well towards the left and upwards (Fig. 2) and (as seen in the lateral view) it was also displaced forwards (Fig. 3).

Barium Meal series.—A faint shadow of the mass was seen occupying the right half of the abdomen. The

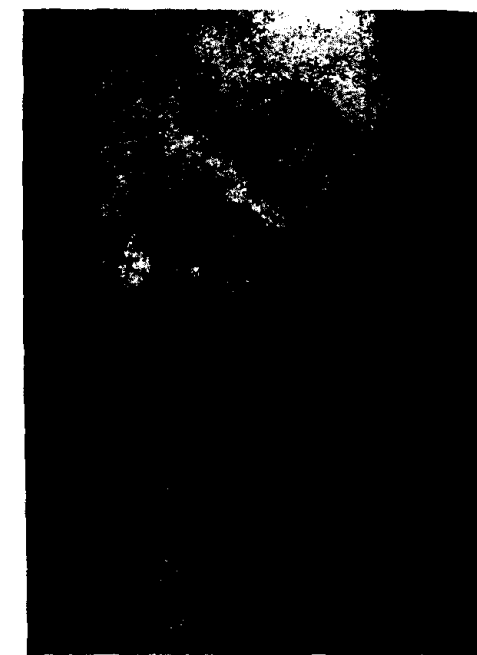


Fig. 2 & 3

Antero-posterior and lateral views (I.V. pyelogram) to show the displacement of the moderately hydronephrotic "right" kidney to the left and anteriorly (Fig. 3).



Fig. 4 & 5

Barium Meal pictures to demonstrate the displacement of the stomach, duodenum, small intestines (Fig. 4) and the ascending colon, hepatic flexure and transverse colon (Fig. 5).

*From a Surgical Unit, Government General Hospital, Madras.

stomach, the duodenum and the small intestines were seen to be occupying a small portion of the left half of the abdomen. (Fig. 4). The ascending colon, the hepatic flexure and the greater portion of the transverse colon were seen to be displaced downwards (Fig. 5), and towards the left, and also forwards. The appearances were suggestive of a retro-peritoneal mass.

A roentgenogram of the chest revealed an elevated right dome of the diaphragm (Fig. 6).

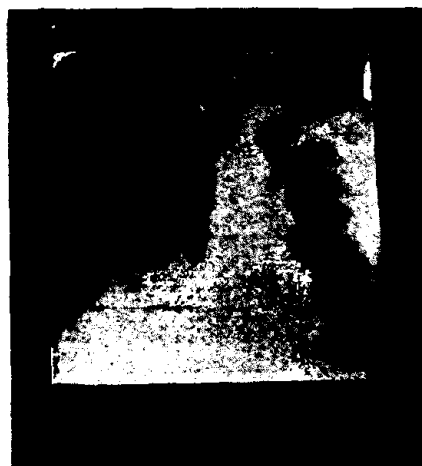


Fig. 6

Roentgenogram of the chest to show the upward enlargement of the right dome of the diaphragm.

A provisional diagnosis of a retro-peritoneal cyst was made. In view of the bifid pelvis and ureter on the left side the possibility of a hydronephrosis in one portion of a similar right kidney was briefly discussed, but was never seriously entertained.

Treatment.—On 22-1-57 under endotracheal anaesthesia using a right paramedian incision, the peritoneal cavity was opened into. A portion of a large retro-peritoneal cystic mass was seen; with adequate precautions to prevent soiling of the peritoneal cavity, the greater portion of the contents of this cyst was suctioned off. More detailed examination, which was then possible, revealed the cyst to be a hydronephrosis, arising from the lower portion of the right kidney. A transperitoneal nephrectomy of the entire right kidney was then carried out.

The incisions were closed as usual.

Post-operatively, the patient had an uneventful recovery.



Fig. 7

The nephrectomy specimen. The two ureters, the small solid upper renal segment and the baggy lower segment (very much smaller in size due to aspiration) are well seen.

Operative specimen showed a kidney with double pelvis and double ureter (Fig. 7). The portion of the kidney and the corresponding pelvis drained by the lower ureter was grossly hydronephrotic, containing a little over 7500 cc. of slightly brownish fluid. The details of calyces etc. could not be made out in this sac. The upper portion of this kidney appeared to be slightly hydronephrotic. A roentgenogram taken after distending this renal pelvis with sodium iodide solution revealed at least two major calyces and several minor calyces; there was no communication with the hydronephrotic sac (Fig. 8).

In view of the roentgenological findings of the left kidney and in view of the number of the major and minor calyces from the upper segment of the nephrectomy specimen, the hydronephrosis appears to have originated in the lower, smaller portion of a duplicated right kidney.

Discussion

Double formation of the pelvis of the kidneys and the ureters is the most common form of malformation of the upper urinary tract. In describing



Fig. 8

An x-ray of the same specimen (as in Fig. 7) the calyces of the upper segment filled with an aqueous sodium iodide solution.

these duplications, Higgins³ has used the term "pyelon", meaning a receiving vessel, to embrace all the derivatives of the embryological ureteric bed. "Pyelon simplex" describes the normal condition of the upper urinary tract, while "Pyelon duplex" will cover all forms of duplications.

Usually, in these cases of double pelvis, the lower pelvis is the larger in size and more normal in shape. The upper pelvis is small and consists of little more than two minor calyces. Occasional variants of this characteristic pattern are seen—the two pelvis may be equal in size and similar in shape or very rarely, the upper one may predominate (Higgins³ Lowsley-et-al⁴).

These two pelvis may be drained by a single normal ureter; or the two pelvis may have two distinct ureters opening

independently into the bladder (complete duplication) or the two ureters draining the two pelvis may unite at some point before reaching the bladder, so that they open through a common orifice on the trigone (incomplete duplication).

The complete and incomplete duplication may be unilateral or bilateral, or there may be complete duplication on one side and incomplete on the other.

Incidence of Pyelon duplex.—Though this type of abnormality is the commonest anomaly of the upper urinary tract, its overall incidence is not high. Campbell² found 301 instances of ureteral duplication in 47,483 autopsies, an incidence of 1:157. In a series of 4,215 autopsies, Lowsley-et-al⁴ found ureteral duplication in 18 cases—an incidence of 1 in 234. *Bilateral duplications* were rarer than unilateral duplications.

In a survey of 4774 urographs, Nordmark⁶ found 138 cases of double formation of renal pelvis and ureter, an incidence of 2.8%. In these cases, bilateral, complete and incomplete divisions of the ureter were rarer than unilateral completely and incompletely divided ureters.

Complications.—Many patients with these congenital abnormalities remain completely asymptomatic. However, complications such as infection, hydronephrosis and calculus formation are considerably more prone to occur in these abnormal organs.

According to Campbell², the occurrence of clinical hydronephrosis is approximately twenty times that found in normally formed kidneys.

Lowsley and Kirwin⁵, Campbell² and Higgins³ all state that the *upper* (usually

ill-developed) portion is more often the seat of disease than the lower well-developed portion.

The increased incidence of complications is the result of stasis in one or the other segment of the duplicated pelvis and ureter. The exact mechanism of this stasis is not well-understood as yet. Some, like Higgins, blame the defective musculature of the abnormally derived ureters. However, Benjamin¹ has demonstrated the presence of fascial bands and he has reported cases of hydronephrosis with infection that have improved after removal of these fascial bands.

Comments

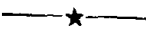
(i) The case herein reported was rather unusual in having bilateral incomplete duplication of the pelvis and ureter, with the lower renal segments being smaller than the upper ones, on both sides.

(ii) The lower segment on the right side had become grossly enlarged into a hydronephrotic sac, containing 7500 c.c. of fluid; the upper better developed portion of the same kidney though displaced forwards and towards the left, was only slightly hydronephrotic.

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A CASE OF GASTRIC CARCINOMA IN A YOUNG ADULT

BY

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Ninty five percent of gastric carcinomas occur between 45 and 69 years of age¹. The highest incidence at the Mayo Clinic was between 40 and 60² and in Paynes's London series between 65 and 70³. Card⁴ states the occurrence is in age groups over 45 while the commonest age incidence mentioned in the latest edition of the Price's Textbook of Medicine⁵ is 45 and 65. Palmer⁶ says that gastric cancer is almost unknown in the first decade of life, rare in the second, uncommon in the third decade and common indeed thereafter from the age of 35 on. Anderson in his textbook of Pathology as quoted by Imgriglia and Lopusiviak has stated that he has seen carcinoma of the stomach in an eighteen year old boy. The latter authors have noted a gastric carcinoma with metastasis in a 24 year old college athlete⁷.

The patient K. S., a male, who stated his age to be eighteen years, was admitted to the East Medical Ward of the V. J. Hospital on the 14th March, 1957. His complaints at the time of admission were generalised weakness of some years, pain upper abdomen 1½ years, loss of appetite one year and vomiting off and on duration one year. The pain was described as dull and continuous in the epigastrium and was neither relieved nor aggravated by food or any other factor. For the last six months the pain had become more severe and every two to four days he would get an attack of severe pain with a moving ball of wind in the abdomen and one or two vomits. He vomitted blood twice, 2 months and 1½ months prior to the date of admission.

The patient admitted to some loss of weight but he had not kept any record. There was no previous history of dyspepsia or epigastric pain. The past history was essentially negative. The economic status and the diet of the patient had been poor.

On examination the patient was thin and pale. There was no edema, glossitis, calf tenderness or deficiency pattern in the skin. There were no telengectasis or jaundice. There was no lymphadenopathy, hepato or splenomegaly. There was no ascites. A firm mass two by three inches in size was felt in the epigastric region. It was intra-abdominal, irregular and mobile.

Investigations

Haemoglobin 12 G./100 cc.
Total leucocyte count 6600/c. mm.
Differential leucocyte count 70 Polys/25 Lymyhos/1 Mono/4 Eosinos, per cent.
Erythrocyte sedimentation rate 10 mm. 1st hour Westergren.
Stool examination N. A. D.
Urine examination N. A. D.
Fasting gastric contents 10 cc; Bile and Starch nil.

Fractional Test Meal

Sample No.	Free acidity	Total acidity in terms of cc of N/10 NaoH to neutralise 100 cc of gastric contents
Fasting	0	15
1	0	18
2	0	17
3	0	28
4	0	16
5	0	19
6	0	31

Barium study of the stomach showed irregular filling due to multiple filling defects (Fig No. 1)? Gastric Carcinoma? Simple tumor.



Fig. 1

Barium Meal showing irregular filling defect in the Stomach.

The differential diagnosis at this stage thus rested between malignant and simple tumor of the stomach. Benign tumors of the stomach and duodenum are generally considered to be comparatively rare lesions. Only 13 cases were reported in 300,000 admissions to the Jefferson Hospital, Philadelphia, and only 17 in 25,000 admissions to the Cleveland Clinic. However it has been repeatedly pointed out by several authors that the actual incidence is probably considerably higher than the clinically observed incidence. The relative proportion of benign and malignant tumours that make up the neoplasms of the stomach and duodenum which have come under clinical observation in several reported series is approximately 1:50 (i.e. 2%). On the other hand gastric carcinoma, as stated earlier, occurs at a much later age while benign gastric tumours often occur in young individuals.

The weight loss which was never recorded and the normal E. S. R. were unhelpful. The absence of free acid in the gastric juice is a well known observation in some cases of cancer of the stomach, but in the majority of gastric adenomas also histamine achlorhydria exists and pernicious anaemia is not uncommonly associated with achlorhydria. The diagnosis of carcinoma appeared more probable because of the greater frequency of malignant tumours as compared to simple ones in the stomach.

The patient was transferred to the East Surgical Ward on 1-4-57. He was operated on by one of us (S. S. Anand) on 16-4-57. The abdomen was opened through a left para-median incision and the diagnosis of gastric carcinoma was confirmed. Subtotal gastrectomy was performed by Hofmeister's technique. The specimen is shown in Fig 2. Enlarged lymph nodes were present in the greater curvature and in the subpyloric region, and were resected. The patient was discharged on 3-5-57 after an uneventful convalescence.

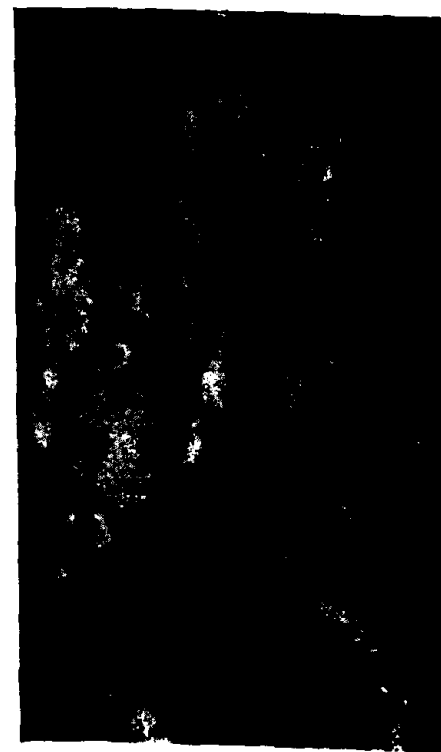


Fig. 2

Photograph of the specimen removed at Operation.



Fig. 3



Fig. 4

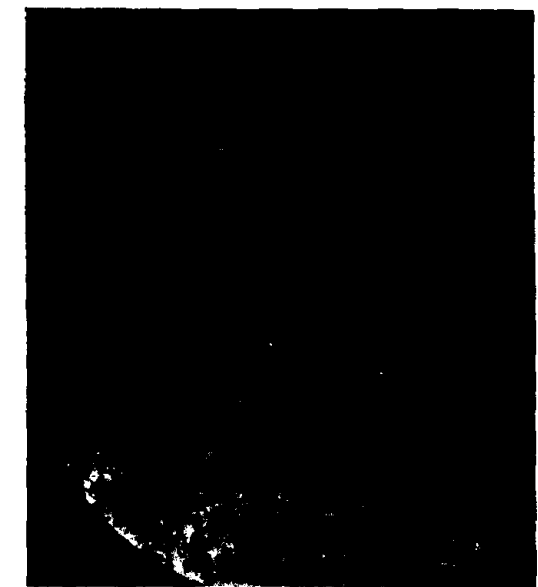


Fig. 5

Figs. 3, 4 & 5 Microphotographs showing the histological picture.

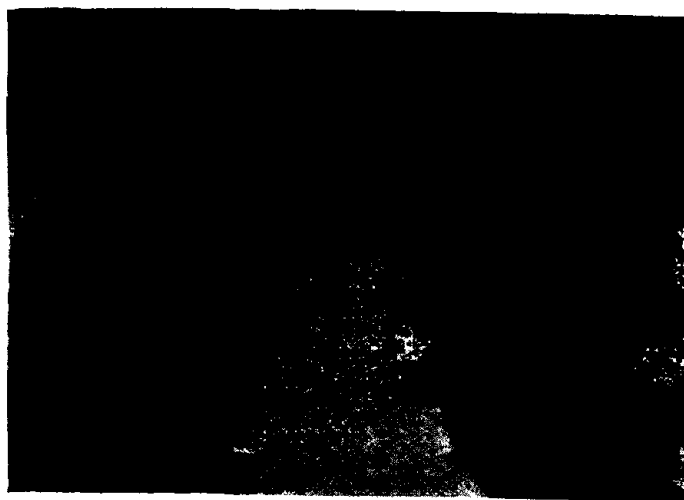


Fig. 6

X-Ray showing epiphysis of sternal end of Rt. clavicle not fused.

The pathological report was:—"Microscopic examination shows large sheets of cells, round or ovoid, with slight amount of cytoplasm; the nuclei are large and vesicular. Groups of cells are separated by thin bands of fibrous tissue and at places there is an attempt at acinous formation. Diagnosis: Carcinoma stomach" (Fig. 3, 4 & 5). Examination of a lymph node from the greater curvature revealed metastasis (Plate 4). Examination of the supra and infra duodenal glands was negative for secondaries.

Now that the diagnosis of cancer of the stomach had been proved, it remained to establish the age of the patient. The x-ray picture of the medial part of the clavicle taken in September 1957, shows the presence of the epiphyses of its sternal end which has not yet fused with the body of the clavicle (Fig. No. 6). According to Galstaun⁹ this epiphyses appears in Bengali males at 15-19 years and fusion occurs at the age of 22. Jit and Singh (1957) working

in the Anatomy Department of the Medical College, Amritsar, have found that this epiphysis appears at 17 years and fuses with the body of the clavicle at 22 years¹⁰. Thus the age of our patient is below 22 years, and since the symptoms started two years ago, the age of the patient at the time of onset of gastric carcinoma was probably less than 20 years.

Follow-up.—With the exception of mild epigastric discomfort, the patient is doing well till the time of writing this report (October, 1957).

Acknowledgements

We are thankful to Dr. N. L. Chitkara, Professor of Pathology, Medical College, for the histopathological report, and Dr. M. L. Aggarwal, Associate Professor of Radiology, for radiological studies.

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A CASE OF GIANT FOLLICULAR LYMPHOMA IN A GIRL AGED SEVEN YEARS

(A Case Report)

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Among the tumours of the lymphoid tissue, Giant Follicular Lymphoma is considered as a relatively benign condition. The growth is slow and not a few tumours of this kind have been cured by simple enucleation or irradiation. Most pathologists however, feel that it is a potentially malignant condition, in the sense that it frequently develops into some other fatal form of malignant lymphoma—a sarcomatous growth or leukaemia (Jackson and Parker², and Willis⁴). Early diagnosis of this condition, therefore, is important.

This tumour has been usually found to be in middle aged or old persons. Wright¹ in a series of 136 cases found an average age of 52.8 years, the earliest case seen was in a person aged 25 years. Jackson and Parker² have reported the average age group as 50-59 years and the minimum age in their series of 39 cases was 21 years. Gall and Mallory³ and Lumb⁵ have reported cases occurring in the age group of 10-20 years but have not mentioned the minimum age. The following table summarises the common age group and the minimum age incidence of giant follicular lymphoma, as reported by the above mentioned authors.

Author	Year	No. of cases	Common Age group	Minimum Age
Wright	1956	136	50-59	25
Lumb	1954	29	50-60	10-20
Jackson & Parker	1947	39	50-59	21
Gall & Mallory	1942	38	50	Below 20 One case

It is apparent that giant follicular lymphoma is extremely rare below the age of 20 years. None of these writers have reported a case in the age group less than 10 years. In the recent literature also no case has been reported in this age group. The case reported here is of importance and significance as the tumour was seen in a child aged seven years.

Case No. S. 56-3024. (R.P.) A girl aged seven years was seen in the outpatient department of Medical College Hospital, Nagpur on 14-10-56 with the complaint of bilateral cervical lymphadenitis of two months duration. The axillary and inguinal group of glands were not palpable. Screening of the chest did not show any evidence of enlarged mediastinal glands. Total leucocytic count was 14,200 per cmm. with a differential leucocyte count showing Polymorphs 26 percent, Lymphocytes 65 percent, and eosinophils 9 percent. There was no evidence of infection in the oral cavity. A clinical diagnosis of tubercular lymphadenitis was made and a gland from the posterior triangle of neck was removed for biopsy.

The gland measured 1.5 × 1 × 1 cms. in size and was of rubbery consistency. The cut surface showed a uniform pale appearance with small pinpoint follicles distributed uniformly (Fig. 1).

Histological examination showed that the capsule was thickened. The whole gland was studded with large, closely packed rounded follicles with a discrete outline and

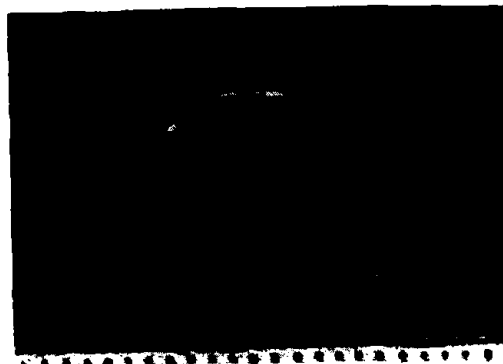


Fig. 1.

Cut surface of the lymphnode showing circumscribed follicles distributed uniformly. (X 4).

a peripheral rim of mature lymphocytes. At places the follicles tend to split away from the surrounding rim of lymphocytes (Fig. 2).



Fig. 2.

Showing closely packed large follicles with tendency to split away at the margins. Note the absence of sinus reticulosis. (X 130).

The cellular structure of the follicles disclosed larger cells with pale cytoplasm and a vesicular nuclei (Fig. 3). In the reticulin preparation the reticulin fibres were compressed around the follicles (Fig. 4)



Fig. 3.

Higher magnification of an area from Fig. 2. Showing uniformity of the cells in the follicles, absence of phagocytosis and sinus reticulosis. (X 250).

Comment

In this case there were no general signs or symptoms. Such cases have been described by Lumb¹, Jackson and Parker² and Wright³. The criteria of diagnosis are mainly histological in the absence of any blood or bonemarrow changes. The histological picture of giant follicular lymphoma bears a close resemblance to the follicular hyperplasia in glands draining an area of infection. This differentiation is of



Fig. 4.

Showing condensation of the reticulin around the follicles. Laidlaw's reticulin stain. (X 130).

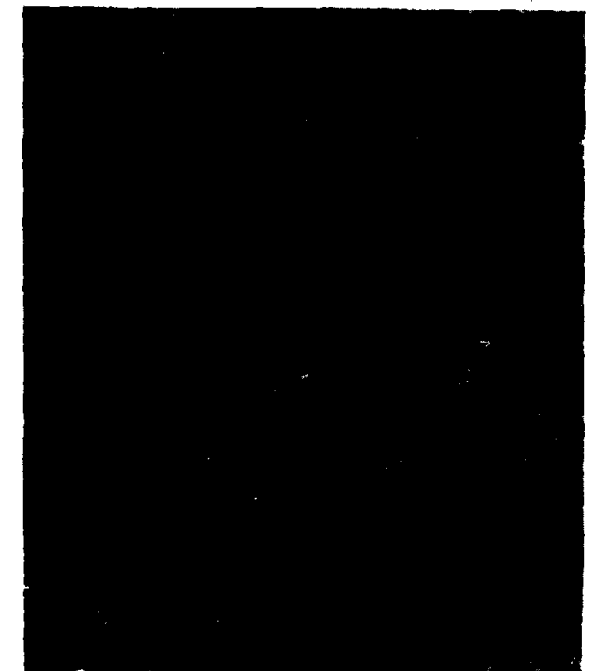


Fig. 5.

Showing a large follicle in a gland draining an area of infection. Note the presence of sinus reticulosis at X. (X 180).

importance particularly in children. It can be differentiated from follicular hyperplasia (Fig. 5) on the following grounds.

1. The follicles are large and closely packed, replacing the entire gland structure.
2. Paucity of mitosis in the germinal centres.
3. Absence of sinus reticulosis usually associated with follicular hyperplasia.

4. Absence of macrophages and phagocytosis in the germinal centres.

Summary

A case of giant follicular lymphoma occurring in a girl aged seven years has been described. The histological features of this entity and its differentiation from follicular hyperplasia of a reactive lymphnode have been briefly discussed.

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METASTASES IN CARCINOMA OF THE THYROID

(Report of unusual cases)

BY

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Spread to distant parts of the body is a biological property of cancer. Metastases at unusual sites, especially when solitary and symptomatically active, may create problems in clinical diagnosis. With a small, asymptomatic primary, such metastatic tumours are often mistaken for primary neoplasms and treated as such. Carcinomas of the bronchus, thyroid, kidney and breast are perhaps most notorious for creating such situations. This communication is a report of 3 cases of carcinoma of the thyroid in which the metastatic growths were mistaken for the primary neoplasms and radically treated.

Case Reports

Case 1.—A Hindu woman aged 50 (no. U. 1171) was admitted to the Tata Memorial Hospital, Bombay,

on February 20, 1958, for a swelling of the left lower jaw. The duration was 3 months. The swelling had increased gradually in size and was painless. The clinical diagnosis lay between a benign giant cell tumour, bone cysts and an adamantinoma. Hemimandibulectomy was carried out.

Roentgenologic findings.—There was a multicystic, translucent defect in the ramus of the mandible. (Fig. 1). The bony margin was broken through and the tumour had extended into the soft tissues. A diagnosis of malignant adamantinoma was made by the radiologist on these findings. On screening the chest was normal.

Gross Findings.—The specimen was of half the mandible and showed a circumscribed, hemispherical growth measuring 5.5 cm. in its long axis. The cut section showed a variegated appearance: greyish fleshy areas were seen interspersed with areas pinkish in color (Fig. 2).

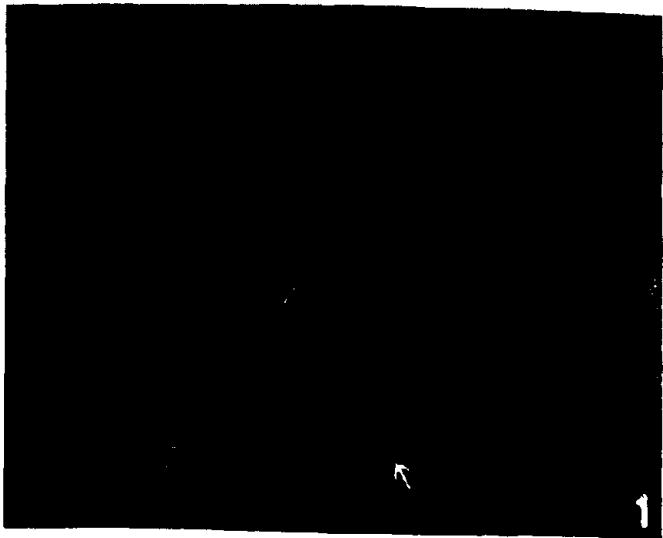


Fig. 1

Roentgenogram showing defect in the ramus of the mandible. (Indicated by arrows).

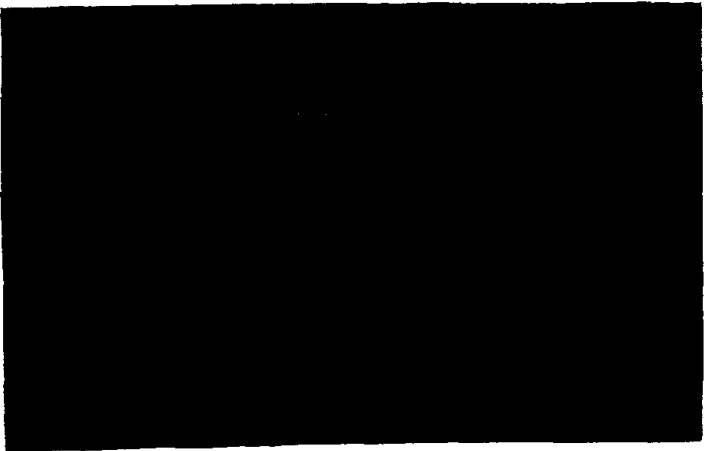


Fig. 2

Surgical specimen of half of the mandible showing circumscribed, hemispherical growth. Metastases secondary to carcinoma of the thyroid gland.

Microscopical Findings.—These were typical of a well differentiated carcinoma of the thyroid. The tumour was characterised by acini of varying sizes, some containing acidophilic colloid material. The cells lining the acini were cuboidal and their nuclei were hyperchromatic and showed variability in size. (Fig. 3).

Comment.—Obviously this was a metastatic carcinoma of the thyroid in the mandible. The true nature of the lesion was however recognised only after histological examination of the specimen. A small hard nodule was detected in the thyroid gland subsequently. Unfortunately the patient left the hospital against medical advice.



Fig. 3

Photomicrograph of the metastatic tumour in the mandible showing a well differentiated adenocarcinoma of the thyroid (H & Estain X 230).

References are available in the literature to similar instances where metastases in a bone from a thyroid carcinoma have been treated as primary bone tumours. Metastatic carcinoma of the jaw is not common. When it occurs it is in the molar areas of the mandible because this region contains red-marrow. According to Willis⁸ the red marrow is the most frequent site for bone metastases.

Case 2.—A Parsee woman aged 84 (no. 1522. U) complained of a lump on the right side of the abdomen of 3 years' duration. The lump had gradually increased in size and was painless. She also complained of hematuria. A firm nodule was felt in the thyroid but it was not producing pressure effects. Intravenous pyelography revealed a non-functioning kidney on the right side. Nephrectomy was carried out. On the 10th day of the operation, the patient developed obstruction in the small intestine. She was opened up again and died 3 days later. There was no autopsy.

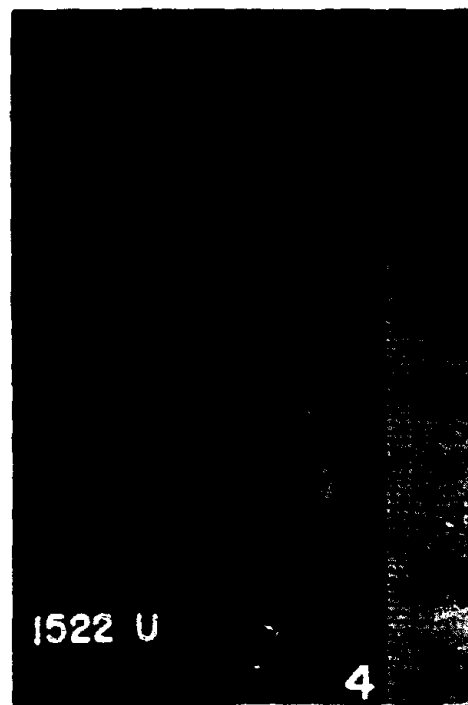


Fig. 4

Surgical specimen of kidney showing a well circumscribed tumour mass with a variegated appearance. Kidney is a rare site for carcinoma of the thyroid to metastasize.

Gross Findings.—The specimen of the kidney showed on cut section a well circumscribed tumour-mass, measuring 10 cm. in the long axis. The mass had almost completely replaced the renal tissue, which could be made out only at the upper pole. It showed a variegated appearance. Scattered areas of haemorrhage and necrosis were seen in the tumour (Fig. 4).

Microscopical Findings.—The tumour was characterised by papillary finger-like processes around central fibrovascular cores of connective tissue. (Fig. 5). The tumour cells were polygonal and had acidophilic cytoplasm. The nuclei were round or ovoid, hyperchromatic and showed variability in size. Scattered within the papillary masses were acini containing acidophilic colloid material.

Comment.—The interesting feature of the case is that a renal metastasis of thyroid carcinoma was treated radically on the assumption that it was a primary tumour. Although clinically a nodule was felt in the thyroid it was not suspected to be cancerous. Kelly¹ in 1897 reported a similar case in which a clinical diagnosis of a primary renal tumour was made and nephrectomy performed; necropsy however revealed a primary carcinoma of the thyroid. Willis⁸ has given autopsy findings of cases of thyroid carcinoma with metastatic spread to the kidney.

Case 3.—A Muslim woman aged 50 (No. U. 3834) was admitted to the Hospital, in June 16, 1958, for a lump in the left breast of 3 years' duration. According to the patient the lump had been increasing in size for the last 2 months. Ultimately it ulcerated and chocolate coloured-fluid exuded from the wound. On clinical examination a hard irregular mass was felt in the breast. It was located in the lower, outer quadrant and was partly felt in the central portion of the breast also. There was an excavated ulcer in the region of the areola. The lump was fixed to the deeper structures. The left axillary nodes were hard. Simple mastectomy was carried out.

Gross Findings.—The specimen was of simple mastectomy and was covered an elliptical skin flap measuring 19 × 16 cm. The cut surface showed cysts of varying sizes separated by greyish opaque areas. Many of the cysts seemed to contain gelatinous material (Fig. 6).

Microscopical Findings.—The tumour showed acini of varying sizes and shapes and papillary processes around a fibrovascular core of connective tissue. The nuclei were ovoid in shape and showed a variability

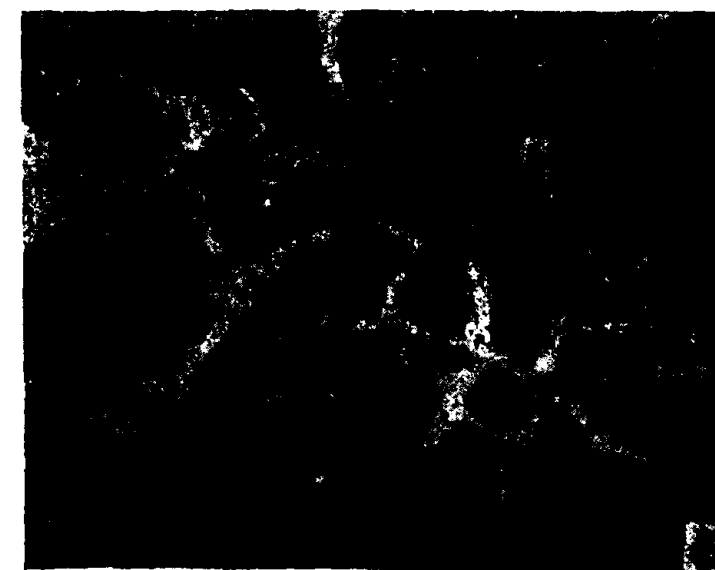


Fig. 5

Photomicrograph of section through specimen Fig. 4, showing structure of papillary adenocarcinoma. Some of the acini contained colloid material. (H & E stain X 230).

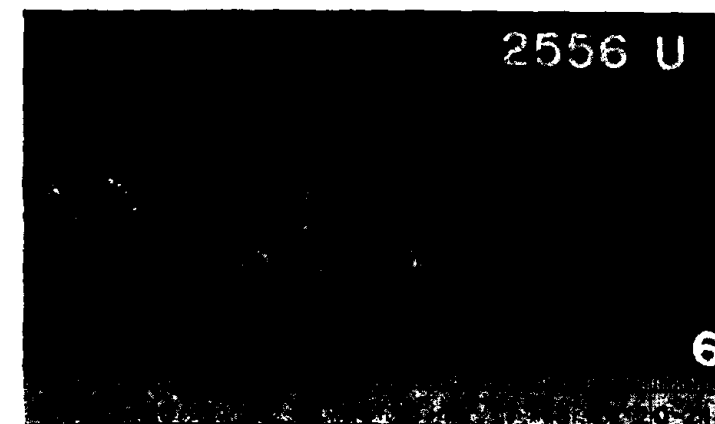


Fig. 6

Surgical specimen of simple mastectomy. The tumour beneath the skin shows cystic spaces filled with colloid material. Surrounding these are opaque areas of cancer. Breast is an extremely unusual site for carcinoma of the thyroid to metastasize.

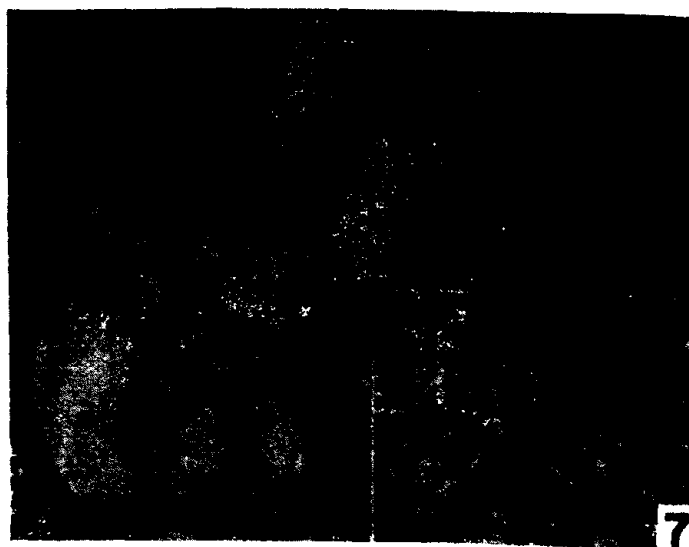


Fig. 7

Photomicrograph showing acinar areas of carcinoma. The portion in the inset shows papillary areas. (H & E stain X 120 and 105).

in size. (Fig. 7). The surrounding connective tissue showed areas of old haemorrhage, cholesterol crystals, mononuclear inflammatory cells and foreign body giant cells.

Comment.—This is an example of carcinoma of the thyroid metastasizing in the breast. The nature of the lesion was recognized after the histological examination. A re-examination of the patient disclosed a hard nodule in the thyroid gland. Wells² in 1919 reported a case of carcinoma of the thyroid with bilateral metastases in the breast. An extensive survey of recent literature failed to show a similar occurrence.

Summary

Three cases of carcinoma of the thyroid, one with a metastasis in the mandible, the second with metastasis in the kidney and the third with metastasis in the breast are reported. In all these cases the primary in the thyroid was not recognised and the patients were treated radically on the assumption that the operated lesion was the primary tumour.

Acknowledgment

I wish to thank Professor R. A. Willis for his interest in the cases and to Dr. T. E. Udawadia, house surgeon to Dr. A. V. Baliga, for the clinical notes of case no. 2.

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RARE ANOMALY OF THE GALL BLADDER, THE CYSTIC, THE HEPATIC AND THE COMMON BILE DUCTS

BY

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Numerous anomalies involving the hepatic, cystic and common bile ducts have been described. They are more frequent than generally understood and are of great importance to the surgeon dealing with the biliary tract. These abnormalities may involve the various components of the biliary tree (Flint 1923) including the gall bladder (Gross 1936, Stoll Kind 1940 and Finney & Owen 1942) either singly or jointly. A case is being presented here wherein the abnormality met with involved nearly all the components of the biliary tree.

Case Report

S. B. 36 years, had recurrent attacks of acute colicky pain in the right hypochondrium of 3 years' duration. There were two episodes of obstructive jaundice during these attacks which subsided with medical management.

He was a moderately built man. Pressure in the right hypochondrium elicited sharp pain. Per oral cholecystography showed non-filling of the gall bladder.

In view of the recurrent pain, history of jaundice and non-filling of the gall bladder on cholecystography, operation was decided upon.

Operation.—21—2—56.

Right paramedian incision. The gall bladder was shrunken, thick walled and there were dense, firm adhesions with omentum, transverse colon and duodenum. Numerous small calculi were felt within the shrunken gall bladder. Dissection was started at the hilum of the gall bladder. A narrow attenuated cystic duct was isolated and it was seen and followed down to where it disappeared behind the duodenum (Fig 1). The structure medial to the cystic duct was at first thought to be common duct but on aspiration was identified as the portal vein. The common hepatic duct was not seen.

Dissection of the gall bladder wall revealed two large ducts emerging from the undersurface of the liver and entering the fundus of the shrunken gall bladder. Of these, the left appeared to be larger and was about 1" in diameter. The right duct was about ½" in diameter (Fig. 1).

The hepatic artery was isolated. It divided early and the division into right and left branches were followed. The right hepatic artery followed the cystic

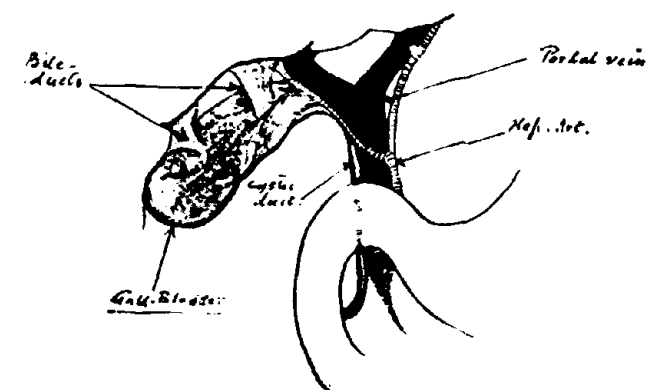


Fig. 1

Shows the details of the anatomical abnormality met with (See Text).

duct in a wide sweep superiorly and after giving a large cystic branch to the gall bladder, disappeared into the liver substance behind the point where the left of the two ducts were emerging from the liver to join the fundus of the gall bladder (Fig. 1). The right branch of the hepatic artery was normally placed. After some deliberation, it was decided to remove the gall bladder and establish biliary continuity by hepatico-duodenal anastomosis using the large dilated left duct emerging from the liver.

The junction of the neck of the gall bladder with the narrow cystic duct (? common bile duct) was divided and the gall bladder was dissected out of the liver fossa. The right sided duct emerging from the liver was divided and transfixed. The dilated left duct was divided but carefully preserved.

The 1st and 2nd parts of the duodenum were liberally mobilized until the duodenal bulb could be easily brought up to the undersurface of the liver without any tension. After carefully approximating the bulb and the dilated hepatic duct, an incision about $\frac{1}{2}$ " was made on the bulb and hepatico-duodenal anastomosis was performed (Fig. 2). One layer of

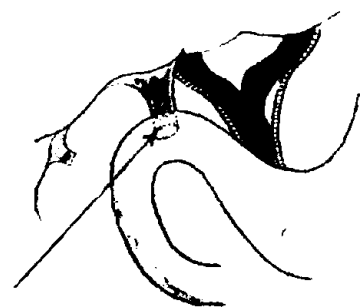


Fig. 2

Hepatico-duodenal anastomosis.

interrupted sutures using No. 0 chromic catgut on atraumatic needle was used throughout. To reinforce the suture line and prevent tension, the duodenal bulb was hooked up to the undersurface of the liver by a few additional sutures. A stab drain was left behind the anastomosis site and brought out at the flank. The wound was closed in layers.

Post-Operative Course

This was marked by slight leakage of bile through the flank drain for the 1st 3 or 4 days and by development of pyrexia and slight icteroid tinge lasting for about 2 weeks. However, the patient progressively improved and after the drain was removed on the

14th day, he was up and about quickly and his stools contained large amounts of bile and the icterus disappeared. He was discharged on the 21st day after operation.

He has been followed up regularly for over 2 years and continues to keep good health without any untoward symptoms.

Discussion

The abnormalities presented in this case could be explained in two ways. It may be looked upon as a case of congenital total absence of the common bile duct in which the cystic duct was directly draining into the duodenum or as is more likely, it could be described as a case of congenital absence of the gall bladder in which the upper part of the common bile duct was somewhat dilated and took on the shape and was performing the function of the gall bladder. This second explanation appears more likely in view of the finding of the two hepatic ducts opening into the fundus of the supposed 'gall bladder'.

There may be differences of opinion as to the best method of tackling this problem. It might be thought that instead of taking the risk of removing the supposed 'gall bladder' and subsequent hepatic-duodenal anastomosis, one could do cholecystostomy or choledochostomy and remove the small calculi.

It should be remembered, however, that the 'gall bladder' was shrunken, fibrosed and apart from the difficulty of doing cholecystostomy or choledochostomy in such a case, it would have most probably led to stricture formation in the lumen in a short while making subsequent management even more difficult.

The question of hepatico-duodenal anastomosis also presented a difficult problem. There were two ducts emerging from the liver, but the right duct was

diminutive and the left one was large. It was concluded, therefore, that the left duct was the main one and was draining most of the liver. Anastomosis with this duct was decided upon and carried out with relative ease. That this anastomosis has been adequate, is evident from disappearance of the slight icterus that the patient developed in 2 weeks' time, the presence of adequate amounts of bile in the stools and the continued good general health of the patient for over 18 months.

Summary

A rare case of abnormality involving the whole biliary tree is presented. This case

could be looked upon either as one of total absence of the common bile duct with the cystic duct directly draining into the duodenum or as one of congenital absence of the gall bladder with the proximal portion of the common bile duct taking the shape of and functioning as the gall bladder.

This abnormal gall bladder was pathological and was shrunken, fibrous and contained stones. It was treated by resection and the biliary continuity was restored by hepatico-duodenal anastomosis. The patient is doing well after 18 months. Salient points of this unique abnormality are discussed.

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RETROPERITONEAL LIPOSARCOMA

Report of a case

BY

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Retroperitoneal tumours arise from the structures that are in the retroperitoneal space, namely, fibrous and areolar tissue, fat, fine muscle bundles, small blood vessels, capillaries and nerve elements. *Morgagni* (1761) first described tumours of the retroperitoneal space with a case report of a lipoma. Various types of tumours arising from the retroperitoneal region have been recorded. But true lipo-sarcoma arising from the retroperitoneum is of infrequent occurrence. *Harnell*¹ (1952) could find only 2 cases of lipo-sarcoma of the retroperitoneal region out of 205 soft tissue sarcomas. *Stout*² (1944) recorded 43 cases of lipo-sarcomas, collected from the surgical pathology laboratory of Columbia University and reviewed 134 cases reported in the literature and gave an admirable account of liposarcomas. Cases have been periodically reported from India. *Sirsat*³ (1956), from Bombay, recorded 7 cases out of 146 soft tissue tumours. *Roy*⁴ et al (1958) have come across only one case of liposarcoma in their five cases of primary retroperitoneal tumours. We have reviewed both the autopsy and biopsy records of the Pathology Department of the Andhra Medical College (1926-todate) and have come across no case of primary liposarcoma of the retroperitoneum. The present case, first to be recorded, is described below.

Case Report

A Hindu female B.S. aged 40 years was admitted on 18-2-1958 for the complaint of a mass in the abdomen of 6 months' duration. The complaint

started with a small firm swelling just to the left of the umbilical region. The swelling increased in size gradually and began to grow in all directions and has attained the present size. In conjunction with the growing tumour mass, the patient developed pain and dyspnoea. She was constipated all through. One month after the development of the swelling there was cessation of menstruation.

On Examination, a swelling occupying the left lumbar, umbilical and left iliac regions, encroaching slightly on to the right side and moving with respiration, was seen. On palpation, a mass 6" x 6", firm in consistency, freely mobile, smooth, with indefinite margins, occupying the left lumbar, umbilical and left iliac regions, was felt. No visible pulsations were seen. The dullness was not continuous with that of the spleen and it had no connection with the kidney. Other systems did not reveal any abnormality.

Investigations done.—Routine investigations did not reveal any abnormality. Intravenous Pyelographic findings: Excretion was present in both the kidneys. Left kidney appeared to be displaced upwards, medially and anteriorly by a retroperitoneal mass in the lumbar region (Fig. 1). The patient was referred to the gynaecological department for pelvic examination to eliminate an ovarian tumour, in view of the amenorrhoea and mass in the abdomen. Gynaecological examination revealed that the tumour had no connection with the ovary.

A clinical diagnosis of retroperitoneal tumour was made and the patient was operated upon on 23-4-1958. On opening the abdomen a yellowish retroperitoneal mass was seen, which, on aspiration, did not contain any fluid. The peritoneum over the tumour mass was incised and the tumour was found to be a big sized retroperitoneal lipoma and was adherent to the perinephric fat. The whole tumour mass was excised; the patient made an uneventful recovery and was discharged on 6-5-1958.

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Fig. 1

Photograph showing the upward and medial displacement of the left kidney by the retroperitoneal mass shown by means of intravenous Pyelography.



Fig. 2

Photograph showing the cut section of the tumour. Areas of haemorrhages and degeneration could be made out.

Gross specimen.—The entire tumour mass measured 12" x 18" and weighed 2,875 gms. It was round and markedly yellowish in colour with blood vessels

coursing prominently over it. The growth looked to be well encapsulated. A cut section of the tumour revealed uniformly yellowish areas, which were soft; areas of haemorrhages and degeneration could be made out in these yellowish areas (Fig. 2). Amidst these yellowish areas, solid white areas were seen which were very firm. The tumour was lobulated.

Histological appearances.—Biopsy No. 2508 10/58 and 2666-2671/58. Several sections covering the entire neoplasm were studied. They were stained with haematoxylin and eosin, Van Gieson's stain and reticulum stain. Frozen sections were stained with Sudan III for the presence of fat. Histo-chemical study with periodic acid, Schiff technique, was also done to study the presence of intercellular mucin in these sections.

The tumour showed varying stages of differentiation of the fat cell (from mature fat cell to immature fat cell). In some areas the large vacuolated mature fat cells with the peripheral nuclei could be seen (Fig. 3). Embryonal spindle shaped fat cells, arranged in a whorled pattern, were also seen (Fig. 4). Large areas of necrosis, haemorrhages and myxomatous degeneration of the stroma were seen. Large undifferentiated fusiform cells with mitotic division of nuclei were seen in some of the sections studied (Fig. 5). Some of the spindle shaped cells showed early fatty vacuoles (Fig 6). Intercellular mucin and pericellular reticulum fibres were also seen by special staining methods.

Histological diagnosis.—Liposarcoma.

Comments.—Retroperitoneal tumours are clinically silent for a long time since the area is an ideal site for the continued unhampered multiplication of malignant cells. Neighbouring structures such as the kidney and ureter or those in the peritoneal cavity are pushed to one side with the expansion of the retroperitoneal neoplastic mass without any significant change in their function or form as was seen in the intravenous pyelogram. Thus these tumours can grow to enormous sizes, giving rise to little discomfort to the patient. All these changes are very clearly seen in the case recorded above.

The histological study in this particular case left us no doubt about the diagnosis as the cells of the tumour exhibited most of the varieties of structures, as described by a

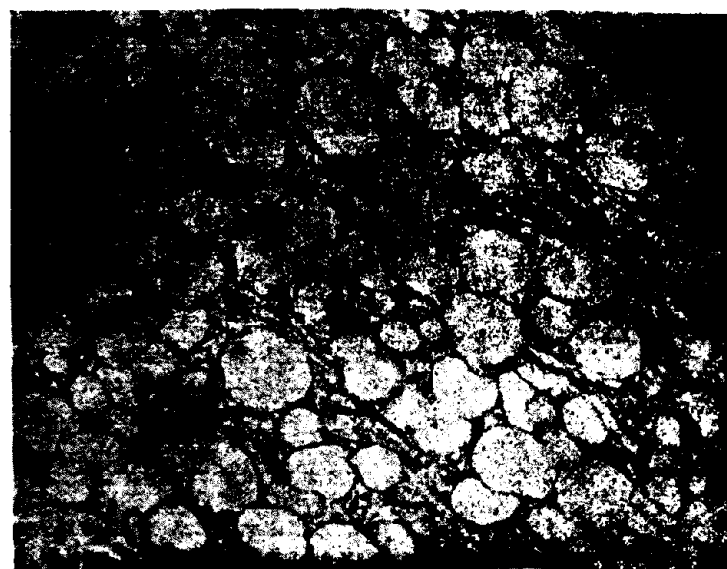


Fig. 3

Photomicrograph illustrates large, vacuolated, mature fat cells with peripheral nuclei.
H & E stain: $\times 105$.

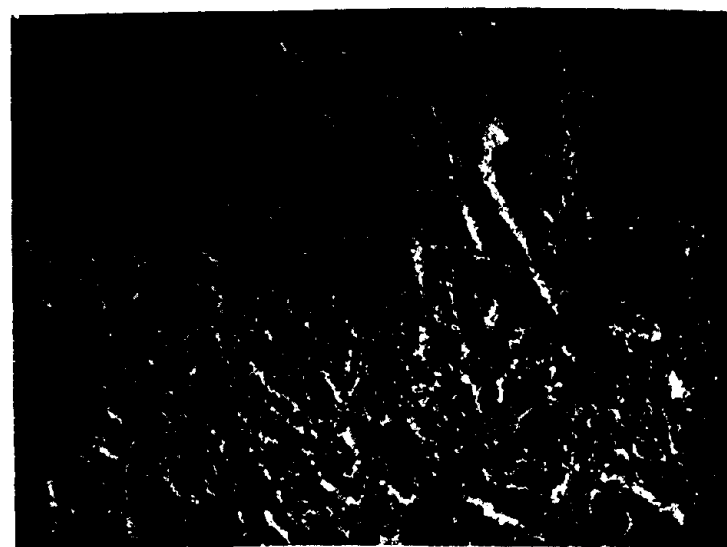


Fig. 4

Photomicrograph illustrates sheets of spindle shaped cells arranged in whorled pattern.
H & E stain: $\times 105$.



Fig. 5

Photomicrograph showing collections of large cells with hyperchromatic nuclei and mitotic division of the nuclei. H & E stain: $\times 420$.



Fig. 6

Photomicrograph illustrates some of the large spindle shaped cells showing early fatty vacuoles.
H & E stain: $\times 420$.

number of authors. Varying pattern, the demonstration of fat both in the uniglobular and multiglobular fat cells, the pericellular reticulum fibres and intercellular mucin, clearly show the nature of this tumour. Willis⁶ is of the opinion that a diagnosis of liposarcoma can only be fully established by the observation of a complete range of intermediate forms between the undifferentiated sarcoma cells and well-developed fat cells of either uniglobular or multiglobular type. All these changes which are distinctly seen in the histological study of the case recorded, illustrate the two different lines of development in these cases one leading to the ordinary type of mature uniglobular fat cell and the other to the multiglobular cell, similar to the characteristic element of brown fats (round or polyhedral cells with central nucleus and abundant granular cytoplasm).

Metastasis is less frequent in liposarcomas than in other types of sarcomas. The case recorded did not show any evidence of

metastases and is being followed up. The patient is doing quite well and no recurrence or any evidence of metastasis has been noticed so far—i.e. till 14-8-58—a period of about 6 months.

Summary

1. A case of primary retroperitoneal liposarcoma is recorded.
2. Detailed histological study of the neoplasm was made with special stains to study the nature of fat, reticulum fibres and intercellular mucin.
3. The histogenesis of this tumour is briefly discussed.

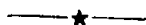
Acknowledgments

We are thankful to Dr. D. Govinda Reddy, M.D., Director of Upgraded Institute of Pathology, Andhra Medical College, for his valuable suggestions and the help rendered in preparing this case report.

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PROLAPSE OF SMALL INTESTINE THROUGH THE ANUS: CASE REPORT

BY

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Prolapse of the small intestine through the anus is a rare condition, discounting cases of intussusception. The following case report illustrates one such case.

Case Report

S. K., a 25 year old Sikh housewife, was admitted on January 21, 1956 with a complaint of pain in the lower abdomen for one month, and loose stools and vomiting for ten days.

Past history.—Four months prior to admission the patient had had a normal delivery followed by phlebitis of the left leg. This was treated elsewhere and she recovered after about five weeks. One month prior to admission pain commenced in the lower abdomen periumbilical in origin, and radiating to the left lower quadrant. Along with this a tender swelling appeared in the left inguinal region and a mass was noted in the lower left quadrant. There was no vaginal discharge. She was treated with penicillin resulting in disappearance of the inguinal swelling but the mass in the left iliac fossa and abdominal pain persisted to a lesser degree. Ten days prior to admission she began to have loose stools (6 or 7 per day) and vomiting. The diarrhoea lasted for only three days.

Physical Examination.—Physical examination revealed an acutely ill woman appearing older than her stated age, severely dehydrated, pale, toxic and irrational. Blood pressure was 105/65, temperature 98°, pulse 92, and respiration 22. Except for the signs of toxæmia and dehydration, the positive physical findings were limited to the abdomen and the lower extremities. There was a sense of fullness in the left lower quadrant but no definite mass was palpated although considerable resistance and tenderness were present. Bowel sounds were present and normal. No hernia was palpable. That left lower extremity was 1" greater in circumference than the right and Homan's sign was positive on the left.

Pelvic examination.—Pelvic examination was not satisfactory and revealed only tenderness in both the fornices with a moderately enlarged uterus.

Laboratory Findings.—On admission, urine was normal except for a trace of albumin. Haemoglobin was 9.5 Gm. %. White blood count was 40,000 per cu. mm. polys 80%, juvenile from 7%, lymphocytes 10%, eosinophiles 2%, and monocytes 1%. Stool revealed no ova, parasites, or blood.

Fluoroscopy.—Fluoroscopy revealed no abnormalities in the chest, but a peculiar gas pattern and bowel movement in the abdomen with moderate distention was noted. There were no air-fluid levels. The impression of the radiologist was that it was a walled-off intraperitoneal abscess.

A diagnosis of thrombophlebitis, left leg, and pelvic inflammation, possibly with a pelvic abscess, was made.

Course.—The condition of the patient was too poor to permit immediate operation and therefore she was started on Crystalline Penicillin and the dehydration corrected. However, she continued to be disoriented and at times had fever up to 101° daily. On her fifth hospital day, blood examination showed haemoglobin 7.25 Grams %, red blood count 4,250,000 with moderate anisocytosis and marked hypochromia hematocrit 32.5% and white blood count 27,000. 1 Gram streptomycin daily was added to the penicillin and she also received a blood transfusion. From that time onwards she showed definite improvement in her general condition. Temperature started to settle down, with the abdominal pain and tenderness diminishing gradually. Although the antibiotics were continued, on the 15th hospital day her temperature rose again to 101° with increasing tenderness in the left lower quadrant and on the following day a vague mass was palpated in the left lower quadrant. At this time it was thought that she had developed an abscess and that her condition

had improved enough to withstand surgery. She was therefore scheduled for laparotomy the next day.

At 1-30 that night the patient had a bowel movement and along with it a loop of gangrenous small intestine about 18 inches long was passed per rectum and found protruding from the anus. There was no pain or any other untoward symptoms. Her general condition was fair.

Laparotomy was immediately performed through a generous left paramedian incision. There was no evidence of generalized peritonitis and no pus was found. However, there was a mass of omentum present in the left lower quadrant at the bottom of which there was a hole in the descending colon about 1½ inches in length through which three to four feet of small intestine had passed. The small intestine had had its blood supply compromised, was gangrenous and had actually sloughed off, its mesenteric vessels containing clots. Accordingly, end-to-end anastomosis of the small bowel was done and, because the patient's condition was deteriorating, a defunctioning transverse colostomy was done and the wound

was closed in layers with a drain. No attempt to close the sigmoid or exteriorize it was possible, because of the severe local reaction.

Post-operatively the patient did very well, but on the 13th post-operative day she began spiking a temperature of 102° and became irrational. She expired on the 23rd post-operative day, probably from a brain abscess. No autopsy was obtained.

Discussion

The etiology of the condition in this patient is uncertain. It is felt that the patient probably had an abscess in the left iliac fossa which perforated into the sigmoid colon and was followed by the small intestine which, in turn, became gangrenous.

The etiology of the abscess is uncertain but was possibly due to a perforated diverticulum, although at her age it would seem unusual. More probably, it was secondary to pelvic inflammatory disease.

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INTERVERTEBRAL DISC PROTRUSIONS*

BY

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The total bulk of the intervertebral discs is equal to about a third of the height of the vertebral column. It is surprising that this constituent of the spinal column escaped notice for such a long number of years. It is only for the past 30 years that lesions of the intervertebral disc have been recognised as a cause of disease. The intervertebral disc is involved in severe trauma to the spine and is one of the important elements causing pressure on the cord. It also has a tendency to undergo degeneration; and mild trauma to the degenerated disc is likely to cause a rupture of the peripheral fibrous ring. On rupture the softer nuclear mass prolapses and may cause pressure on the neural elements contained in the vertebral column.

There are two aspects in the symptomatology of the prolapsed intervertebral discs. One is the change that is caused in the mechanism of the vertebral column. The prolapsed disc narrows the intervertebral space (Fig. 1) and thus strains the concerned inter-articular joints. The strain on the inter-articular joints tends to cause pain in the back and this in turn induces local muscular spasm. This muscular spasm is the cause of the scoliosis that is seen in cases of protruded intervertebral disc. The other aspect is compression of nerve elements by the backward protrusion of the disc mass which acts like a space occupying lesion in the spinal canal. The disc is more likely to protrude backwards in the lateral part of the spinal column rather than in the central

portion because of the presence of the posterior longitudinal ligament. With lateral protrusion, the neural element likely to be affected is the nerve root and hence a common symptom of protruded disc is a single nerve root compression manifesting itself either as a sciatica if in the lumbosacral region or as a brachial neuritis if in the cervical region. Occasionally it so happens that the disc protrusion is massive and pushes the posterior longitudinal ligament backwards and protrudes directly backwards into the vertebral column. In



Fig. 1

Narrowing of L₄ L₅ intervertebral space with a tilt to the right.

*Paper presented at the Regional Orthopaedic Conference of the Association of Surgeons of India held at Madras in August 1958.

such instances the disc presses on the spinal cord itself or on the elements of the cauda equina thus causing symptoms of cord compression or cauda equina compression.

The problem of intervertebral disc protrusion is a real one and with proper diagnosis and correct treatment the relief that can be given to these patients is considerable. This paper deals with the experience of the Department of Neuro-Surgery, General Hospital, Madras with cases of intervertebral disc protrusion during the past 8 years. It is better to consider these cases into three groups, according to the anatomical level.

Table I

No. of cases of suspected Disc Protrusion

Sciatica	... 475 cases
Brachial neuritis	... 75 "
Thoracic disc	... 3 "

During the period of October 1950 to December 1957, 455 cases of sciatica were examined in the Neuro-Surgical Clinic. Of these only 180 of cases were admitted for in-patient treatment and 47 cases were operated.

In this paper we shall deal only with some important considerations in the diagnosis and treatment of herniated nucleus pulposus. The commonest disc protrusions occur at the level of the lumbosacral region. The intervertebral discs between L₅ and S₁ and L₄ and L₅ vertebra are the commonest to prolapse. This is probably because they bear the greatest strain in man in the erect posture; specially when he bends forwards and lifts a heavy weight the burden of the entire weight is placed on these discs which are liable to be damaged.

As mentioned earlier cases with disc protrusions came with either 'neurological' or 'orthopaedic' signs: Cases with only

orthopaedic signs; 270 cases: Neurological signs; 185 cases. Among Neurological cases 170 came with symptoms of root compression and 9 came with symptoms of cauda equina compression.

Diagnosis in these cases was based on the following symptoms.

Table II

Symptomatology of Lumbar Disc Protrusions.

1. History of:	
(a) sudden onset	... 189 cases
(b) slow insidious onset	... 266 "
(c) Recurrent attacks of lumbago...	292 "
2. Pain in the back	... 420 "
3. Sciatica	... 360 "
4. Limitation of forward bending	... 412 "
5. Limitation of straight leg raising:	
(a) of the same leg	... 340 "
(b) of the opposite leg	... 116 "
6. Presence of Neurological signs:	
(a) Single root compression	... 163 "
(b) Multiple root compression	... 9 "
(c) Cauda Equina compression	... 7 "

From the above table the symptomatology of a herniated disc is fairly clear. Diagnosis should not present any difficulty. With a history of recurrent attacks of pain in the back and radiating sciatic pain a protrusion of the intervertebral disc suggests itself. It is to be noted that herniated nucleus pulposus should be clinically diagnosed only after excluding other causes of sciatic pain. With the growing prominence given to herniated disc, the more serious causes of sciatic pain like tuberculosis, intrapelvic malignancy, secondaries in bone, etc., should not be missed. A thorough pelvic examination in women and rectal examination in men should precede the diagnosis of H.N.P.

After diagnosis the routine followed in the department is to give them a course of

conservative therapy. Usually it is found that if the patient is given absolute bed rest for 3 weeks, the symptoms completely clear. 89% of cases with sciatica alone and 60% of the cases with root signs improved with such conservative treatment.

Surgery is indicated under the following conditions.

1. In those with a recurrent history of sciatic pain,—pain that has recurred after conservative treatment.
2. With definite signs of root compression and with
3. No relief from pain or neurological signs in spite of conservative treatment.

With the above criteria surgical therapy may be thought of.

Table III

Operated cases—47

Central disc Protrusions	... 7
Single lateral disc Protrusions	... 36
Multiple disc Protrusions	... 4

The level of the herniated disc can usually be arrived at by a careful neurological examination. The L₄ S₁ disc when it protrudes laterally is likely to compress the S₁ nerve root. Symptoms of S₁ nerve root compression are clear *viz.* loss of ankle jerk and hypoaesthesia on the outer aspect of the foot. Coughing or sneezing typically radiates the pain to the outer aspect of the foot. With such clinical signs the level of the lesion is definite and surgery can be proceeded with. L₄ L₅ disc protrusion causes L₅ root compression. The symptoms of these are not as clear cut as S₁ root compression. Here the pain radiates only upto the outer aspect of the leg. Some times it may go on to the anteromedial aspect of the leg and

the dorsum of the foot. The ankle jerk is preserved; hypoaesthesia occurs on the outer aspect of the leg and also the dorsum of the foot.

Lumbar puncture is useful in doubtful cases. An increase in protein in C. S. F. indicates root compression. This increase is due to nerve root irritation and also compression of the perineural veins by the protruding disc. When the neurological signs are confusing or the level appears to be multiple it is necessary to do further investigations. Myelography is a very useful procedure. For myelography for lumbar intervertebral discs, the following procedure has been found useful. It is very essential to realise that the disc protrusion is from the anterior aspect of the spinal cavity. Hence, when pictures are being taken it is necessary that the patient lies on his face with his head and trunk elevated by about 35°, so that the dye will rest on the posterior surface of the vertebral bodies. In such a situation, after screening, pictures are taken in the antero-posterior and lateral directions. With two good pictures it is easy to make a correct localisation of the level of the protruded disc. Though a prolonged and complicated type myelography under the screen may be done in institutions where time and facilities permit, for ordinary purposes and in our country where things cannot be done so elaborately this method of taking two pictures as mentioned about is a very useful one. The pictures show typical appearance in the lateral view. Antero-posterior filling defect on the anterior aspect of the dye column is seen (Fig. 2). In the A.P. view if the disc protrusion is lateral a narrowing of the dye column is seen (Fig. 3). On the other hand if the protrusion is big and central one may find that there is a definite break-up of the dye column (Fig. 4). The diagnosis of the level is fairly clear from myelography. Usually there is



Fig. 2

Myelography showing filling defects opposite to the intervertebral disc spaces.



Fig. 3

Myelography showing narrowing of the dye column opposite the intervertebral disc space.



Fig. 4

Myelography showing complete break up of the dye in a case of central disc protrusion.

only one level in which the protrusion is seen; mild protrusion may be seen in the myelogram at other levels. These small protrusions should not be construed as the cause of symptoms. As mentioned earlier, disc protrusion is the result of degenerative changes which are likely to occur in many discs but only one of them is likely to rupture. In our series only 4.8% of cases had multiple disc protrusions occurring at the same time (Fig. 2) and causing nerve root compressions at different level. 5% of operated cases developed disc protrusion at a different level at a later period.

Operation is usually undertaken by a hemi or quadri laminectomy in cases of lateral disc protrusions. Some surgeons prefer the patient lying on his side. But we prefer the patient lying prone with the pelvis and the chest well supported. The practical point that should be emphasised here is that after removal of part of the laminae and the

ligamentum flavum one should palpate the exposed dura. On palpation if there is a disc protrusion a definite hard resistance at the level of exposure is felt. If on the other hand there is no resistance felt and the dura can be displaced anteriorly without any resistance then the level of exposure is not correct. This feeling of resistance is very important in further progress of the operation as it allows one to be sure that he is at the correct level. The nerve root is then displaced, carefully freeing it from the protruded disc. The usual position is for the disc to push the nerve root directly posteriorly. Under these circumstances one can gently displace the nerve root medially exposing the protrusion. Rarely the disc may protrude between the dura and the nerve root.

Care is required in displacing the root as otherwise, the already compressed root may be hurt and relief from sciatica may take a long time in spite of surgery.

In our series 70 per cent of lateral disc protrusions presented between the dura and nerve root. After exploration of the protruded disc one may often see the actual area of rupture in the annulus fibrosus. This is incised by a sharp knife. In many cases the protruded nucleus pulposus comes out by itself and only a forceps is required to take it out. In some cases it may so happen that disc is not so easily removed. A wider incision in the annulus is necessary and a scoop and a punch may be required to remove the entire degenerated disc material. From the prognostic point of view it is found that when the disc comes out as a full sequestrum easily the results are very good. But if it requires the punch and the scoop to get the protruded disc out, post operative pain in the back is often present. If the cases are carefully selected and operated only for the above indications, the results are good.

There have been conflicting reports about the operative results in herniated disc. If operation is undertaken indiscriminately in all cases of sciatica, then the results are not necessarily good. If good pre-operative selection is done, the post-operative results are very satisfactory.

Dealing with central disc protrusions, they may have two types of history. One mode of onset is with an initial typical history of sciatica with a single nerve root compression and later involvement of the other nerve roots, causing symptoms of difficulty in micturition, perianal anaesthesia and pain on the opposite leg. The other way in which a central disc protrusion may present itself is with a sudden onset of pain in the back followed by difficulty in passing urine. Later the patient finds that he has perianal and sacral anaesthesia which later spreads down both legs, one side more than the other. The diagnosis of cauda equina compression is not difficult in these circumstances. Taking all cases of cauda equina compression, it is found that central disc protrusion equals in number the incidence of spinal tumours. Myelography is essential in central disc protrusions because with a cauda equina syndrome, it is necessary to exactly localise the level, as a lesion at L₁ level may simulate a lesion at L₅ level.

It is preferable to do a complete laminectomy in compression of cauda equina. This is necessary because the amount of traction and pressure exerted on the cauda equina during surgery will be minimal and post operative recovery will be good.

In the post operative period it is very important to teach the patient bladder training. He should be advised to empty his bladder as completely as possible by pressure on the supra pubic region. This quickly facilitates the return of bladder function. The results in operations for central disc

protrusions are good. The patient gets complete recovery.

The third group of cases of lumbar disc protrusions are those that come with predominantly orthopaedic signs without objective neurological signs. The patient comes complaining of severe pain in the back which often radiates down both legs. On examination the lumbar lordosis is obliterated and there may also be an element of scoliosis. Straight leg raising is impaired on both sides. But there are no objective neurological changes. In these cases conservative therapy *viz.*, rest in bed with traction on both legs is often helpful. After a period of rest, spinal exercises and short wave diathermy help to restore the patient to his work: if inspite of such therapy the pain and symptoms persist then it is essential to do myelography and if there is evidence of disc protrusion surgery is indicated despite lack of neurological signs. These are difficult cases and close consultation between the orthopaedic and Neurological Surgeons is essential. It is in these cases that one should consider whether a fusion of the spine after removal of the disc is indicated, because it is these cases that come back again with recurring backache. This is a problem on which much thought has to be bestowed.

There is another aspect to be considered in such cases. Often the psychic element in a case of back ache may be pronounced. It may be a overlay of an escape phenomenon over a mild case of sciatica. A proper evaluation of the patient and the symptoms often shows and reveals the psychic overlay. In such cases manipulation under anaesthesia often restores the patient to complete normality.

Cervical Disc Lesions

Next in frequency to lumbar and lumbosacral disc herniation are disc lesions in the

cervical region. The general pathology and patho-genesis of cervical disc lesions are almost the same as in the lumbar region. Here also the disc may protrude laterally and cause nerve root pressure: Or occasionally it may protrude directly posteriorly and cause cord compression. There are certain special features associated with cervical disc lesions. Bony changes are common in the cervical region in association with degeneration of the discs. The changes that occur in the cervical spine are now generally known as cervical spondylosis. When cervical spondylosis occurs there is a narrowing of the entire intervertebral disc space (Fig. 5) and this strains the inter-articular joint. In addition the anterior



Fig. 5
Lateral view cervical spine—showing narrowing of the C₄, C₅ disc space.

surface of the cervical column becomes irregular due to multiple disc protrusions. When the inter vertebral space narrows, the ligamentum flavum is thrown into corrugated

folds and this still further narrows the spinal canal. These changes also interfere with the proper blood supply to the cervical spinal cord. The changes that are caused in the cervical spinal cord by cervical spondylosis are known as cervical myelopathy. In lateral disc protrusions in the cervical region the presenting symptom is pain radiating from the neck to the arm and forearm commonly known as brachial neuritis.

Table IV

Brachial Neuritis—75 cases

1. Objective signs of Root compression	...	32 cases
2. Pain in the neck	...	28 "
3. Pain in interscapular region	...	37 "
Operated 8 cases		
(1) Cord compression	...	5
(2) Root compression	...	3

This pain may often be accompanied by sensory changes—a sense of numbness along the shoulder or the outer or inner aspect of the forearm depending on the nerve root involved. Localisation in these cases is easy. But when there are cervical cord changes due to cervical spondylosis, the symptomatology varies. The disease process may resemble a straightforward problem of cord compression or may simulate in its early stages, diseases like amyotrophic lateral sclerosis, progressive muscular atrophy, subacute combined degeneration etc. It is important to realise that whenever the symptoms point to a cervical cord lesion, cervical spondylosis must be borne in mind. When there is evidence of cervical myelopathy full investigation of the spinal cord function must be undertaken. Lumbar puncture may show increased proteins or may reveal a partial block. It may also happen that the Quickenstedt's may not show a block. In any case of doubt it is wiser to keep the patient under observation and do a

cervical myelogram. Unlike as in the lumbar region myelogram of the cervical region is elaborate and must be done with great caution. 6 c.c. of myodil are usually required and screening is very essential. When there is evidence of partial block and filling defect. (Fig. 6) the question of treatment arises.



Fig. 6
Myelography showing filling defects opposite the disc spaces in the cervical region.

The indications for surgical treatment in cervical spondylosis are more strict than those in the lumbar regions. Unless the cases are chosen with great care the post operative results will be far from satisfactory. The patient with his severe pain in the neck will continue to be a great pain in the neck for the surgeon. It is always worthwhile trying conservative treatment for some days. Rest in bed with halter traction is necessary and often relieves the symptoms. After a reasonable period of rest, spinal exercises are taught to the patient. Often the pain is

relieved and the patient feels better. But if there is definite evidence of cord compression surgery should not be delayed. If the symptoms and myelography point to a unilateral lesion, a hemi laminectomy will suffice. But if symptoms of cord compression are severe bilateral laminectomy is indicated to lessen trauma to the cord during operation. Operations in the cervical region are not easy to perform. They require all the skill of the Neurosurgical team to bring to a successful conclusion. We operate on our patients in the sitting posture, which is very convenient. After laminectomy the dura is gently retracted and an attempt is made to remove the disc. If there is any serious difficulty or if excessive traction is required, then it is wiser to open the dura and release the ligamentum denticulatum. This will enable the cord to be retracted sufficiently without trauma. After retraction the anterior dura is incised and the disc is removed. Post operatively the patients may take quite some time for full recovery. But the pain clears and they are happy to co-operate in rehabilitation.

Cervical disc protrusions also occur in cases of cervical vertebral fractures and may be the essential cause for the presence of neurological signs due to cord compression. When there is radiological absence of vertebral dislocation in a case of cervical

cord trauma, an acute traumatic retropulsion of the intervertebral disc may be compressing the cord.

Thoracic Discs

Protrusion of the thoracic disc is uncommon. When they occur they may cause cord compression with paraplegia or root compression with intercostal neuralgia. The presence in the x-rays of Schmorls nodes, corresponding to the neurological level, suggests the possibility of a protruded disc. Occasionally spots of calcification may be seen in the intervertebral space. In the presence of neurological signs surgery is indicated. Removal of the disc by an anterolateral approach may give better results than a routine laminectomy approach.

Summary

This paper presents the practical experience gained in the treatment of intravertebral disc lesions over 7 years. The indications for surgical treatment are discussed and the results of therapy assessed. Lesions at the lumbo sacral level, the cervical level and the thoracic level are treated separately.

Our thanks are due to the Dean, Government General Hospital, Madras for permission to publish this article and to Dr. K. M. Pillai, Radiologist, Barnard Institute of Radiology, for his invaluable help in the investigation of these cases.

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FRACTURES OF THE RADIUS AND ULNA

Incidence, Technique of closed reduction and Management in 631 cases

BY

K. S. BOSE, Calcutta.

Fractures of both bones of forearm are fairly common. Apart from greenstick fractures with slight angulation and isolated fracture of one bone which are not included in this series, fracture of both bones of forearm formed the second major group of cases requiring reduction under general anaesthesia in the Orthopaedic Department, Medical College, Calcutta. Of 1793 fracture cases reduced under anaesthesia in 1954, 278 cases were fractures of radius and ulna. Of these cases, manipulative reduction was successful in 233 cases on first attempt and second manipulation was done in 45 cases—out of which 23 required operative reduction eventually (Bose 1955). In 1955, 353 cases of fractures of radius and ulna were manipulated under anaesthesia, reduction of 279 cases were acceptable on first attempt and 74 cases required a second manipulation out of which only 30 needed operative reduction. Out of 631 cases in two years only 53 cases required open operative interference. This finding was similar to the experience of Sowles (1934) who did 41 operative reduction out of 422 cases. Of these 53 cases, 42 were adults and 11 were adolescents between ages 11—20 years.

Failure of closed manipulative reduction has led many surgeons to adopt open reduction straightaway. Strong musculature of forearm specially in adults, overriding, angulation and rotation of fragments with peculiar axis of movements of pronation and supination in the two radio-ulnar joints (Last (1954), Watson Jones (1956) make manipulative reduction difficult and cause poor

results unless perfect reduction is ensured. To secure perfect anatomical position, open method seems a certain and easier one especially with the development of aseptic Surgery, nonreacting metals and antibiotics, but it transgresses physiological principles of fracture and soft tissue healing. Thus there is a controversy and problem in the management of these fractures. Surgeons having perfect aseptic arrangements and modern internal fixation appliances advocate open reduction in all these cases while others equally advocate closed method technique because of sound physiological principles. This has led the author to study the comparative methods of managements of these fractures. (A detailed technique and management as actually followed is also outlined).

Methods and Materials

The study was undertaken on consecutive cases with fractures of radius and ulna that attended the orthopaedic and fracture department, Medical College Hospitals, Calcutta, in the years 1954 and 1955. A total of 631 cases were seen in 1954 and 1955.

Manipulative reduction was done in Orthopaedic Dept. under general anaesthesia using gas and oxygen. X-ray screen or any muscle relaxant was not routinely used. Vertical traction as described by Charnley (1950) with some modifications was used for fractures of upper and middle thirds of forearm while in lower third horizontal traction was applied. Plaster of Paris immobilisation was kept for 10 weeks

in adults, 8 weeks in adolescents and 6 weeks in children as a rule. A change of plaster with clinical examination was done to detect any angulation after subsidence of oedema as and when required. Check skiagram was done routinely 48 hours after manipulation. Assessment of results as regards rotation, deformity or angulation, union and limitation of joint movements was done every fortnight after removal of plaster for 2 months and then monthly checking till recovery. Though no physio-therapy was available methods and advices regarding massage, exercise and movements were given to patients.

Observations

Incidence was common in children and adolescents than adults. Out of 631 cases, children between 0—10 years were affected in 253 cases, adolescents between age 11—20 years were 304 cases while adults above 20 formed only 74 cases.

Table I

Incidence with age	1954	1955
0—10 yrs.	109	144
11—20 yrs.	134	170
above 20 yrs.	35	39
	278	353

Site of fracture showed preponderance of middle and lower third while that of upper third affection was only 35 cases.

Table II

Site	1954	1955
Upper 1/3	17	18
Middle 1/3	127	147
Lower 1/3	134	185
	278	353

Table III

Manipulative reduction was acceptable on	1954	1955
1st attempt	233	279
2nd attempt	22 out of 45	44 out of 74
Failure after 2nd attempt...	23	30
Open operative reduction...	23	30

Table IV

Percentage of success	1954	1955
1st attempt	83.8	79
2nd attempt	48.8	59.5
Overall 1st attempt success	87.4	
Overall success by closed method	91.5	

Table V

Percentage of success with regard to age		
Below 10 Yrs.	100%	
11—20 Yrs.	96%	
Above 20 Yrs.	45%	

Complications were few in closed method. Failure of reduction in 53 cases, delayed union in 3, volkman's ischaemic contracture in 2 were noted. Gross limitation of rotation as reviewed after one year was nil. Average morbidity period was 6 months. Minor limitation of pronation and supination were present in some cases.

Manipulative Technique

The patients were given supportive cast on first attendance in hospital and advised active finger movements and elevation of limbs. Xray was taken and closed reduction was done usually between 2-6 days. This

delay was due to circumstances in a busy outdoor clinic but was helpful in that oedema and haematoma subsided by the time manipulation was done.

Under general anaesthesia, vertical traction was applied by an assistant by holding thumb separately with his one hand, and other 3 fingers of patients (index, middle and ring) by the other hand. 'Monkey puzzles' or any gadgets were not used. Traction by this method was applied for about 5 minutes, taking care that elbow was free from table. Some counter traction at elbow by downward push on arm was often necessary in adults. Tense forearm was lightly massaged by effluration to dispense haematoma to aid reduction. The rotation of forearm was adjusted during traction depending on the fracture sites. Fracture in upper third of bones above the insertion of pronator teres, needed comfortable supination but not forced supination. For fractures below the insertion of pronator teres midprone position of forearm was accepted. For lower third fractures, complete pronation and ulnar deviation with, slight flexion of wrist was used. Manipulation of fragments were done by angulatory method to hitch them together by the sense of palpation.

Clinical tests of reduction

Before application of plaster clinical tests for reduction were done as shape and length of forearm shown by level of radial and ulnar styloid process, disappearance of crepitus between fragments on palpation in transverse axis, stability of fragments in longitudinal axis. Vertical position of forearm was helpful in assessing the angulatory displacements. Palpation of subcutaneous border of ulna was helpful in detecting the rotational and overriding displacement. Sometimes stability of fragments were not secured and required

pressure and careful holding during setting of plaster. It has been the experience of the author that detection of soft tissue interposition could be made during the manipulation of fragments. In these cases crepitus disappeared without simultaneous stability being attained.

Plaster technique

Plaster immobilisation extended from upper arm just above the insertion of deltoid to knuckles of fingers. A dorsal cast and a short volar cast, completed by circular turns of plaster bandages was used. A thin layer of cotton was used as padding of whole area with special protection of bony points. During setting of plaster, attention was given to hold the fragments in correct alignment. Squeezing grip with thumb pressure between the forearm bones with the idea of keeping the integrity of interosseus space was used. The plaster casing was moulded into oval cross section to make a good fit of forearm. Thumb was included up to first inter phalageal joint and kept in anatomical forward plane with the idea of preventing late collapse of radial fragments especially in lower third fracture. Plaster in hand was trimmed so that apposition of thumb and flexion of other fingers were full and free. Check up of plaster was done to prevent circulatory disturbances and changed when necessary.

Post-reduction advice

Active exercises of fingers were encouraged as well as movements of shoulder specially rotation and abduction. Apposition of thumb and flexion of other fingers were made full and free. A sling was used as a support, better a triangular one. Immobilisation depended on age and maintained till clinical union was attained.

Check Skiagram

In check x'ray the following points were noted :—

1. Overriding of fragments shown in lateral view and double lines in anteroposterior (A. P.) view.
2. Angulation of fragments demonstrated in lateral view. A. P. view or oblique views may not be helpful.
3. Rotation of fragments shown by width of interosseous space in A. P. view. Uniformity of this space in A. P. view was taken as a sign of absence of rotation.

Acceptable standard

Manipulation reduction was taken as successful by the following standard :—

(1) Clinical—shape, axis and length of forearm should be regained with normal volar concavity of radius. Stability of fragments during manipulation was an additional help.

(2) Radiological—Post reduction x'ray plates showed near normal or more than half width apposition of fragments with absence of angulation in lateral view and more or less uniform width of interosseous space in A. P. view.

Operative reduction

Operative reduction was done in twice failed cases or cases showing delayed union and non-union. Open reduction with or without different methods of internal fixation was used. Operative finding consisted of overriding, angulation, excessive callus, cross apposition of radius and ulna, with tear of interosseous membrane and interposition of soft tissues. The results of operative treatment on the whole was not encouraging either. Every sort of complication as non-union, delayed union, osteomyelitis,

short forearm, painful scars, complete or marked limitation of rotating movements, and joint stiffness were noted. Unusually long morbidity period, an average of 12 months was noted in the operated cases. 4 cases required about 2 years of hospital attendance at regular intervals.

Discussion

Analysing the total 631 cases treated in Orthopaedic Dept. in 1954 and 1955, the following statistical figures evaluating the closed manipulative reduction was obtained. Of 631 cases, 578 cases were managed by closed method with fairly satisfactory results i.e. 91.5% of consecutive cases were managed by closed manipulated technique as described. The success was full i.e. 100% in patients below 10 years and for adolescents it was 96%. For adults above 20 years, the success fell to 45%. The overall first attempt success was 87.4% of all fractures. The average morbidity period was 6 months in adults, 4 months in adolescents and 2 months in children.

It was also noted that in some cases (specially children and adolescents) though the anatomical results were far from satisfactory in final X'ray, yet physiological function was full. Some operated cases on the other hand with perfect anatomical position showed moderate or complete loss of physiological function.

It is evident from analysis of the results of this series, that closed method is ideal and treatment of choice in children and even in adolescents. Fracture of radius and ulna presents little or no problem in them and operative reduction is hardly necessary, and is to be avoided - Bagley (1926), Buxton (1939) and Bosworth (1941).

In adults the chances of success by closed reduction are about 50% and present problems regarding methods of treatment

the choice depending on facilities and inclination of the surgeon.

Summary

1. A review of management of 631 consecutive cases of fracture radius and ulna is presented. Technique of closed manipulation and subsequent management are also described.

2. Standards of closed reduction and acceptable position are described.

3. Evaluation of results with chances of success of closed reduction in different age groups are presented in this study.

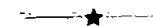
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My thanks are due to Dr. S. C. Bose, Principal and Superintendent, Medical College, Calcutta for permission to use records and to Prof. K. Sarbadhikari and to Dr. D. Banerjee of Orthopaedic Department for co-operation in the work.

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ATYPICAL OSTEOMYELITIS—MODIFIED FEATURES OF OSTEOMYELITIS FOLLOWING INADEQUATE PENICILLIN THERAPY

(It similarity with malignant bone tumours)

BY

K. S. BOSE, Calcutta.

The typical clinical picture of pyogenic osteomyelitis has changed considerably since the introduction of penicillin in the treatment. This has been described in detail by Agerholm & Trueta (1946), Altemier & Helmsworth (1945), Compere et al (1945), Higgins et al (1947) and McAdams (1945). The clinical condition usually improves after administration of a few doses of penicillin and hence the disease may often be treated inadequately with the result that incomplete resolution or chronic inflammatory changes with atypical features occur.

Altemier and Reincke (1945), Brailsford (1948), Gray et al (1950) and Meschan (1956) Gray et al (1950) and others have described the changes in the radiological appearance of bones in pyogenic osteomyelitis following penicillin treatment. The changes are minimal bone destruction with hardly any sequestra formation and little new bone formation in the shape of involucrum. Other feature is a slowly developing osteoporosis involving diaphysis even after the disease is clinically quiescent. This osteoporosis lasts for several months.

Nash (1951) concluded after reviewing the effect of penicillin in pyogenic osteomyelitis that the final bone texture after adequate penicillin therapy should be normal while cases resistant to penicillin would show typical patterns and sequestra. By adequate therapy he meant that "Penicillin in reduced doses should be continued for a minimal period of 6 weeks after fever has subsided or until at least 4 weeks

after disappearance of radiographic signs of rarefaction and texture irregularity." He did not however mention the effect of irregular and inadequate doses so often used in this country.

Instead of the standard clinical and radiological features of chronic pyogenic osteomyelitis, the author has noticed in recent years, some variable and grossly atypical patterns following inadequate penicillin therapy, simulating malignant tumours and various diseases of bones; tumours such as Ewings and osteogenic sarcoma and diseases like fibrous dysplasia, osteoid osteoma, Caffey's cortical hyperostosis, Engelmann's, Pagets and Gaucher's disease. The resemblance was of course radiological and partly clinical but the follow up and histopathological studies revealed the true nature of the disease.

It appeared that these atypical features of osteomyelitis resulting from inadequate administration of antibiotic especially penicillin have not yet received sufficient recognition. It was therefore decided to investigate these cases from clinical, radiological and histopathological aspects with a view to ascertain the lesions as far as possible.

The present report deals only with cases of osteomyelitis with penicillin modified feature simulating malignant bone tumours. The other group of atypical osteomyelitis cases simulating various diseases of bone will be reported in a separate paper.

Material and Method

The patients were selected from cases of pyogenic osteomyelitis attending the Orthopaedic Department, Medical College in the years 1957 and 1958. Cases causing some difficulty in diagnosis due to atypical features were only selected. Routine clinical examination with history of penicillin treatment was particularly noted. Skiagraphy and blood picture were done routinely. W.R. and Khan tests were done as necessary. Histopathological examination by bone biopsy was conducted. Culture from biopsy material was done in some cases.

Case Reports

Case No. 1.—A. K. D. 13 years old boy presented with diffuse swelling over left forearm in lower third for 3 weeks. He had fever of 99° F to 101° F at onset which responded to penicillin (about 50 lacs). On examination, a diffuse bony swelling with tenderness was found over lower third of left radius.

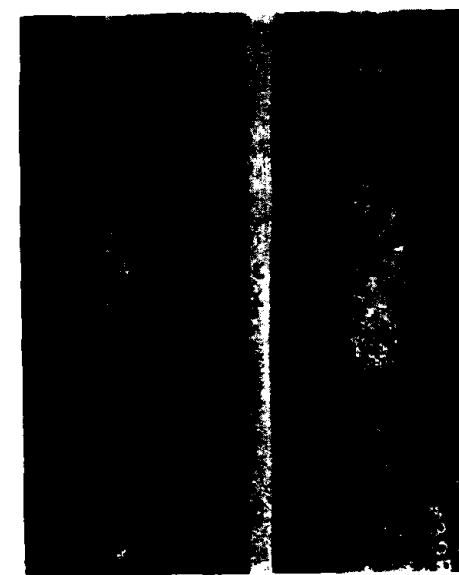


Fig. 1

X-ray print of typical osteomyelitis with sequestra and involucrum.

Skin was healthy and warm and there was little soft tissue swelling. Blood picture showed leucocytosis with a total count 11,500 and neutrophils 72%. X-ray suggested (Fig. 2) malignancy. W. R. and Khan tests were negative. Biopsy was refused. He was kept under observation of plaster cast and penicillin injections (another 50 lacs). On review after 3 weeks swelling was found to have subsided and a second review after another 3 weeks with check skiagrams demonstrated (Fig. 3) the case as chronic osteomyelitis.



Fig. 2

X-ray print of case 1 suggesting malignancy.

Case No. 2.—C.R.D a 12 years old girl presented with pain and swelling in upper and of right arm for 3 months. She had fever which responded to 60 lacs of penicillin but swelling persisted. On examination there was diffuse swelling in right upper arm. Skin was healthy and slightly warm. On palpation, bony thickening and slight tenderness was present in upper third of right humerus. X-ray showed erosion, periostitis in upper



Fig. 3
X-ray print, Case 1 after 6 weeks showing appearance of Chronic Osteomyelitis.

end of right humerus with no sequestra (Fig. 4). The question of malignancy could not be ruled out. Shoulder joint was not involved. Needle biopsy of the affected area showed blood which on culture revealed staphylococcus aureus.

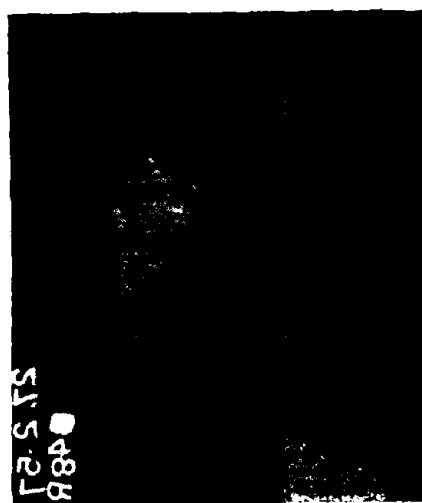


Fig. 4
Case 2 showing erosion, periosteal reaction without any sequestra suggestive of osteogenic sarcoma.

Case No. 3.—B. C. A girl aged 11 years presented with a bony swelling lower half of right femur, insidious in origin, for last 6 months. She had temperature of 99° F to 101° F for sometime at onset, which was treated with antibiotics including penicillin. Blood picture on 10-7-58 showed leucocytes as 10,200 with poly 64%. Skiagram on 14-6-58 shows osteoporosis with slight periosteal layering suggestive of Ewings.

Another skiagram on 22-7-58 showed multiple areas of rarefaction and destruction of various sizes of spongiosa corticalis of lower half of shaft of femur with thickening and lamellation of overlying cervex of most of the affected segment of bone. Lower epiphysis does not show evidences of the changes. The findings recorded above point to one of two things :—

Either a low grade chronic osteomyelitis or Ewings Endothelioma. Physical findings, Lab data and history and its response to treatment have to be correlated with radiological findings for purposes of differential diagnosis. Biopsy on 21-10-58 showed thickening of bone. On guttering, pus was found and one small sequestrum. Culture showed staphylococcus aureus.

Case No. 4.—R. P. a 11 years old boy presented with swelling of right thigh following an injury sustained about 3 days back. He was having temperature and pain with slight swelling of right thigh for last one month and was treated initially by only 5 injections of penicillin (20 lacs). On examination, a diffuse moderate swelling of right thigh was present and the boy was in agony. The skin was healthy and warm. A distinct bony swelling with marked tenderness and moderate soft tissue swelling was noticed by palpation. Blood picture showed W.B.C. 12,000 with neutrophils 70% and temperature

of 100° F. Skiagram (Fig. 5) showed erosion with pathological fracture through lower third of shaft of femur. There was also a suggestion of malignancy. Like case 3 needle biopsy showed staphylococcus aureus. Patient was treated with antibiotics and immobilisation subsequently.



Fig. 5
Case 4 showing necrosis and pathological fracture simulating osteogenic sarcoma.

Case No. 5.—N. L. a 14 year old boy from interior district of Bengal presented with swelling of right arm for two months. He gave history of recurrent attacks of osteomyelitis since the age of 8 years with healed sinus in left arm and pelvis. He was treated with penicillin (about 100 lacs) since the onset of inflammation in right arm. On examination, there was marked bony thickening in right shaft of humerus over middle third without any sinus. X-ray (Fig. 6) showed appearances like Ewings Tumour. He was treated with immobilisation with satisfactory results. Previous history and subsequent result were suggestive of chronic osteomyelitis.



Fig. 6
Case 5 X-ray print showing appearances like Ewing's Tumour.

Observations

All the 5 cases showed atypical features simulating malignant bone tumours—3 cases like osteogenic sarcoma and 2 cases like Ewings tumour. Osteogenic sarcoma cases often mimic a chronic pyogenic infection. It is only by repeated clinical and radiological examination during follow up studies, and routine bone biopsy and culture that the final diagnosis could be established in each case.

Discussion

It is common knowledge now-a-days (since the advent of penicillin) that at times, it becomes difficult to differentiate between malignant bone tumours and chronic osteomyelitis cases by clinical and routine radiological diagnostic methods. The clinical difficulty is due to the fact that incomplete resolution of inflammation in osteomyelitis due to inadequate penicillin administration may mimic swelling and fever in malignant disease the latter due to tissue destruction (Pickering) 1958. Radiologically the necrosis

caused by inflammatory process and subsequent poor bone regeneration due to penicillin effect, is difficult to differentiate from bone necrosis of osteolytic type of osteosarcoma. The round cell infiltration may simulate many types of sarcoma causing errors in histopathological examination in addition to the usual fallacies of bone biopsy (Brailsford 1948).

It is in these type of cases that clinical observation for a period of 3—4 weeks is necessary before a diagnosis can be made. Arteriography is often helpful in doubtful cases (Santos, 1950, Bose, 1957). Many authors have reported diagnostic difficulties due to the above facts between osteomyelitis and Ewings tumour - Bose (1953), Bryd (1956), Lichenstein (1953), Dublin (1955).

But the diagnostic difficulty between penicillin modified osteomyelitis and osteogenic sarcoma is hardly stressed in available literature though surmised and experienced by many. DeWitte (1956) in continental literature recently stressed the difficulties in radiographic interpretation between sarcoma and penicillin modified osteomyelitis. Excepting this, there is hardly any mention of this problem in available literature.

The value of bone biopsy inspite of its fallacies is stressed to arrive at a diagnosis—the presence of inflammatory cells in stroma will suggest chronic inflammation. The presence of bacteria as shown by positive culture of biopsy material clinches the diagnosis in dubious cases.

Probable pathogenesis of the condition

In some cases due to inadequate administration of penicillin necrosis becomes more marked as shown by rarefied areas in skiagrams confusing with various radiolucent bone diseases as osteogenic sarcoma, osteitis

fibrosa, chronic fibrous osteomyelitis, (Phe-mister), bone cyst, osteoid osteoma—the nature of which is uncertain (Lichenstein, and Jaffe (1940), Davison 1956).

The radiological similarity to osteolytic type of bone malignancy is due to persistent osteoporosis, characteristic of penicillin effect on bone. Associated secondary pathological fracture in osteoporic osteomyelitic bone may cause clinical confusion with malignancy and there are records of many mistaken amputations for an apparently benign condition (Brailsford 1950). The anatomical features of these atypical osteomyelitis may also be explained from local vasculature and segmental blood supply of long bones. According to Waschulewski (1957) in the mild type of osteomyelitis seen now a days, "infection is prone to localise in diaphysis of bone in supply areas of segmental arteries. They are branches from arterial stem to supply periosteum and their ramifications form half rings around shafts of bone and send further branches through Haversian canals. In view of anatomy of these segmental vessels, a haematogenous infection may manifest as periostitis secondly as a cortical abscess and thirdly as an intraosseous abscess, confusing with radiolucent bone diseases.

Summary

1. Penicillin therapy has changed the clinical, radiological and even histopathological patterns of pyogenic osteomyelitis.

2. At times, the atypical features may be so confusing as to simulate various types of radiolucent bone lesions radiologically like osteogenic sarcoma, Ewings and osteitis fibrosa.

3. The clinical diagnosis between penicillin modified osteomyelitis having atypical features with osteogenic sarcoma and Ewing's is a real problem. Line of investigation are suggested.

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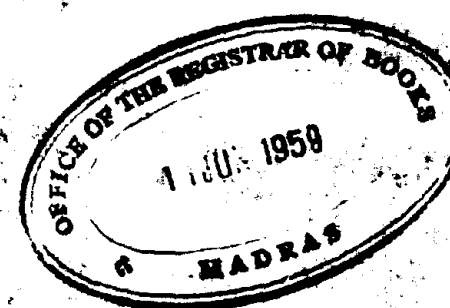
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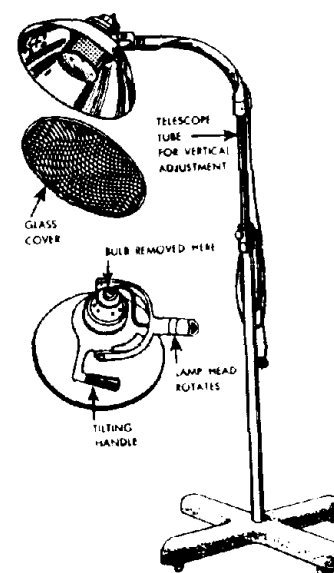
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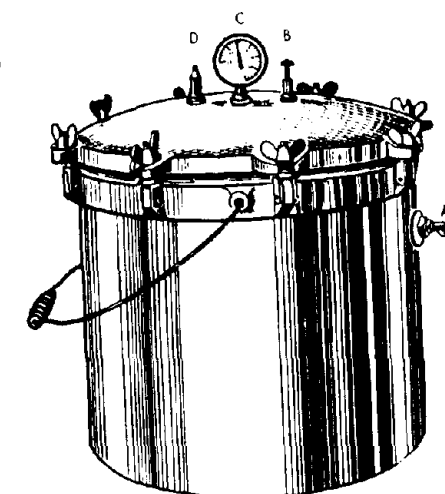
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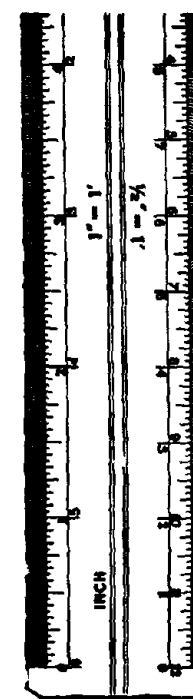
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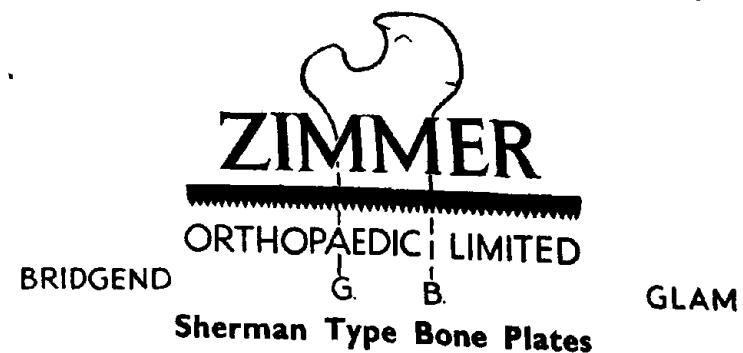
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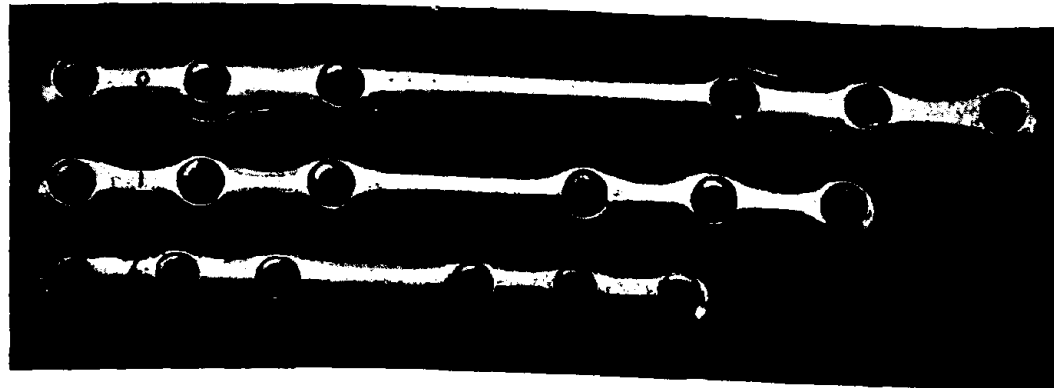
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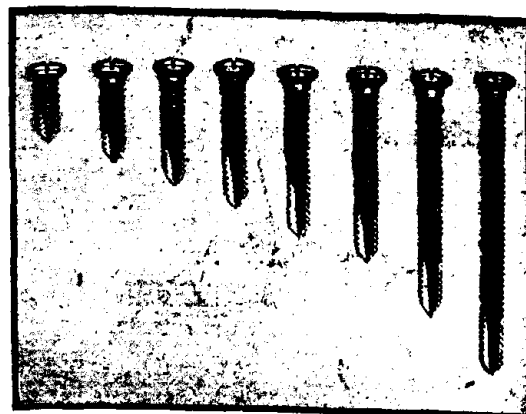


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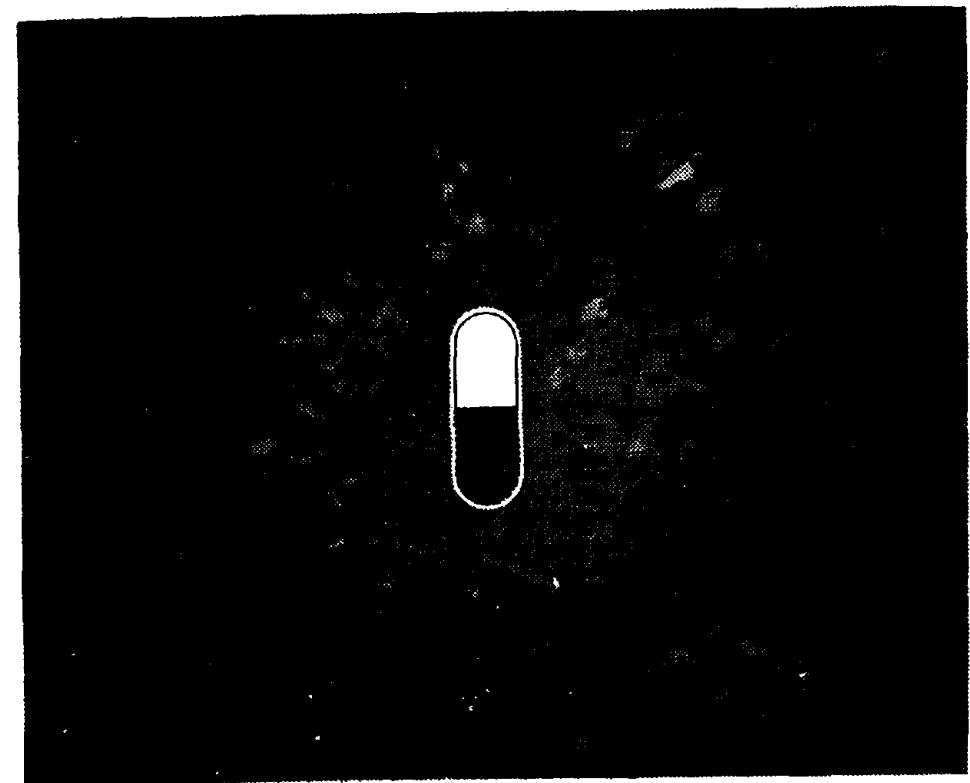
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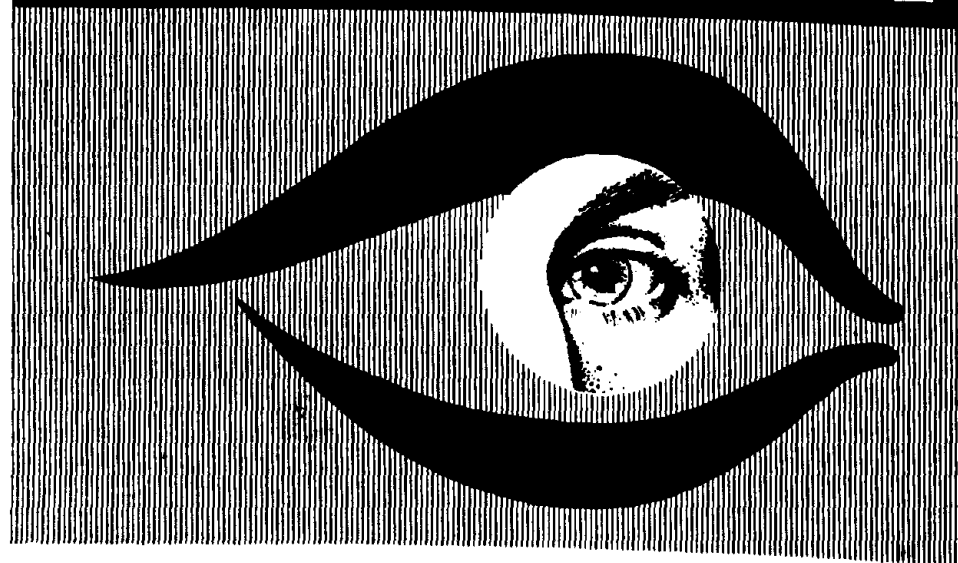
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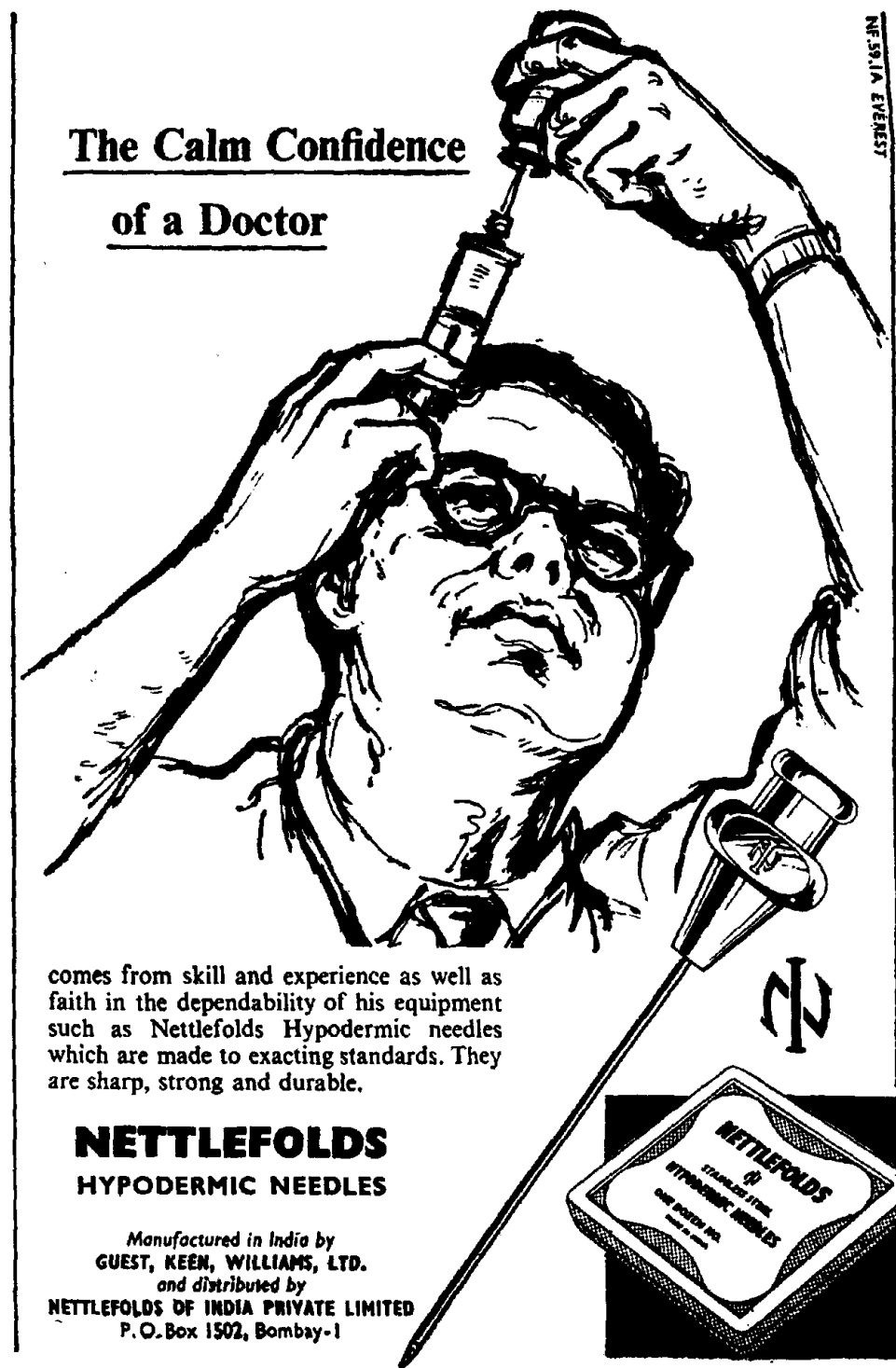
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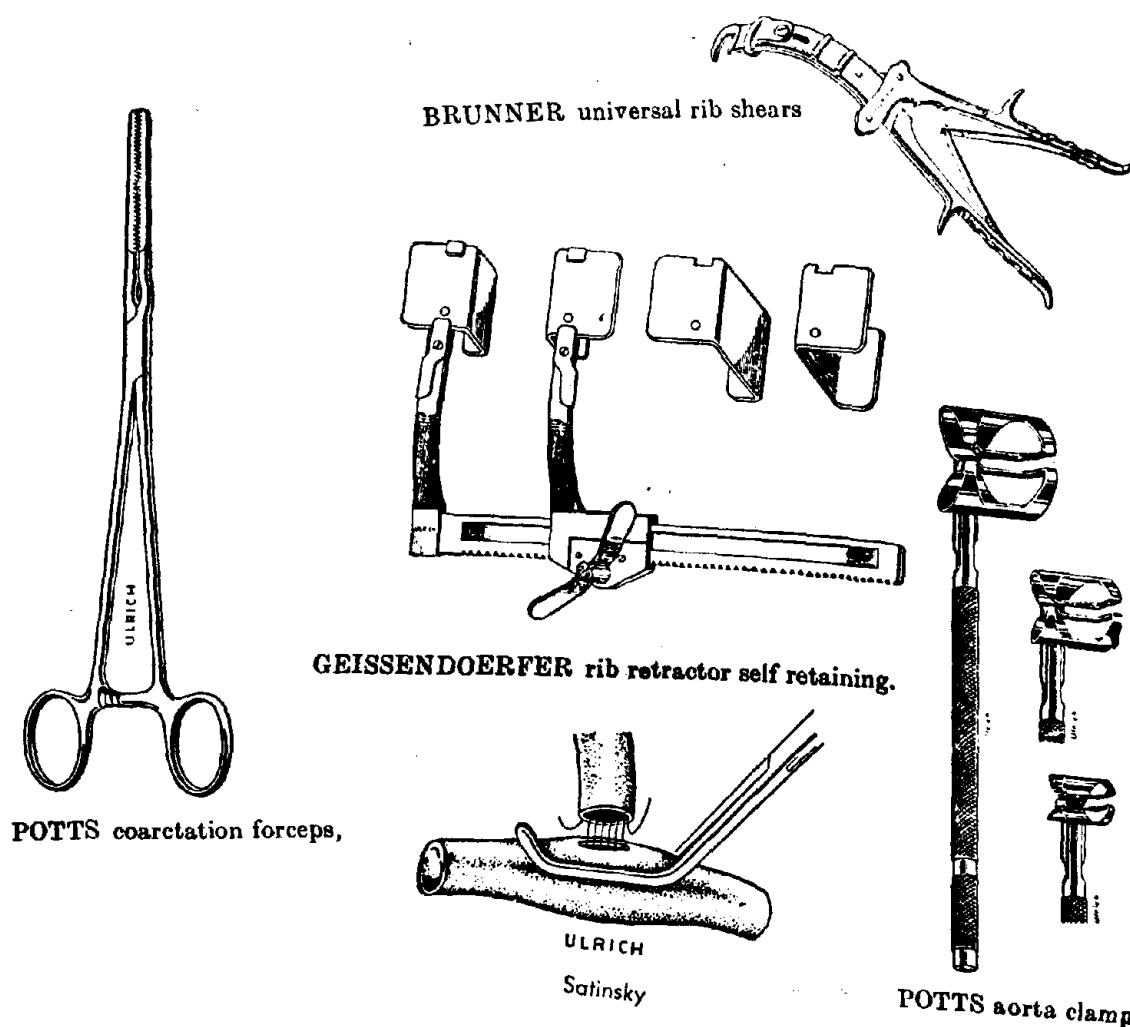


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KINI MEMORIAL LECTURE*

BY

SIR HARRY PLATT, Manchester-13, U.K.

Introduction

I must thank the Council of the Association of Surgeons of India and the officers of the Orthopaedic Section for the honour they have done me in inviting me to give this, the first *Kini Memorial Lecture*.

To be remembered in a Memorial Lecture is given to few men. Wilfred Trotter, that great surgeon philosopher, meditating on the commemoration of the lives of famous men, in a Hunterian Oration at the Royal College of Surgeons, deplored the lack of recognition accorded to many men of great distinction during their life-time. But if we look at the procession of the great master surgeons throughout the ages, we find that their virtues and qualities were generously acclaimed by the contemporary societies in which they lived and had their being.

In the Middle Ages great military surgeons such as Ambroise Pare were richly rewarded by monarchs for whose armies their surgical skill was available. Nor was the genius of John Hunter unrecognised during his life. In the 19th century, Joseph Lister lived long enough to see himself proclaimed throughout the world as the

creator of a new epoch in surgery. It has been said of Lister that he first made surgery safe for the patient.

In more modern times in the English-speaking World, honours were bestowed in full measure on such surgical giants as Moynihan, Robert Jones, and the brothers Mayo. For them no memorial occasions are needed, although many exist; their place in the gallery of heroes in the hall of fame is secure.

Memorial lectures therefore are particularly appropriate for the purpose of recalling the achievements of men who led less spectacular lives—men whose devoted labours in the service of their fellow men might otherwise have remained relatively unknown to the wider world. In the practice of Surgery the rewards which the average man who shuns publicity appreciates most of all, are the satisfaction of work well done and the gratitude of countless numbers of patients. It is a high honour to be described as "surgeon-in-ordinary to large numbers of humble people."

M. G. Kini, in whose memory we are assembled here today, was born in 1893. He

*Delivered at the Annual Meeting of the Association of Surgeons of India, Monday, December 29th 1958, at Visakhapatnam (S. India).

received his early education in Mangalore and his Medical education in the Madras Medical College. In the first World War he served as a medical officer with the fighting troops, and was awarded the Military Cross. Turning to the teaching and practice of surgery after the War, he was appointed in 1925 as Assistant to the Professor of Surgery in the Madras Medical College. Two years later (1927) he went to the United Kingdom in search of a higher surgical qualification and obtained the Fellowship of the Royal College of Surgeons of Edinburgh, and later the Mastership in Orthopaedic Surgery of the University of Liverpool. On his return to South India, he lectured in Orthopaedics in Madras for a time before going to Vizakha-patnam as second surgeon and teacher in operative surgery. With this varied experience behind him he was recalled to Madras to occupy the Chair of Surgery in the Stanley Medical College. During this phase of his career he published a large number of papers on general surgical and orthopaedic subjects. In 1947 he was elected as President of the Association of Surgeons of India, in the year before his retirement from his teaching and hospital post. Amongst his activities outside his own school he played an important part with other colleagues in the organisation of the Hospital for Crippled Children in Bombay. He died in 1952 at the age of 59.

For these brief details of the career of Dr. M. G. Kini I am indebted to one of India's elder statesmen in Orthopaedics, Dr. Narasimha Iyer.

Surgery and Orthopaedics in the United Kingdom

(Post First World War).

What was the state of the art and science of surgery in the United Kingdom in 1927 when Dr. Kini arrived there? He would find British Surgery at that time dominated by three great leaders, Moynihan, Robert

Jones, and Harold Stiles. Moynihan was in his second year as President of the Royal College of Surgeons; Robert Jones though approaching his 70th year was at the peak of his activities; and Stiles in the Regius Chair had reinvigorated the Edinburgh School of Surgery. In Edinburgh, where Kini obtained his Fellowship, two younger stars were appearing—David Wilkie and John Fraser, but orthopaedics as an independent speciality did not exist in that city of medical learning. Kini would also find in England that the major specialities were emerging from within the parent body of *general surgery*. Indeed orthopaedics was already launched as an independent speciality, a development which was fostered by special legislation designed to provide education and treatment for the large number of crippled children who could not attend day schools. Under the leadership of Sir Robert Jones, in collaboration with that remarkable pioneer in the care of the cripple, Dame Agnes Hunt, the Oswestry orthopaedic scheme of a central long-stay institution with after-care clinics covering a wide "catchment" area, became the model for all regions in the United Kingdom. New long-stay orthopaedic hospitals, either for children alone or for both adults and children, built either by philanthropic gifts or by public funds, began to appear, e.g. the Wingfield-Morris at Oxford (one of Lord Nuffield's early gifts); Harlow Wood Hospital; Princess Elizabeth Hospital, Exeter; and the Princess Margaret Rose Hospital, Edinburgh. The latter institution came into being from the indefatigable labours of *W. A. Cochrane*, a pupil both of Sir Harold Stiles and of Dr. J. E. Goldthwait of Boston. Cochrane's early death was a serious loss to British Orthopaedics. These institutions, and others I could name, came to play a notable part in the nation-wide orthopaedic schemes in the United Kingdom between the two World Wars.

There was much to be done for the crippled child in Great Britain in the years following the first World War. It was an exhilarating experience for those of us who were then the younger orthopaedic surgeons, united in our devotion to our great leader Sir Robert Jones. Our major problems in addition to congenital deformities—often neglected—were the deformities following poliomyelitis; tuberculosis of bones and joints; the deformities of rickets; the deforming after-effects of *acute osteomyelitis* and *suppurative arthritis* with lesions often unhealed; *obstetrical palsy* and the *spastic palsies*. This remained the picture for nearly a quarter of a century, but before the end of that period there were signs of a change—rickety deformities demanding operative correction were fast disappearing, and there was a noticeable decline in the incidence of bone and joint tuberculosis. So much for the field of cold orthopaedics in children. But the experience of the first World War in the military orthopaedic centres directed by Sir Robert Jones had stimulated interest in the organisation of fracture units in the general hospitals. The foundation in 1926 of the Vienna Accident Hospital under the direction of Lorenz Bohler was a powerful influence in this movement. Many of us visited Vienna in the next few years and much of the technique of the Bohler clinic, e.g. the use of unpadded plaster splints and the revival of early weight-bearing, became the routine practice in the new fracture departments. The establishment of such units was based on the principle of *segregation, unity of control, and continuity of treatment*. The movement was at first resented by many of the older general surgeons and more particularly in the teaching hospitals of the metropolis. The first segregated fracture services as integral parts of orthopaedic departments were set up in large non-teaching hospitals in the provinces. The publication in 1935 of a

report of a Fracture Commission of the B.M.A., and the later report (1937) of an Interdepartmental Committee of the Home Office and Ministry of Health on the treatment of accidents, hastened this development. The movement had gathered strength and public opinion was now behind it.

When Dr. Kini went to Liverpool to join the course for the degree of Master in Orthopaedic Surgery (M. Ch. Orth.), he thus found himself in the atmosphere of the emergence of orthopaedics as a major division of general surgery covering a field of practice defined by Sir Robert Jones as: "The treatment by manipulation, operation, re-education and rehabilitation, of the injuries and diseases of the locomotor system". He would also have found that orthopaedic departments had been set up in both teaching and non-teaching hospitals in many areas and that fractures were gradually becoming segregated. In addition there were the special long-stay orthopaedic institutions with provision for the treatment and after-care of disabilities which could not be adequately dealt with in the new departments of the general hospitals with their urge for a rapid turn-over in beds.

Developments in India

On his return to India Dr. Kini found it necessary to continue to practice and teach general surgery, but he was able to develop and foster orthopaedics from that basic position. This was what Robert Jones himself had done long ago; and amongst those of the generation to follow, both T.P. McMurray and I myself began life as general surgeons in our respective hospitals. Evidently for reasons which were known to Dr. Kini's contemporaries, the time was not ripe for the creation of completely independent orthopaedic units at the Madras teaching hospital. But today as I know from

personal experience both the *Madras Medical College* and the *Stanley Medical College*, have flourishing orthopaedic departments directed by able and progressive young men. In that centre of medical teaching as in other great centres which I have had the privilege of visiting, orthopaedics in India is now securely launched on its voyage of high endeavour. Not everywhere however, have I found that these departments have been allocated enough beds and the special out-patient accommodation needed to take over the organised control of fractures and other injuries. The "battle of the fractures" was over in the United Kingdom by the time of the opening of the 2nd World War, and the peacetime organisations were readily expanded to meet the new emergency of civilian populations exposed to the horrors of bombing.

Changing Pattern in Orthopaedics in the United Kingdom

If Dr. Kini had lived to be able to visit the United Kingdom during the past 10 years he would have noticed great changes in the pattern of orthopaedic practice. This change has been most striking in the field of children's orthopaedics. With the advent of the antibiotic era the severe destructive effects of *osteomyelitis* and *suppurative arthritis* are now rarely seen. Birth palsy has almost vanished from our clinical material, and the decline in the incidence of *bone* and *joint tuberculosis* and the rapid healing of such lesions under streptomycin therapy is one of the most dramatic features of the new pattern. In the United Kingdom we now have an excess of beds for the long-term treatment of physically handicapped children. But the incidence of *congenital deformities* and *spastic palsies* remains relatively constant, and we are not yet free from the risk of poliomyelitis epidemics. On the other hand there has been a steady increase in the

number of *serious accidents* in children, despite efforts to interest all concerned in preventive measures.

In adult orthopaedics the increase in numbers of accidents of road traffic, of domestic accidents in an ageing population, and the special hazards of the newer industries, provides a heavy load for the orthopaedic departments of the general hospitals. In the long-term problems, the gap created by the decline in bone and joint tuberculosis has been filled by the increasing field of the *reconstructive surgery of chronic arthritis*.

The Future of Orthopaedics

I now address my orthopaedic brethren. The wide field of our speciality now has an extensive and increasing literature. It is difficult for any one individual to keep in touch with the contributions from the many countries where orthopaedics is established as a speciality. In large orthopaedic units with an ample number of assistants a "literature circle" held at monthly intervals or more frequently is the only method of ensuring that all are kept abreast of advancing knowledge. Will the field of orthopaedics expand or contract in the future? There seems little likelihood of any appreciable expansion. Contraction might be the result of natural causes—the disappearance of certain diseases—or might be the result of erosion by other specialities. We should keep an open and tolerant mind on this question.

The young orthopaedic surgeon of the future should beware of becoming a mere operating machine. Orthopaedic surgeons have in the past given a lead in the educational and social problems connected with crippling disease, and have created and controlled the rehabilitation programmes which are of fundamental importance in the final restoration of useful function. In the

higher training period of the young orthopaedic surgeon, provision should be made for experience and instruction in the range of physical treatments which come under the heading of rehabilitation. All this was once our sole responsibility, and we should not be content to see it fall into the hands of those who do not pass through the long periods of clinical apprenticeship and discipline necessary to produce consultants in the major special fields of medicine and surgery.

In the teaching centres the orthopaedic surgeon must take a major share in the teaching of surgery—not as a specialist teaching elaborate techniques—but expounding the basic principles of diagnosis and treatment in the wide field of crippling diseases of the locomotor system.

Ours is a great heritage, and in the words of Isaac Newton, we stand on the shoulders

of those who have gone before. Orthopaedics was the first major speciality to emerge from the field of general surgery. It is now one of the two main divisions of general surgery, representing a large part of the old general surgery of the 19th century and early 20th century. I have elsewhere on several occasions spoken in India on the dangers of premature specialisation. In combating this danger orthopaedic surgeons must give a lead. The orthopaedic surgeon of the future must be a scholar, a teacher and a master craftsman. He must be responsive to the impact of the new scientific age. But as of old in common with his fellow surgeons in other major fields he will continue to need "the Eye of an Eagle, the heart of a Lion, and the hand of a Lady".

And so we salute the memory of Dr. M. G. Kini, a pioneer in the evolution of orthopaedic surgery in India, whose influence lives on amongst us today.

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OBSERVATIONS ON INDUCED CARDIAC ARREST ALONG WITH HYPOTHERMIA AS AN AID TO OPEN CARDIAC SURGERY

BY

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Introduction

With the advent of open cardiac surgery as very much of a practical possibility, the problems and disadvantages of operating on a beating heart have engaged the attention of surgeons and the idea of temporarily arresting the cardiac contractions and so obtaining a still and relaxed heart has gained increasing attention in the last few years. The advantages of induced cardiac arrest in cardiac surgery are obvious. A heart relaxed in diastole allows accurate visualization of the complex intra cardiac anatomy and helps the surgeon in the correction of such anatomical defects. Another great advantage of a temporary still heart from the operative view point is that a relaxed still heart allows better elimination of trapped air bubbles and thus prevents the great danger of air embolisation.

Cardiac arrest also leads to reduction of total cardiac metabolism and this may have significant bearing in the reduction of incidence of cardiac complications during and after intracardiac operations. Reduction of metabolism may particularly be of great importance when the cardiac inflow is occluded to obtain a dry field in open cardiac surgery without at the same incorporating a by pass pump oxygenator system. Winterschied et al (1958) have calculated that the energy production of the arrested heart is approximately 1/1000—1/2000 that of the isolated beating heart for the same time

interval. This procedure is currently routinely followed in many cardiac surgical clinics with the help of hypothermia. Delorme (1955) on the basis of his oxygen uptake studies has pointed out that the hypothermic process has relatively less reducing effect on the myocardial metabolism than on metabolism of other vital organs such as the brain, kidney, liver etc. It is known that the hypothermic heart with inflow occlusion undergoes a continuing and progressive hypoxia (Swan 1956) and the frequent incidence of fibrillatory complications in these hypothermic and inflow occlusive procedures may be explained on this basis (Moulder et al) and if such be the case, the added advantage of an arrested heart and consequent total metabolic suppression may be a great safety factor.

When combined with a pump oxygenator by pass system in open cardiac surgery, induced cardiac arrest would be further useful by eliminating the needless waste of continuous coronary sinus back flow. The amount of this back flow may be as much as 25% of the total pump output (Donald et al 1956). Besides continuously flooding the possible operative site, a loss of this amount may, unless adequately replaced, endanger the life of the subject.

Of the different methods whereby temporary safe and reversible cardiac arrest can be produced such as sudden sharp electrical stimulus to the myocardium, blockage

of the sinoatrial node, differential warming of myocardium by intrapericardial infusion, and the use of chemical cardioplegic drugs, the latter has proved most reliable and has up till now been most extensively used. The action of some of the electrolytes on the action of the myocardium has been known for many years. As early as 1883 Ringer mentioned that the beating rhythm of the heart depends on "the antagonizing action of calcium and potassium salts. If they are not in correct proportion, then the trace becomes abnormal. If too little potassium is present, then the contractions become broader and there results fusion of the beats. If too much potassium is present, or too little lime salts, then the contraction of the ventricle is imperfect and by increasing the quantity of the potassium salt, the beat becomes weaker and weaker till it stops".

Hooker in 1929, suggested that potassium inhibition could be used as a method of therapy in ventricular fibrillation and lately Montgomery et al (1954) have advocated the same principle in the management of hypothermic fibrillatory episodes.

In the study of the literature concerning the use of different chemical cardioplegic drugs, one comes across a number of conflicting views and reports.

Starting with the lead of Melrose in London in 1954, the action of potassium has been advocated by many surgeons including Cass and Brock (1958). Acetyl choline—the short acting anti-cholinesterase drug—has been used more recently and seems to have been enthusiastically received by Moulder (1956) and Swan (1956) and others.

Lam (1955, 1956 & 1958) after initially advocating potassium chloride seems to have changed completely over to the latter drug. While it would be unreasonable to expect

unanimity of opinion amongst different workers in the initial phase of a new field of development, the inconsistencies reported were such as to prompt us to experiment and assess our own observations in this important field.

Method

We have up till now used two salts of potassium viz. potassium citrate and chloride and also acetyl choline. The experiments were performed both in hypothermic as well as in a smaller number of normothermic animals. Adult monkeys weighing between 10 to 15 Kg were the test animals. They were anaesthetized with I.V. pentothal 30 mgm/Kgm body weight and intratracheal intubation was performed. The intratracheal tube was connected to an automatic respirator—ventilating at the rate of 30—40 cycles per minute. Cooling was performed by the immersion technique and also by rubbing ice on the surface. The range of hypothermia achieved varied from 29° to 30°C. Electrocardiographic hook up was attached in most animals.

Bilateral transternal thoracotomy was performed. The pericardium was extensively opened. The intrapericardial portions of the superior and inferior venae cavae were cleared and loops of thick silk thread were passed around them. They were subsequently occluded. After allowing 3 seconds for the heart to empty, the roots of the outflow vessels viz. the aorta and the pulmonary artery were occluded by a Potts clamp introduced through the transverse sinus. The specific cardioplegic drug was injected into the root of the aorta distal to the coronary ostia but proximal to the clamp. In a few cases it was injected into the left ventricle. After the estimated period of arrest, the outflow clamp was released first followed by the superior vena cava loop. The inferior vena cava loop was released

last. For resuscitative measures, we used manual cardiac massage, injections of atropine in the some of the acetyl choline cases, injections of calcium salts and in a few cases, coronary infusions of 10% sodium lactate solution.

Material

Acetyl Choline Arrest.—Table I gives the details of the cardiac arrest using acetyl choline in various concentrations varying from 50 mgm to 300 mgm in hypothermic animals. These findings may be compared to the results of the same experiment using normothermic animals which were controlled (Table II).

Comment

A few significant observations may be made and were quite apparent. Acetyl choline arrest is immediate and occurs within a few seconds of the administration of the drug. This finding is in contrast to the potassium induced arrest where there was often a long latent interval. Also the myocardium in acetyl choline arrest retains a certain amount of tone and is not completely flaccid. As a corollary to this, the revival of the cardiac rhythm and contractions was far easier with acetyl choline and was spontaneous. The incidence of fibrillation was much less and even when fibrillation did occur, its reversion to normal rhythm was easily accomplished. A very satisfactory antidote to acetyl choline is injection of atropine and when this drug was used, reversion was both smooth and quick.

The great disadvantage of acetyl choline arrest is its transitory and often incomplete nature. The period of total arrest varied from a few seconds to a maximum of 2 minutes and in some experiments, the arrest was not absolute. This was true both in normothermic as well as in hypothermic

animals and the duration of the state of total arrest could not be significantly increased by increasing the dose of acetyl choline even up to 300 mgm.

In normothermic animals also, the above features of the acetyl choline arrest were generally true. However, the recovery phase from asystole seemed to be even smoother than in hypothermic animals and there was no incidence of fibrillation in any of the animals.

It appears, therefore, that so far as acetyl choline induced arrest is concerned there is little to choose between the normothermic and the hypothermic states; in fact, hypothermia may be a disadvantage in some cases in initiating minor fibrillatory episodes in the recovery phase.

Potassium Induced Arrest

Tables III & IV give the results of potassium induced arrest in hypothermic and normothermic states. The dosage used varied from 75 to 300 mgm depending on the weight of the animal.

Comment

The potassium induced asystole is completely flaccid and absolute. The duration of the asystole varied from 5 minutes to a maximum of 19 minutes. However, in some cases, there was a definite and variable latent interval between the injection of the drug and the initiation of the arrest. With the release of the inflow occlusion, there was significant cardiac dilatation. This was followed by development of ventricular fibrillation in almost all the cases. The duration and the severity of the ventricular fibrillation was much more marked than in acetyl choline induced arrest and unlike atropine in acetyl choline induced arrest, there was no certain method of terminating and reverting the fibrillation.

TABLE I
Experiments on Cardiac Asystole under Hypothermia using Acetyl Choline

Expt. No.	Animal No.	Pre-Hypothermic Temp.	Temp. at Cardiac Arrest	Doses of Acetyl Choline	How revived	Time of Circulatory Arrest	Time of Complete Asystole	REMARK
56	M 26	39.5	29.5	100 mg at the root of aorta	Cardiac massage for 5 mins.	8 mins.	—	Incomplete asystole. Occasional irregular beats all along persisted. Regular beats came back after massaging. The animal died 6 hours later.
59	M 29	39	30	50 mg in left Ventricle	Cardiac massage for 2 mins.	5 mins.	30 secs.	Transitory asystole. When the Superior vena cava was opened after 5 mins., the heart was dilated and massaged for 2 mins. Regular beats came back. Animal died after 8 hours.
60	M 30	39	30	100 mg at the root of aorta	Cardiac massage for 5 mins.	5 mins.	1½ mins.	Phase of transitory asystole followed by irregular and occasional beats. Ventricles dilated after opening the Superior vena cava. It was massaged. Regular beats returned. Animal survived.
61	M 31	38	30.5	120 mg at the root of aorta	Spontaneous	5½ mins.	2 mins.	After transitory asystole regular beats returned and the animal survived.
65	M 35	38.8	30.5	150 mg + 150 mg at the root of aorta	Massage	5 mins.	2 mins.	After the initial dose of 150 mg. asystole was not observed. Another dose of 150 mg. was injected. This time it was successful. The heart dilated as soon as the inflow channels were opened. Massage. Regular beats returned. Died 1 hour later.
66	M 36	38	31	300 mg in the Lt. Ventricle	Massage and Atropine	4 mins.	1½ mins.	Asystole short lasting. Heart dilated after opening the inflow channels. Massage. Fibrillation. Inj. of grain 1/100 of atropine in the left ventricle. Regular beats returned. Animal survived.
67	M 37	38	30	300 mg in the Lt. Ventricle	Massage & Cal. Chloride in Lt. Ventricle	3 mins.	1½ mins.	Animal died on table, as a result of dilatation of the heart after opening the Superior vena cava and inferior vena cava.

Number of experiments

Conversion into sinus rhythm

— 7

— 6

Survival of animal more than 6 hours

— 5

Survival more than 24 hours

— 3

TABLE II
Experiments on Cardiac Asystole under Normothermic Condition using Acetyl Choline

Expt. No.	Animal No.	Body Temp.	Doses of Ac. Chol.	How revived	Time of Circulatory Arrest	Time of Complete Asystole	REMARK
51	M 21	41	25 mg in the root of Aorta	Spontaneous	3 mins.	62 secs.	Asystole immediate, complete but transitory. Revival spontaneous, Survival.
52	M 22	40	50 mg in the root of Aorta	Spontaneous	2½ mins.	2 mins.	Immediate complete asystole, Recovery spontaneous, Survival.
53	M 23	40	100 mg in the root of Aorta	Spontaneous	3½ mins.	3 mins.	Near complete asystole, Recovery spontaneous, Survival.
54	M 24	39	100 mg in the root of Aorta	Spontaneous	3 mins.	2½ mins.	Asystole complete but transitory, Recovery spontaneous, Survival.
55	M 25	39.5	100 mg in the root of Aorta	Massage	3 mins.	2½ mins.	Asystole immediate and complete, Revival after 2 minutes of massage, Survival.

Total number of experiments — 5
Conversion to sinus rhythm and survival — 5

TABLE III
Experiments on Cardiac Asystole under Hypothermia using Potassium Salts

Expt. No.	Animal No.	Pre-Hypothermic Temp.	Temp. at Cardiac Arrest	Doses of Potassium Salt	How revived	Time of Circulatory Arrest	Time of Complete Asystole	REMARK
44	M 14	41.5	32	75 mg K-Citr. in L.V.	Massage	5 mins.	—	Only slowing of Heart after 2 inj. of 1 c.c. and ½ c.c. Dilatation of heart after release of occlusion. Regular rhythm after massage.
45	M 15	39.5	29	250 mg K-Citr. in L.V.	No revival	6 mins.	—	Immediate complete asystole Dilatation of heart after release of clamp, Massage. No revival.
46	M 16	40	31	250 mg K-Citr. in L.V.	Spontaneous	6 mins.	5½ mins.	Spontaneous revival following arrest.
47	M 17	39	30	150 mg K-Citr. in L.V.	No revival	5 mins.	—	Incomplete asystole, Cardiac dilatation following release of occlusion, Fibrillation, Death.
48	M 18	40	33	150 mg K-Citr. in L.V.	Massage for 5 mins.	5 mins.	10 mins.	Complete immediate asystole. Dilatation of heart after inflow occlusion. Weak contraction following massage, Death.
49	M 19	40.5	31	150 mg K-Citr. in Aorta	Massage & Inj. of 2 cc CaCl ₂ in L.V.	5 mins.	17 mins.	Asystole immediate, Weak fibrillation following massage for 2 mins, Rhythmic contraction after inj. of CaCl ₂ and massage for 10 mins, Survival.
50	M 20	40	33	150 mg K-Citr. in Aorta	Massage & Inj. of 3 cc CaCl ₂ in L.V.	6 mins.	12 mins.	CaCl ₂ injected into ventricle before release of outflow clamp, Fibrillation, Massage, Regular rhythm after 5 mins, Survival.
68	M 38	38	30	150+150 mg of K-Citr. in L.V.	Massage	3 mins.	—	Asystole incomplete for 2 mins, Dilatation of Heart, Ventricular fibrillation, Massage, Normal rhythm after 5 mins, Survival.
70	M 40	39	31	300 mg K-Citr. in L.V.	Massage	3½ mins.	13½ mins.	Asystole 2 mins, after Injection, Dilatation of Heart following release of outflow clamp, Fibrillation following 5 mins, massage, Normal rhythm after massage, Survival.
71	M 41	39.5	31	200 mg K-Citr. in L.V.+ 50 mg in Aorta	Massage & 6 c.c. M. Sod. Lact. in L.V.	5 mins.	17 mins.	Asystole 3 mins, after Inj. Dilatation of heart after release of inflow vessels, Cardiac Massage, Fibrillation, Regular rhythm after 17 minutes, Survival.
72	M 42	38.5	30	3 cc 15% KCl in L.V.	Massage	5 mins.	15 mins.	Incomplete asystole, Dilatation of heart after release of inflow vessels, Massage, Normal complexes returned after 15 mins, Survival.

Total number of Experiments — 11

Return of Sinus rhythm and survival — 8

TABLE IV
Experiments on Cardiac Asystole under Normothermic Condition using Potassium Salts

Expt. No.	Animal No.	Body Temp.	Doses of Potassium Salts	How revived	Time of Circulatory Arrest	Time of Complete Asystole	REMARK
40	M 10	39.5	3 cc 15% KCl in L. V.	3 cc M. Sod. Lact in L. V. & Massage	2½ mins.	4 mins.	Immediate asystole. Dilatation of heart following release of inflow. Fibrillation. Massage. Infusion of Sod. Lact. Normal rhythm after 3 minutes. Survival.
41	M 11	41	5 cc 15% KCl in L. V.	Could not be revived	3 mins.	—	Incomplete asystole. Dilatation of heart following release of inflow. 5 cc of M. Sod. Lact. infused in L. V. Massage for 20 minutes. Death.
42	M 12	40	3 cc 15% KCl in L. V.	5 cc M. Sod. Lact in L. V. & Massage	3 mins.	8 mins.	Immediate complete asystole. Dilatation of heart following release of inflow. Infusion of M. Sod. Lact. in L. V. Massage for 5 minutes. Revival of normal rhythm. Survival.
43	M 13	40	2 cc 15% KCl in L. V.	"	3 mins.	30 secs.	Immediate asystole but incomplete. Infusion of M. Sod. Lact. in L. V. and massage for 3 mins. Regular rhythm. Survival.
57	M 27	39.5	150 Mg K-Citr. in the root of Aorta	Could not be revived	3 mins.	—	Complete asystole and atony of heart. Massage after infusion of 3 cc M. Sod. Lact. in L. V. Death.
58	M 28	38	"	"	3 mins.	8 mins.	Asystole incomplete. Enormous dilatation of heart following inflow release. Cardiac massage and infusion of 5 cc M. Sod. Lact. in L. V. Revival after 5 mins. followed by death.
62	M 32	38.5	150 Mg K-Citr. in L. V.	"	3 mins.	—	Immediate asystole. Myocardium atonic. Massage for 5 minutes. Fibrillation. Death.
					Total number of experiments		— 7
					Conversion to sinus rhythm		— 4
					Survival		— 3

Discussion

It appears to us that if induced cardiac arrest is to become a standardized procedure in open cardiac surgery, potassium salts are likely to be more helpful than acetyl choline. The complete flaccidity of the myocardium and the long duration of the asystole in potassium induced arrest are in contrast with the incomplete and transitory nature of the asystole obtained with acetyl choline. From the operative surgeon's view point, these are definite advantages in enabling better visualization and accurate correction of the intracardiac defect. The disadvantages of the potassium induced arrest are the invariable dilatation of the heart following release of the inflow occlusion and the development of a severe degree of ventricular fibrillation before reversion to sinus rhythm.

The former may be obviated to some extent by delaying releasing the inflow after the release of the outflow clamp, until rhythmic contractions start, and by again delaying the release of the I. V. C. after the release of the S. V. C. clamp. This procedure is at present being investigated by us.

For the fibrillatory complication, we used manual cardiac massage, intraventricular injection of calcium chloride and coronary infusion of sodium lactate solution. It is difficult to exactly assess the value of the different procedures from the limited number of experiments carried out so far but a few observations may be made.

Manual cardiac massage is definitely helpful and if persisted in for a long time, will be successful. We have had reversion to normal rhythm even after 19 minutes of fibrillation and massage. In the two cases in which calcium chloride injection was used, reversion was obtained after some

time but it is difficult to judge how far the massage or the drug was effective and certainly its effect is not so immediate or specific as the use of atropine in acetyl choline induced arrest. Coronary infusion of sodium lactate solution was disappointing as only 4 of the 7 animals survived. It has been recently reported that continuous coronary infusion of oxygenated whole blood may have definite advantages (Cass 1958) and further experiments are being carried on by us from this aspect.

The benefits of the hypothermic state in the potassium induced arrest are undoubted. 8 out of 11 animals where hypothermia was used survived whereas in the normothermic group survival was rare. Even in those cases where the fibrillatory stage lasted for more than 15 minutes and was ultimately reverted by massage, the animals under hypothermia did not suffer any ordinarily detectable brain damage.

It may, therefore, well be said that in future the combination tread of moderate hypothermia, potassium induced arrest and the use of a pump oxygenator with infusion of oxygenated whole blood would be the standard procedure in open cardiac surgery. At the present time, this combination appears to be a relatively safe procedure and will give the surgeons reasonably sufficient time to correct intracardiac anomalies in a still and relaxed heart.

Summary

Acetyl choline and potassium salts were used to obtain a state of temporary cardiac arrest along with inflow occlusion to the heart. The experiments were performed in hypothermic as well as in normothermic animals. Altogether 30 experiments have been performed so far.

The characteristics of acetyl choline arrest are its immediate onset and transitory

nature varying from $\frac{1}{2}$ to 2 minutes. The myocardium is not completely relaxed. The duration of the asystole cannot be significantly increased by increasing the dosage of the drug even up to 300 mgm. The incidence of ventricular fibrillation in the recovery phase, is mild in hypothermic and was absent in the normothermic animals. Fibrillation was immediately reverted by atropine.

In potassium induced arrest, there was often a variable latent interval between the injection and the initiation of the arrest. The myocardium become completely flaccid.

The duration of the arrest period was long—up to a maximum of 17 minutes in this series of experiments and could be further prolonged if desired. The incidence of ventricular fibrillation was invariable in the recovery phase. Its intensity was severe and there was no certain method of its reversion.

Hypothermia was definitely helpful in potassium induced arrest so far as the survival of the animal was concerned. In the acetyl choline group, its usefulness was questionable.

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ELECTIVE CARDIAC ARREST FOR OPEN CARDIAC SURGERY

Studies in Chemical Cardioplegia with and without Hypothermia

AN EXPERIMENTAL STUDY

BY

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Introduction

This paper is concerned with studies in temporary cardiac arrest produced by certain drugs given by coronary perfusion for the purpose of obtaining a quiet and bloodless heart during cardiac operations. With the general acceptance of the fact that open cardiac surgery is not just an essay into the future but very much a thing of the present, the difficulties and problems of open heart surgery are engaging our attention more and more.

A contracting heart is the natural enemy of visual and definitive intracardiac procedures. A moving and contracting heart is incapable of adequate retraction and internal visualisation, precludes accurate surgical or plastic techniques, anatomy is difficult to recognise, and sutures applied to a contracting heart are less likely to hold. On opening, air enters, gets trapped and is forced on as a bolus in the circulation blocking the coronary, cerebral, visceral or peripheral arteries. Lastly, a heart in diastolic arrest rules out ventricular fibrillation. Cardiac metabolism is at a minimum in diastolic arrest and a flabby, relaxed, 'dead' organ is ideal for delicate and definitive intracardiac procedures such as septal repairs and valvular replacement.

Early in 1954 Melrose¹ in London, reported the use of coronary perfusion of 25% potassium citrate dissolved in blood to obtain artificial cardiac standstill. This is not at all a new idea as potassium was originally used by Hooker² and Wiggers³ in 1929 for prevention of ventricular fibrillation and is a natural antifibrillatory agent for the ventricles. When perfused through the coronaries it also led to temporary cardiac standstill and as such was the first drug to be tried for elective cardiac arrest. Subsequently other drugs have been used—Acetylcholine by Bjork⁴ and later by Lam⁵ and others. Later, Magnesium was tried, singly and in combination with other drugs (Young et al)⁶. The results reported by various workers were however confusing and in many instances inconsistent. We accordingly decided to embark on a series of our own.

The work undertaken so far consists of six phases. They were not pre-planned but developed according to experience gained as we experimented with various cardioplegic drugs.

These are as follows:—

1. Use of potassium citrate alone. This was repetition of work along the lines pursued by Melrose.

- 2. Use of acetyl-choline alone, along the lines used by Bjork and others.
- 3. Combination of potassium citrate in different concentrations with acetyl-choline.
- 4. Use of potassium-citrate with acetyl-choline under hypothermia.
- 5. Use of potassium chloride with acetyl-choline under hypothermia.
- 6. Use of Magnesium sulphate, Potassium citrate, and prostigmine as used by Young and others, under hypothermia.

The investigation is being continued and this communication is in the nature of a first report.

Adult healthy mongrel dogs weighing between 10-15 kg. were used throughout. Anaesthesia was induced by intravenous sodium pentothal not exceeding 30 mg./kg. body weight. Pre-medication was not employed. Positive pressure ventilation with air by a respiratory pump through an endotracheal tube was commenced from the start and except in those animals where hypothermia was used the rate of ventilation was 20 per minute. Those undergoing hypothermia were ventilated at 48 times per minute.

The chest was opened through the 4th interspace with a transverse incision carried across the front of the chest, the sternum being divided after the internal mammary arteries had been ligated. The superior and inferior venae cavae were dissected and loops of silk placed around them. The azygos vein was ligated. The fat, fascia and connective tissue in front of the pericardium were dissected and lifted off the roots of the great vessels. The preaortic body of fat was excised and the root of the ascending aorta dissected free with a mixer forceps. A loop of stout silk or twine was then placed around the aortic root. Inflow

occlusion was practised in all these cases, before bringing about chemical cardiac arrest to prevent the right side of the heart being over distended by the returning blood (Fig. 1).

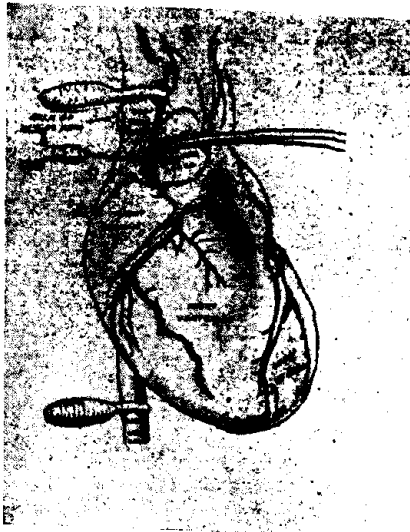


Fig. 1.
Diagram illustrating technique of elective cardiac arrest (chemical cardioplegia).

Electrocardiographic monitoring continued throughout the procedure, the standard limb lead II being the most frequently used lead.

A time keeper with a stop watch marked all the important steps. After the dissection of vessels was complete, bulldog clamps were applied on the venae cavae and a clamp placed around the ascending aorta about an inch from the aortic valve (a snare of the Rumel type using a silk loop placed around the aorta has also been used in some of our cases, but this has a tendency to cut through). The cardioplegic drug was then injected into the ascending aorta through No. 18 gauge B. D. needle until the heart came to a stop in diastole. Following the injection of a dose of cardioplegic solution a certain time interval was allowed to elapse

TABLE No. 1
Showing results obtained with the use of potassium citrate

Serial No.	Dog No.	Weight in kg.	Temp. °C	Drugs used	Duration of diastolic arrest	Revival	Ventricular fibrillation during revival	Brain damage	Restitutive Measures
1	6	13	30	Pot. cit. 1250 mgms. 25% 5 ccs.	4 Mins.	No	Yes	Yes	Massage, calcium chloride, adrenalin.
2	8	14	31	Pot. cit. 400 mgms. 10% 4 ccs.	4 Mins.	No	Yes	Yes	Massage, calcium chloride, neostigmine.
3	11	13.5	32	Pot. cit. 800 mgms. 5% 16 ccs.	4 Mins.	No	Yes	Yes	Massage, calcium chloride.
4	19	14	31	Pot. cit. 400 mgms. 5% 8 ccs.	2 Mins.	No	Yes	Yes	Massage, calcium chloride.
5	20	15	32	Pot. cit. 250 mgms. 5% 5 ccs.	2 Mins.	No	Yes	Yes	Massage, calcium chloride, Neostigmine.
6	23	10	28	Pot. cit. 1000 mgms. 5% 20 ccs.	2 Mins.	No	Yes	Yes	Massage, calcium chloride, Neostigmine.
7	27	11	37	Pot. cit. 750 mgms. 5% 15 ccs.	1 Min.	No	Yes	Yes	Massage, adrenalin, cal. gluconate & neostigmine.
8	29	14	37	Pot. cit. 550 mgms. 5% 11 ccs.	1 Min.	No	Yes	Yes	Massage, adrenalin, cal. gluconate & neostigmine.
9	31	14	37	Pot. cit. 750 mgms. 5% 15 ccs.	1 Min.	No	Yes	Yes	Massage.

TABLE No. 2

Showing Results obtained with use of Acetyl-choline (Ac. ch.)

Serial No.	Dog No.	Weight in kg.	Temp °C	Drugs used	Duration of diastolic arrest	Revival	Ventricular fibrillation during revival	Brain damage	Restitutive Measures
1	32	12	37	Ac. ch. 120 mgms.	25 secs.	Yes	No	No	—
2	33	15	37	Ac. ch. 150 mgms.	less than 1 minute	No	Yes	—	Massage.
3	34	20	37	Ac. ch. 200 mgms.	less than 1 minute	Yes	No	No	—
4	36	15	37	Ac. ch. 150 mgms.	less than 1 minute	Yes	No	No	—
5	38	15	37	Ac. ch. 150 mgms.	less than 1 minute	Yes	No	No	—
6	40	15	37	Ac. ch. 150 mgms.	less than 1 minute	Yes	No	No	—
7	41	15	37	Ac. ch. 150 mgms.	less than 1 minute	Yes	No	No	—
8	42	15	37	Ac. ch. 150 mgms. Eserine 2 mgms.	20 seconds.	Yes	No	No	—
9	44	15.5	37	Ac. ch. 150 mgms.	20 seconds.	Yes	No	No	—

TABLE No. 3

Showing Results obtained with combination of potassium citrate 1% and Acetyl-choline

Serial No.	Dog No.	Weight in kg.	Temp °C	Drugs used	Duration of diastolic arrest	Revival	Ventricular Fibrillation during revival	Restitution time	Brain damage	Restitutive Measures
1	45	10.2	37	Pot. cit. Ac. ch.	4 mins.	Yes	Yes	6 mins.	Yes	Massage.
2	46	9.75	37	Pot. cit. Ac. ch.	2 mins. 15 secs.	Yes	Yes	10 mins.	Yes	Massage.
3	48	16.5	37	Pot. cit. Ac. ch.	5 mins.	No	Yes	—	—	Massage.
4	49	14	37	Pot. cit. Ac. ch.	5 mins.	Yes	Yes	4 mins.	Yes	Massage.
5	51	14	37	Pot. cit. Ac. ch.	2 mins.	Yes	Yes	20 mins.	Yes	Massage and Cal. chloride.

TABLE No. 4

Showing Results obtained with combination of potassium citrate 1% and acetyl-choline under hypothermia

Serial No.	Dog No.	Weight in kg.	Temp °C	Drugs used	Duration of diastolic arrest	Revival	Ventricular fibrillation during revival	Restitution time in mins.	Restitutive Measures	Brain damage
1	50	14	32	Pot. cit. 100 mg., Ac. ch. 150 mg.	7 mins.	Yes	Yes	20	Massage	Doubtful
2	52	14	32	Pot. cit. 100 mg., Ac. ch. 100 mg.	4 mins.	Yes	Yes	5	Massage	No
3	53	10	32	Pot. cit. 80 mg., Ac. ch. 100 mg.	4 mins.	Yes	Yes	5	Massage	Yes
4	54	7.5	32	Pot. cit. 60 mg., Ac. ch. 60 mg.	3½ mins.	Yes	Yes	4	Massage	Yes
5	55	13.5	31.5	Pot. cit. 100 mg., Ac. ch. 100 mg.	3 mins.	Yes	Yes	20	Massage & Cal. Chloride	No
6	56	13	32	Pot. cit. 90 mg., Ac. ch. 90 mg.	3 mins.	Yes	Yes	4	Massage	No
7	57	12	32	Pot. cit. 100 mg., Ac. ch. 100 mg.	3 mins.	Yes	Yes	15	Massage	No
8	58	8	32	Pot. cit. 60 mg., Ac. ch. 80 mg.	3 mins.	No	Yes	—	Massage & Cal. Chloride	—
9	59	7.5	32	Pot. cit. 45 mg., Ac. ch. 60 mg.	3 mins.	No	Yes	—	do.	—
10	60	13.5	32	Pot. cit. 100 mg., Ac. ch. 100 mg.	3 mins.	Yes	Yes	1	Massage	No
11	61	10.5	31	Pot. cit. 100 mg., Ac. ch. 100 mg.	2½ mins.	Yes	Yes	2	Massage	No
12	62	11	32	Pot. cit. 80 mg., Ac. ch. 80 mg.	2½ mins.	Yes	Yes	1	Massage	No
13	64	14	30	Pot. cit. 100 mg., Ac. ch. 100 mg.	3 mins.	Yes	Yes	1	Massage	Doubtful

TABLE No. 5

Showing Results obtained with Potassium Chloride 1·2% and Acetyl-choline under hypothermia

Serial No.	Dog No.	Weight in kgs.	Temperature	Drugs used		Duration of diastolic arrest	Revival	Ventricular Fibrillation during arrest	Restitution time	Restitutory Measures	
1	74	12.5	30° C	Ac. ch.	60 mgms.	P— 36 mgms.	3 mins.	Yes	No	1 min.	Massage
2	75	14.25	30° C	Ac. ch.	100 mgms.	P— 60 mgms.	1 min.	No	Yes	—	Massage
3	76	15.70	30° C	Ac. ch.	140 mgms.	P— 84 mgms.	3 mins.	No	Yes	—	Massage Ca. Cl.
4	77	15.20	30° C	Ac. ch.	140 mgms.	P— 84 mgms.	3 mins.	Yes	No	3 mins.	Massage
5	78	14.00	30° C	Ac. ch.	160 mgms.	P— 96 mgms.	3 mins.	Yes	No	1 min.	Massage
6	80	14.70	30° C	Ac. ch.	180 mgms.	P— 108 mgms.	4 mins.	No	Yes	—	Massage Ca. Cl.
7	81	14.00	30° C	Ac. ch.	280 mgms.	P— 168 mgms.	3 mins.	Yes	Yes	7 mins.	Massage
8	82	16.60	30° C	Ac. ch.	180 mgms.	P— 108 mgms.	4 mins.	No	Yes	—	Massage
9	83	12.75	30° C	Ac. ch.	160 mgms.	P— 96 mgms.	2 mins.	Yes	Yes	6½ mins.	Massage
10	84	13.12	30° C	Ac. ch.	140 mgms.	P— 96 mgms.	3 mins.	Yes	Yes	6½ mins.	Massage

TABLE No. 6

Showing results obtained with { Magnesium Sulphate — 2·47 gms./100 ccs. } under hypothermia
{ Potassium citrate — 0·54 gms./100 ccs. }
{ Prostigmine — 1 mgm./100 ccs. }

Serial No.	Dog No.	Weight in kgs.	Temperature	Amount of drugs used	Duration of diastolic arrest	Revival	Ventricular fibrillation during revival	Restitution time	Restitutive Measures
1	92	13·25	30° C	20 ccs.	3 mins.	Yes	No	3 mins.	Massage Ca. Cl.
2	93	10·00	30° C	17 ccs.	3 mins.	No	No	—	Massage Ca. Cl.
3	94	15·85	30° C	20 ccs.	3 mins.	No	Yes	—	Massage Ca. Cl.
4	95	14·37	30° C	20 ccs.	2 mins.	Yes	No	3 mins.	Massage
5	96	10·85	30° C	15 ccs.	3 mins.	Yes	Yes	23 mins.	Massage Ca. Cl.
6	98	14·20	30° C	16 ccs.	3 mins.	Yes	No	2 mins.	Massage
7	99	15·60	30° C	20 ccs.	3 mins.	Yes	No	4 mins.	Massage
8	100	16·75	30° C	35 ccs.	2 mins.	Yes	No	2½ mins.	Massage
9	101	12·50	30° C	20 ccs.	3½ mins.	No	Yes	—	Massage Ca. Cl.
10	102	11·25	30° C	16 ccs.	4 mins.	Yes	No	2 mins.	Massage

depending on the type of arrest. With some drugs like acetyl-choline resumption of heart action occurred in a very short time. In others it was a few minutes before steps were taken to wash out the cardioplegic solution from the coronary circuit. In these cases the needle was removed and re-inserted after a few minutes. Various substances were used to wash out the cardioplegic drug, e.g. whole blood, Ringer's solution, 5% glucose, normal saline and 10% sodium lactate. As soon as the heart started to beat again slowly and definitely both inflow and outflow clamps were released and artificial ventilation of the lungs re-started. In many instances injections of calcium, adrenalin, and cardiac massage were necessary for proper restitution of heart beats to regular and normal rhythm. The chest was then closed in layers without drainage.

Cooling of the dogs where hypothermia was used was done by immersion in ice cold water bath (at 4°C) and warming later in water at a temperature of 45°C. This technique has been described in detail by us in an earlier paper and is now a standardised procedure. Hypothermia used in this series has been of moderate depth—around 28°C, measured by a high rectal electrode.

Data

The material and observations of our experiment are set out in tables 1, 2, 3, 4, 5 and 6. The first group (Table 1) deals with our initial experiments which were of the nature of pilot procedures where only potassium citrate was used. In the first dog a solution of 25% potassium citrate was employed and in the next a 10% solution. 5% potassium citrate solution was used in the rest of this group. A solution of 2½ to 5% strength of potassium citrate has been used by most workers with adequate cardioplegic effects. The amount of potassium citrate injected varied from 250 mg. to 1250 mg. The

speed of injection was rapid but varying amounts of the solution may have regurgitated into the left ventricle through an open aortic valve accounting for this marked variation in the amount of drug necessary to produce complete diastolic cardioplegia. 9 animals were treated thus. All these hearts went into ventricular fibrillation when attempts to restore normal rhythm were made after maintaining diastolic arrest varying from 1 to 4 minutes. The restitutive measures varied somewhat but generally consisted of manual cardiac compression (massage), injection of calcium chloride, adrenalin and occasionally neostigmine into the ascending aorta after cross clamping, so as to ensure coronary perfusion of the drug.

Table No. 2.—In this series only acetyl-choline was used. 9 dogs were treated thus. A dose of acetyl-choline equivalent to 10 mg. per kg. body weight was injected into the ascending aorta after cross clamping. The speed of injection was rapid and it is thought that most of the drug entered the coronary system. Diastolic arrest occurred in all within a few seconds but was effective for a very short time—less than one minute. Ventricular fibrillation developed in only one instance which did not respond to massage. Normal rhythm was restored in all except in the one instance where ventricular fibrillation developed.

In all animals where restoration to normal rhythm took place there was no evidence of brain damage within the next 24 hours or even later. 2 dogs were sacrificed on the table for other purposes and therefore presence or absence of brain damage could not be determined. The longest survival time was 8 days.

Table No. 3.—In this series acetyl-choline and potassium citrate were used together. Acetyl-choline in the same dose as in group 2

(10 mg. per kg. body weight) and potassium citrate, a 1% solution varying between 60 to 100 mg. 5 dogs were treated thus. Rapid diastolic arrest occurred in all and attempts to reconstitute normal rhythm were made after 2 to 5 minutes of arrest. 4 animals were revived to normal rhythm with the use of massage alone except in one instance where calcium chloride was required. Ventricular fibrillation developed in all these animals during attempts at restitution to normal rhythm. In one animal ventricular fibrillation remained permanent. The time for restitution ranged between 4 minutes to 20 minutes. Evidence of brain damage was apparent in all.

Table No. 4.—13 animals were treated in this group in which acetyl-choline and potassium citrate were given in the same manner as in Group 3, except that hypothermia was first induced ranging between 30°C and 32°C (rectal temperature). Diastolic arrest occurred immediately on rapid injection and was maintained between 2 to 7 minutes after which restorative measures were started. Injection of intracoronary calcium chloride was used in 3 animals besides massage. Reversion to normal rhythm took place in all before reversion. Restitution time varied between ½ minute to 20 minutes. Brain damage was doubtful in two and definite in two. The remaining of those who survived for the first 24 hours did not show evidence of brain damage. There were no long time survivals. However this was not aimed at as the experiments were in the nature of acute studies.

Table No. 5.—Potassium chloride 1.2% and acetyl-choline 2% combination was used in 10 dogs, after inducing hypothermia of 30°C. Diastolic arrest ranging from 1 to 4 minutes was obtained in all cases with amounts of acetyl-choline varying between

60 and 280 mgms. and of potassium-chloride between 36 and 168 mgms. 6 dogs were revived with cardiac massage of 1 to 7 minutes' duration while the remaining 4 did not respond to either massage or calcium-chloride which was injected in two of these. Ventricular fibrillation occurred in 7 out of 10 animals during restitution. The results obtained in this group appear to resemble those in Group 4, except that incidence of ventricular fibrillation during revival was lower with this combination.

Table No. 6.—A series of 10 animals was treated with a mixture of cardioplegic drugs containing Magnesium-sulphate 2.47 gms. per 100 ccs., Potassium-citrate 0.54 gms. per 100 ccs. and Prostigmine 1 mgm. per 100 ccs., after induction of hypothermia of 30°C (rectal temperature). Diastolic arrest ranging from 2 to 4 minutes was maintained in all cases before attempts at restitution were made. The arrest in all these cases did not occur immediately on injection of the cardioplegic mixture but came on from ½ to 2 minutes after the injection. 7 animals were restored to normal rhythm by massage, with calcium chloride injections in some cases. Restitution time varied from 2 to 23 minutes. An observation that at once strikes one's attention was that ventricular fibrillation occurred in only 3 of these dogs during restitution, of which 1 was revived to normal rhythm after 23 minutes of cardiac massage combined with injection of 4 ccs. of 10% calcium-chloride into the coronary system, while the other 2 could not be revived at all.

Conclusions and Discussion

Certain definite facts emerge from a study of these separate groups. Much of this is old physiological knowledge, but they make an interesting study when seen in the comparative light of possible therapeutic application.

Acetyl-choline has the most rapid action in producing diastolic arrest. But this arrest is often not complete and vagal escape soon occurs leading to very early recovery from arrest. Potassium arrest is both rapid and complete but recovery from acetyl-choline arrest is early, definite and unaccompanied by ventricular fibrillation while recovery from potassium arrest is uncertain, often late and accompanied by ventricular fibrillation during restitution. It almost seems as though the return passage to normal rhythm is *via* ventricular fibrillation. A combination of acetyl-choline and potassium appears to have a balanced action of both—*i.e.* rapid diastolic arrest of relatively shorter duration and easier restitution of rhythm. The incidence of ventricular fibrillation with this mixture however appears to be almost as frequent as with pure potassium. The action of potassium in producing cardiac arrest and its use together with other agents as prostigmine and glucose for potentiation effects has been studied by several workers (Jordan et al)⁷ who have found a glucose-potassium mixture more useful than acetyl-choline or magnesium.

Magnesium sulphate used in lower concentrations failed to produce an arrest.—20 ccs. of 1% solution only slowed the heart-rate moderately. In higher concentrations this salt showed a tendency to produce ventricular fibrillation. Injection of 20 ccs. of 3.69% solution resulted in ventricular fibrillation 30 seconds after the completion of the injection and 20 ccs. of 10% solution caused ventricular fibrillation while the last few ccs. were still being injected.

A mixture of Magnesium sulphate, Potassium citrate and Prostigmine produced a slower but definitive diastolic arrest with the least incidence of ventricular fibrillation, and a highly reversible type of cardiac standstill.

In a series at present under trial, we are using a mixture of Magnesium Sulphate, Potassium citrate and Acetyl-choline. The results obtained with this mixture will be the subject of a future communication, but the early indications are that this may prove to be superior to the other mixtures tried thus far.

While a suitable explanation for the occurrence of ventricular fibrillation during recovery from potassium asystole has not been established, one can be offered on the basis of K-glucose linkage. Fenn⁸ has postulated that potassium linked with phosphate produced hexosephosphate when glucose in association with insulin was available. The potentiating effect of insulin in potassium—produced asystole has strengthened this belief of potassium effect being prolonged when linked with endogenous glucose. It is possible that such linkage takes place even when glucose is added to potassium as a diluent. This bond apparently is a fairly firm bond and requires a special catalase for its disruption. Sodium lactate has been used for this purpose as reported by Jordan et al. It is our belief that in order to avoid ventricular fibrillation electrical neutrality of the myocardium must be maintained at all times during induction as well as the recovery phase of cardiac asystole. This may be difficult if excess potassium gets linked in strong bonds with glucose and does not leave the myocardium smoothly and equally. Thus areas may develop in the myocardium during resuscitatory measures which contain a greater or lesser amount of potassium in such bondage leading to an irregular distribution of this ion producing electrical instability of the ventricular muscle. Such irregular distribution of electrical potential has been described with the anoxic heart leading to fibrillation. It has also been further postulated that these potential difference in anoxia are associated with irregular

movements of the K-ion through the cell membrane. It is our submission that a similar state develops when potassium is used to induce asystole. The distribution of potassium is fairly equal when it is injected and perfused through the coronaries but during the recovery phase the excess potassium leaves the heart muscle patchily, being held in bondage, leading to the development of irregular areas of electrical potential and ventricular fibrillation. When rhythmic cardiac compression is instituted and coronary flow thus restored for a time, the excess potassium in these patchy areas is finally removed. The heart muscle then settles down to a pattern of electrical stability and resumes its normal rhythmic behaviour.

Summary

Experiments with the use of certain drugs in producing temporary cardiac arrest by coronary perfusion for purposes of open heart surgery are reported, both at normal temperatures and under hypothermia.

56 experiments were done consisting of six groups.

1. Use of potassium citrate alone.
2. Use of acetyl-choline alone.
3. Combination of potassium citrate and acetyl-choline.
4. Combination of potassium citrate and acetyl-choline under hypothermia.
5. Combination of potassium-chloride and acetyl-choline under hypothermia.

6. Combination of Magnesium-sulphate, Potassium citrate and prostigmine.

Potassium citrate alone is not satisfactory because of very low rate of recovery from cardiac arrest. Acetyl-choline produces rapid and often incomplete cardiac arrest, with rapid recovery but the duration is unsuitable for open heart surgery.

Combination of potassium citrate and acetyl-choline is more effective and produces rapid arrest, with a high percentage of recovery from arrest. Combination of potassium chloride with acetyl-choline gives almost the same results but with lower incidence of ventricular fibrillation.

A combination of Magnesium-sulphate, Potassium-citrate and Prostigmine produces a definitive but delayed arrest, with a very low incidence of ventricular fibrillation and a highly reversible type of cardiac standstill. In the series under study at the moment, acetyl-choline is being used instead of prostigmine in this mixture with a purpose to achieve a quicker onset of arrest. This mixture appears to be (on the limited data available) the best agent investigated by us so far.

Wherever potassium citrate has been used either singly or in combination ventricular fibrillation seems to occur in most cases during recovery to normal rhythm. The mechanism of onset of ventricular fibrillation during these procedures is discussed. This tendency towards ventricular fibrillation production by potassium appears to be countered by the use of Magnesium ion and acetyl-choline in combination with potassium.

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THE AMELIORATION OF SEVERE AORTIC REGURGITATION BY USE OF THE HUFNAGEL VALVE*

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Aortic insufficiency has long been a challenge to those interested in cardiovascular lesions. When it develops slowly over a prolonged period the heart maintains compensation for a time by marked hypertrophy of the left ventricle. As the ventricular muscle mass increases there is a corresponding demand for an enlarged blood supply at a time when the amount delivered tends to become less as the valvular insufficiency becomes more extreme. Inevitably the time comes when the markedly hypertrophied left ventricle is unable to cope with the increased load and the diminished vascularity. The more quickly the process develops, as in some luetic lesions, the quicker the ventricle fails.

Attempts to construct an artificial valve to be inserted at the site of the damaged aortic valve have been complicated by the need to prevent valvular insufficiency and yet not occlude the orifices of the coronary arteries. The problem has been most extensively studied by Hufnagel¹ and his associates who have been working on this problem since 1944. After a long series of experiments the valve which we have used was developed by them. It is a ball-valve type which permits free flow in one direction, peripherally and prevents regurgitation centrally (Fig. 1). The ball itself is of hollow nylon, covered with siliconized rubber. This is contained within a plexiglass channel. The newer models are much less

noisy than the earlier ones although the clicking sound of closure is easily audible with a stethoscope and may also be heard when the examiner's ear is kept close to the patient's open mouth. The valve lies in close proximity to the left main bronchus and the sound is easily transmitted up this column of air. The weight of the ball is critical so that it changes position quickly with any change in flow.

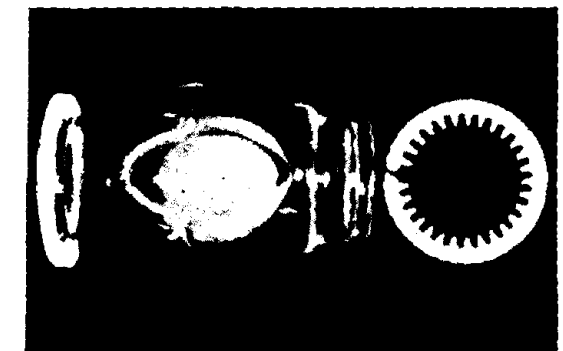


Fig. 1

Photograph of Hufnagel Valve showing one of the multiple point fixation rings, dis-assembled from the valve. The siliconized, rubber-covered nylon ball allows blood to flow in one direction and checks any flow in the opposite direction.

The biggest problem in the development of the valve was to devise a method of rapid but secure fastening of the valve in the aorta. A circumferential ligature, for instance, would soon cause sloughing of the end of the aorta. The evolved procedure

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seems eminently satisfactory and yet simple. Each valve comes with two split nylon rings which can be slipped over the aorta (Fig. 1). They have teeth which, when the ring is closed, hold the aortic wall in close proximity to the valve but do not completely penetrate the wall and also allow the vascular supply to pass between the teeth to nourish the aortic wall beyond.

The placement of the Hufnagel valve in the aorta just beyond the left subclavian corrects the regurgitation only from that point onwards. Hufnagel¹ states that this is approximately 70% of the circulation. Although it would be desirable to correct all the return flow, if the valve were successfully placed proximal to the innominate artery, there would not be sufficient regurgitant blood for proper coronary circulation.

In a recent communication Hufnagel et al² have described some of the newer experimental models which they hope may be inserted at the level of the aortic valve itself and which, because of their open sides, will permit adequate coronary filling without allowing any regurgitation back into the left ventricle. There is no report as yet of such models being employed in clinical cases.

Indications

The prosthetic valves mentioned above have been used to help control regurgitation in various types of patients including syphilitic aortic valvular disease by Hufnagel and his group^{1, 2}. It is indicated in any type of case where aortic regurgitation is the predominant lesion. Our experience has been limited to its use in cases of rheumatic origin.

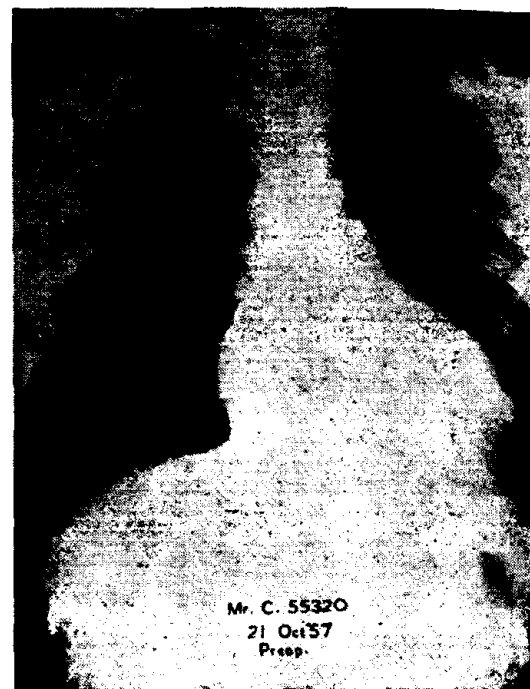


Fig. 2 (a)

Preoperative x-ray of Mr. C. showing the left ventricular hypertrophy which is characteristic of aortic regurgitation.

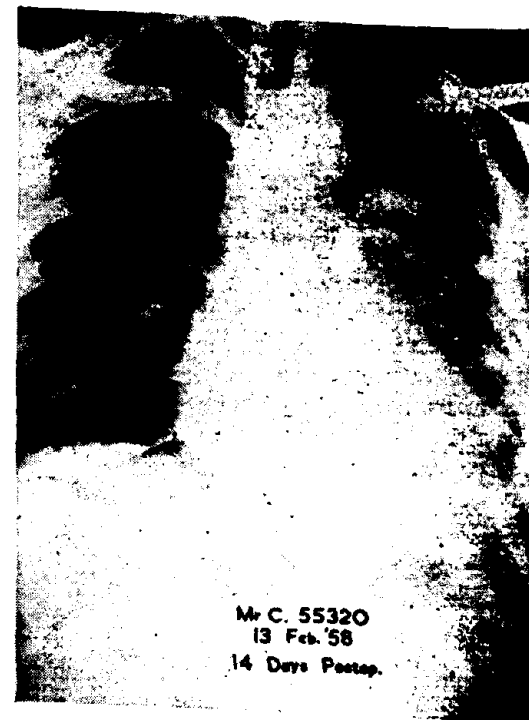


Fig. 2 (b)

X-ray fourteen days postoperative. There is still a slight haziness in the region of the descending aorta.

Hypothermia

When the Hufnagel valve is inserted in the aorta it is necessary to occlude the circulation temporarily. It is probable that the aorta can be occluded for approximately twenty minutes without danger of damage to the spinal cord or kidneys, but it is better to shorten the period, if possible, and Hufnagel states that the period of occlusion is usually between three and six minutes. Knowing that we lacked the extensive experience of this group we contemplated we might require a longer period of aortic occlusion and to give a wider safety margin have employed hypothermia in all our cases. The operation has usually been started when the rectal temperature has been reduced to 95°F and it usually drifts another one to two degrees by the time the aorta is occluded. In some cases we have been able to complete the insertion of the valve in fifteen to twenty minutes, but in two instances the total time of occlusion was 55 minutes. In spite of these prolonged periods there has not been any evidence of damage to the cord or the kidneys. We believe hypothermia to be a useful safeguard. Moderate ranges of hypothermia, between 90°F and 94°F, carry very little additional risk.

Operative Procedure

It is not necessary to repeat here the technic of operation which has been fully presented by Hufnagel^{1, 2} and illustrated by Rodriguez³. Exposure is obtained through a left fourth intercostal incision and posterior division of the fourth and fifth ribs. Wide exposure considerably facilitates the use of the aortic clamps and insertion of the valve. Due to the unusually large heart that most of these patients have, much room is necessary as the heart seems to take up most of the left hemithorax.

The pleura is incised on both sides of the aorta for 8 to 10 centimeters and the pleura left attached to the aorta. The aortic segment is then mobilized and three or four sets of intercostal vessels are ligated and divided as are any other branches to the esophagus or bronchi that arise in this area just below the left subclavian. The multiple point fixation ring of the chosen valve is then placed around the aorta. It should be sufficiently small to open two to three millimeters with each systole but sufficiently large to close completely during diastole. It is mandatory to have a full set of valves (four sizes) for any operation, so that the proper one may be selected for use.

The site of insertion is carefully chosen with due regard for the two to three centimeter segment that will need to be resected. If a segment of aorta is not removed it becomes redundant and tends to increase the potential space between the end of the valve and the aortic wall. When the site has been cleared an aortic clamp is slowly applied just beyond the left subclavian. If the heart does not react badly the clamp is locked and a similar one applied just beyond the point to be used for insertion. The aorta is then cut across except for the posterior one-fourth of its diameter. Leaving this posterior segment facilitates insertion of the valve. The distal end of the valve is introduced into the aorta and the nylon, multiple point fixation ring is closed by use of the special clamp (easily made from a long handle, right-angle clamp). The heavy silk or linen ligature in the groove of the multiple point fixation ring is tied tightly and the ring is then further secured by a wire ligature passed through the holes in the ring that are used for the ring closure.

The aorta is then divided and the proper length removed to take out all slack and yet still allow insertion of the proximal end of

the valve. The valve is now filled with a dilute solution of heparin and the proximal end inserted into the aorta in the same manner and fixed as was the distal end. We have found the suggestion of one of us (V.K.S.) most helpful in the actual insertion of the valve. Before attempting to insert the valve and to prevent damage to the friable aortic wall, four sutures are placed thru all layers of the aorta at equidistant points. These mattress type sutures start and end on the intimal side of the aorta, so that when they are held taut the lips of the aorta are opened out thus making the insertion of the valve end much easier.

When both ends have been secured, as much air as possible is aspirated from the valve by a needle inserted thru the aortic wall. The distal aortic clamp is then released and the valve allowed to fill with blood. The proximal aortic clamp is next slowly released and the valve will be seen to begin to function.

Hufnagel² has found that in some cases there is a tendency for thrombi to form in the *cul-de-sac* between the end of the valve and the aortic wall. To try to obliterate this space completely he advises, and we have used, a piece of nylon or dacron cloth sutured firmly around each end of the valve to hold the aortic wall and valve end in apposition during systole.

Clinical Experience

Since January 1958 to the present (1 September) we have treated four patients with severe aortic regurgitation by the use of Hufnagel valves. The pertinent details of each case are summarized in Table I. In each instance there has been a prompt return of the diastolic level in the lower extremities and usually some lowering of the systolic reading in the upper extremities.

TABLE I
AORTIC REGURGITATION

Case	Age	Sex	Date	Operation	Blood Pressure				Remarks
					Pre-op	Post-op	1 mo	6 mo	
1	45	M	1958-10-10	Valvulotomy	180/110	120/80	120/80	120/80	Good result
2	52	M	1958-11-15	Valvulotomy	180/110	120/80	120/80	120/80	Good result
3	58	M	1959-01-20	Valvulotomy	180/110	120/80	120/80	120/80	Good result
4	65	M	1959-03-10	Valvulotomy	180/110	120/80	120/80	120/80	Good result

Each patient sometime during the post-operative period has complained of rather severe but poorly localized pain in the abdomen. In two patients it was noted soon after operation, but in the others not until seven to ten days later. There were no other accompanying intestinal symptoms and the pain has disappeared in one or two weeks in all. In those instances where it came on soon after operation we had thought that it might be due to some air bubbles remaining in the valve and forming air emboli in the mesenteric vessels. This could not be the explanation, however, in those instances where the symptoms have developed later. It is possible, of course, that these could be due to breaking off of small emboli from this aortic-valvular junction although there have been no other signs of peripheral embolization.

Results

In Hufnagel's¹ report in 1954 in his first twenty-three cases he had six deaths, but all the fatal cases were in Class IV. In his more recent report² he only says that they have done a large series of patients but does not give results.

Some of the more badly damaged hearts do not withstand the added strain imposed by occluding the aortic circulation beyond the left subclavian. There is also always the possibility of damage to the aorta or improper fastening of the valve so that it slips out when circulation is established.

The threat of subacute bacterial endocarditis is present, but it has not been noted in any of our cases and neither has there been demonstrable emboli.

As the follow up is only eight months in the longest of our cases and one month in the most recent we have no grounds for making a long term prognosis. However, all patients seemed to be very definitely improved at the time of discharge and the improvement has continued to progress since leaving the hospital as far as we can determine. One cannot be traced and one was discharged only recently.

Summary

Aortic regurgitation is a poorly tolerated lesion, no matter what the etiology and is

usually progressive in character. Attempts at amelioration therefore seem justified.

A plastic valve has now been developed by Hufnagel which corrects about 70% of the regurgitation when it is inserted in the descending aorta beyond the left subclavian.

In four patients during the past eight months we have inserted such prostheses with gratifying results in each case. Operations were carried out under moderate hypothermia and there was no evidence of any damage to the kidneys or spinal cord even when the aorta was occluded for as long as 55 minutes.

When aortic regurgitation is the dominant lesion and when disability is being manifest one should consider the use of this ingenious prosthesis.

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“NEGATIVE POST-OPERATIVE RESPONSE” FROM
NOR-EPINEPHRINE IN PATIENTS WITH
PULMONARY HYPERTENSION

BY

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Surgical intervention in patients with severe pulmonary hypertension is usually associated with high mortality. Patients suffering from severe mitral stenosis have co-existing pulmonary hypertension, which may be moderate to severe. It has been the experience of most cardiac surgeons, that when such patients develop hypotension during or after operation, nor-epinephrine is not only ineffective, but often drops the blood pressure further. This “negative” response was experienced in a few patients operated on for mitral stenosis in this institution.

Hypotension is a result of a disturbance in the mechanisms responsible for sustaining the normal level of blood pressure. These mechanisms include :

- (a) cardiac output ;
- (b) arteriolar constriction—maintaining peripheral resistance and
- (c) circulating blood volume.

By virtue of its action of peripheral vasoconstriction, nor-epinephrine is widely used in states where patients develop marked fall in blood pressure. Why then does it fail to raise the systemic pressure in certain patients especially in the absence of any specific causative factors. A review of the literature revealed a study by Fowler et al¹ in 1951, comprising mostly of normal subjects. They showed, when nor-epinephrine was infused, that there was a statistically significant rise in the mean pulmonary artery and capillary pressures. Five subjects, out of thirteen studied, showed a decrease in cardiac output. Then what

effect will nor-epinephrine have on patients with pulmonary hypertension, who presumably have their pulmonary vessels already in a state of constriction. A study was started as a joint undertaking between the Cardiology and the Thoracic Surgery services of this institution to investigate this problem.

Method and material.—Eight patients with varied cardiac lesions selected at random and one normal patient were studied (Table I). To avoid any deleterious effects of nor-epinephrine patients with severe pulmonary hypertension were particularly excluded.

TABLE I.
Patients studied with nor-epinephrine

Particulars	No. of cases
Normal	1
Rheumatic Heart disease	5
Pulmonary hypertension	1
Atrial septal defect	1
A. S. D. and Pulmonic Stenosis	1
TOTAL	9

All subjects were studied during their routine right heart catheterisation. Resting pressures from the pulmonary wedge and pulmonary artery were obtained. The catheter was left in the pulmonary artery. Systemic blood pressure was obtained by a sphygmomanometer on the upper extremity. One ampule of nor-epinephrine (2 mgm) mixed in 150 cc. of 5% glucose in water was

TABLE II
Effect of Nor-Epinephrine on Pulmonary Circulation

Srl. No.	Hospital No.	Age and Sex	State	Heart Rate	B. P. mm. Hg.	P. A.	P. W.	C. O. litres	P. A. R. units	Diagnosis
1	V. R. 65525	12 M	C	115	110	20/0	10/0	...	...	M.I.
2	R. 65256	38 M	N. E.	70	120	48/15	35/3	...	...	Pulm. Hyp.
3	S. N. 66413	15 F	N. E.	75	138	75/25	8	4.43	10.0	M. S. plus M.I.
4	V. R. 66013	17 M	N. E.	100	190	120/30	15	4.5	11.1	M. S. plus M.I.
5	U. S. 63729	40 F	C	115	110	57/25	25	4.4	2.7	M.I. plus M.S. plus A.S.
6	R. B. 65584	26 F	N. E.	62	160	72/35	37	4.6	3.9	A. S. D. plus Pulm. Stenosis.
7	D. T. 64714	23 F	N. E.	100	100	35/10	20/5	4.9	1.6	A. S. D.
8	A. R. 63895	24 F	N. E.	55	150	52/12	35/10	5.0	1.9	M. S. plus M. I.
9	P. S.	M	N. E.	96	120	35/15	25	8.3	3.2	Normal.
			N. E.	82	170	65/35	...	...	...	
			C	100	110	20/0	15/-5	...	...	
			N. E.	55	140	35/10	25/10	...	...	
			C	96	110	25/10	15/0	8.4	2.4	
			N. E.	88	150	38/12	20/8	...	...	
			C	88	100	37/15	15/0	...	...	
			N. E.	50	130	50/25	25/15	...	...	
			C	100	110	25/5	15/5	8.5	.35	
			N. E.	60	170	37/10	30/5	9.0	.7	
C	Control.		P. W.	—	Wedge pressure.			M. S.	—	Mitral Stenosis.
N. E.	—		C. O.	—	Cardiac output.			M. I.	—	Mitral Insufficiency.
P. A.	—		P. A. R.	—	Pulmonary Arteriolar Resistance.			A. S. D.	—	Atrial Septal Defect.

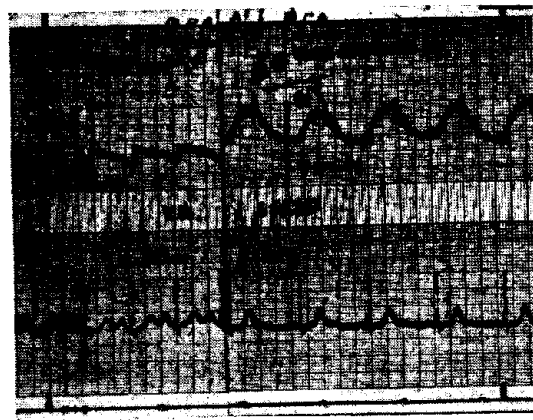


Fig. 1

Pressure tracing from the pulmonary artery of Case No. 1 taken both before and after nor-epinephrine infusion. The increase in the pressure caused by nor-epinephrine is striking.



Fig. 3

Pressure tracings from both pulmonary artery and wedge of Case No. 4 again showing the rise of pressure caused by nor-epinephrine.

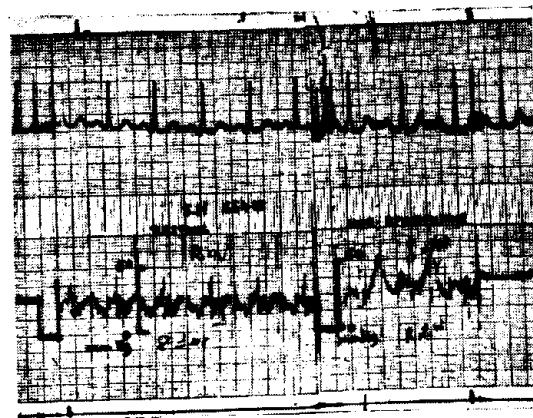


Fig. 2

Pulmonary wedge pressure tracing of Case No. 3 showing the effect of nor-epinephrine.

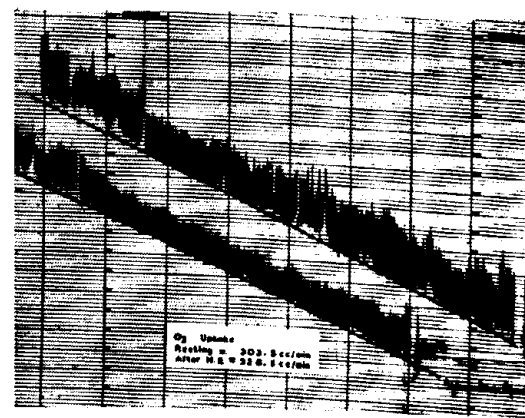


Fig. 4

An oxygen uptake graph of a patient taken before and after nor-epinephrine infusion.

then infused directly into the pulmonary artery by slow drip. When a moderate effect on the systemic blood pressure was obtained, usually within 3-5 minutes, pressures from the pulmonary wedge and pulmonary artery were recorded. Pulmonary arteriolar resistance and cardiac output were studied both, before and after infusion of nor-epinephrine in four cases only. Cardiac output was determined by the direct Fick principle. Oxygen uptake per minute was obtained by the B.M.R. machine.

Results

Four patients had normal pulmonary artery pressures. The upper limit of normal was taken as 25 mm. of Hg. Three patients had slight, and two, moderate, pulmonary hypertension.

Systemic pressure and heart rate.—In each of the subjects there was a definite rise in systemic pressure, and considerable slowing of the heart rate. In one case (No. 6) the heart rate almost became half of the resting value.

Pulmonary arterial and capillary pressures.—In all cases there was a significant rise in pulmonary arterial pressure, thus indicating active vaso-constriction. There was a corresponding rise in pulmonary capillary pressure during the administration of nor-epinephrine in each instance.

Pulmonary arteriolar resistance.—This was compared in four cases. In two cases there was a considerable increase in pulmonary resistance, maximum being 1.2 units, while in two cases there was only a slight increase. There was, therefore, a significant elevation in pulmonary arteriolar resistance in all four cases.

Cardiac output.—Significant cardiac output was only seen in the normal patient. The remaining three cases studied showed very little change. A fall in the cardiac output

was not observed in any case. This is probably due to the fact that a large amount of nor-epinephrine was not injected for fear of producing deleterious effects. Two cases exhibited signs of respiratory distress and the study had to be terminated.

Discussion

Haemodynamic changes observed during this infusion study of nor-epinephrine consisting of increased pulmonary artery, capillary and systemic pressures, increased pulmonary resistance and bradycardia confirm the observations of Fowler et al¹ and Patel et al². The increase in pulmonary resistance was less marked in patients with pulmonary hypertension than in normal patients. While in our study there was no case who exhibited a decrease in cardiac output, it has been shown by Fowler et al that it does occur. It is more likely to occur when severe pulmonary hypertension co-exists. However our four cases are too small a number to give any conclusive information.

The pulmonary arterial pressure is increased in patients with pulmonary hypertension, out of proportion to the left atrial pressure and after exercise, this pressure further rises without a commensurate rise in cardiac output³. This indicates an increase in resistance within the pulmonary vascular bed. Patients having severe pulmonary hypertension usually have a very low and fixed cardiac output. That may be one reason why these patients have cold, clammy extremities.

When patients with pulmonary hypertension are operated upon even though the mitral valve obstruction may be relieved, the reversible pathologic changes in the pulmonary vessels would take some time to return to near normal. Moreover the cardiac muscle needs time to adjust itself to the changed haemodynamics produced by valvulotomy. The pulmonary arteriolar resistance

is also influenced by the oxygen tension of the alveolar air. Hypoxia has been shown to increase pulmonary resistance and pressure⁴. Thoracotomy may produce a certain degree of hypoxia. Thus a number of factors may play a part in producing hypotension, during the post-operative phase. It is seemingly not due to loss of circulating blood volume or lack of peripheral resistance. Therefore it is logical to postulate that this hypotension is due to a further decrease in cardiac output.

In a situation like this nor-epinephrine is not likely to produce any benefit. It is suggested that the increase in pulmonary resistance by nor-epinephrine is probably the offending factor in producing this "negative" response.

Lillihei⁵ has enumerated a number of ancillary procedures to be used when operating upon patients with pulmonary hypertension, such as the use of the midline sternal splitting incision, routine use of tracheotomy to prevent hypoxia and use of a respirator. Goodwin⁶ has shown that an appreciable fall in total pulmonary resistance accompanied by a much smaller fall in systemic blood pressure, and either no change, or an increase in cardiac output can be obtained by the administration of small doses of hexamethonium. Wood⁷ demonstrated a similar response to small doses of Acetyl Choline. These drugs would interrupt

the neurologically controlled pulmonary venous and arteriolar constriction. A further study of these drugs is warranted. In conclusion it is suggested that in a situation where nor-epinephrine does not raise the blood pressure, drugs like hexamethonium or Acetyl choline may be used.

Summary

Most cardiac surgeons have experienced that whenever a patient with severe mitral stenosis develops post-operate hypotension, nor-epinephrine is usually ineffective. This is specially so when there is co-existing marked pulmonary hypertension. Operative mortality in such patients is usually high.

A study of the effect of nor-epinephrine on pulmonary vasculature was undertaken to investigate the cause of this "negative" response. Infusion of nor-epinephrine in the pulmonary artery raises the pulmonary resistance in patients with pulmonary hypertension. This study confirms the observations of Fowler and of Patel. The increased pulmonary resistance may lower the cardiac output further in these cases. Other factors like hypoxia and organic arterial disease may also influence the pulmonary resistance.

It is suggested that in a situation like this, drugs like hexamethonium or acetyl choline in small doses may be used.

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CONGENITAL OESOPHAGOBRONCHIAL FISTULAE WITH AN OTHERWISE NORMAL OESOPHAGUS*

Two Case Reports

BY

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Embryology

The oesophagus, trachea and bronchi are derived from the same embryonal anlage. During the fourth intrauterine week, the oesophagus is a short communication between the pharynx and stomach. The tracheobronchial tree appears in the 3 mm. embryo as a small bud on the ventral aspect of the foregut. A septum growing into the primitive entodermal sac divides it into a posterior alimentary and an anterior respiratory tube. The trachea gets separated from the oesophagus when the embryo is five centimetres in length, by developing two lateral coronal folds which fuse in the median plane to form a septum. This tracheoesophageal septum closes from above downwards, being finally completed by the disappearance of a tiny fistula above the tracheal bifurcation. Thus congenital oesophagotracheal fistula may be regarded as a failure of development with an incomplete separation of the trachea from the foregut (oesophagus). The same concept is true with regard to oesophagobronchial fistulae.

According to Haight¹, Eppinger in 1880, first described a case of oesophagotracheal fistula without atresia of the oesophagus. Vogt, in 1929, described the different varieties of the defects and later in 1940, Lanman² classified them. Haight and Tousley¹⁰ were responsible for describing the diagnosis and treatment. They also performed the first successful anastomosis in oesophageal atresia with tracheoesophageal fistula.

Most of the oesophageal malformations consist of a tracheoesophageal fistula with an atresia of the oesophagus. Gross¹ reports a series of 259 such cases treated by him and Haight² reports 63 cases. These patients are now being successfully operated upon in the neonatal period. Tracheoesophageal fistula with an otherwise normal oesophagus is rare. Only a few cases have been reported (Imperatori³, Holt⁴, Haight⁵, Van Weel⁶. Further, oesophagobronchial fistula without atresia of the oesophagus is even more of a rarity; we could collect only fourteen cases from the literature. The condition is not mentioned in most text books of surgery or embryology.

The rarity of this condition according to Mullard⁷ is due to three causes. Firstly, fistula with atresia was considered a rare condition until a surgical cure was devised and simple diagnostic measures were widely published. Secondly, the simple diagnostic measures which prove the presence of fistula with atresia will not necessarily show the presence of a fistula only. Thirdly, the clinical features of fistula without atresia lack the dramatic qualities of a fistula with atresia; they do not necessarily suggest the diagnosis in themselves, and the onset of symptoms may be delayed until adult life.

This malformation being so rare, the following two cases, one of congenital multiple oesophagobronchial fistulae persistent to old age and associated with bronchiectasis and a second of congenital solitary oesophagobronchial fistula in a young adult, both successfully treated by surgery are presented.

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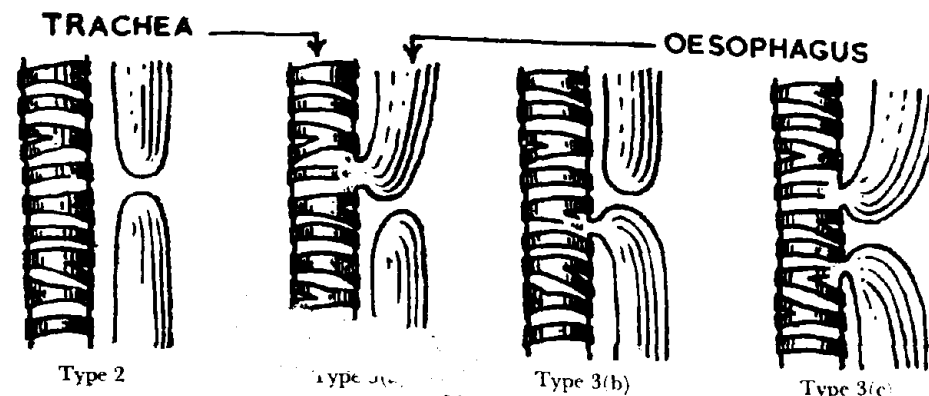


Fig. 1
Vogt's classification of congenital oesophageal fistula and atresia
(Type 1 is complete absence of oesophagus).

Vogt's well known classification of the variations of the anomaly is as follows: (Fig. 1)

Type 1.—Complete absence of the oesophagus.

Type 2.—Cases in which there is an upper and a lower segment, each ending in a blind pouch.

Type 3.—Cases with fistulae communicating between oesophageal segments and the trachea or bronchi.

Type 3(a).—Atresia of the oesophagus with a fistula between the upper oesophageal segment and the trachea.

Type 3(b).—Cases with a fistula between the lower oesophageal segment and the trachea.

Type 3(c).—Cases with a fistula between the trachea and both segments of the oesophagus.

Of all these variations, type 3-b is the most common. 32 out of 35 cases Potts dealt with (1950) were of the type 3-b variety. All other forms are rare. Vogt's classification does not make mention of the condition of

tracheal or bronchial atresia or tracheo-oesophageal fistula without atresia of the oesophagus which is suggested to be taken as type 4 (Fig. 2).

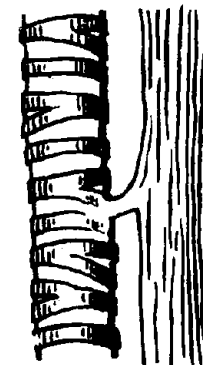


Fig. 2

Suggested type 4. Tracheal or broncho-oesophageal fistula without atresia of the oesophagus.

Acquired Oesophagotracheobronchial Fistula

Oesophagotracheal or oesophagobronchial communications may be congenital or acquired. The acquired type, which is more common, is usually due to carcinoma of the oesophagus invading the trachea or bronchus. Tuberculosis and syphilis of the oesophagus and trachea have been reported as causes of fistulae. An oesophageal diverticulum after a process of inflammation

and ulceration can burst into the bronchus and thus give rise to an abnormal communication. Trauma to the oesophagus due to swallowing of irregular sharp foreign bodies can produce a fistula. Murtagh and Tyson¹² describe a patient who developed tracheo-oesophageal fistula after swallowing a bone. The fistula healed promptly, after the bone was removed oesophagoscopically.

Diagnosis

The most characteristic symptoms are choking and coughing immediately following a liquid feed. Fistula may be suspected if mucus appears in the lung after the ingestion of water (Ono's sign)¹¹. Oesophagoscopy reveals an abnormal opening in the lumen of the oesophagus and if the examination is followed after instilling a few drops of methylene blue in the trachea, the dye may be seen escaping from the orifice in the oesophagus. X-ray examination after lipiodol swallow will usually delineate the fistula, or if instilled into the bronchial tree the oil may be seen in the oesophagus. An oesophagogram using lipiodol, with the patient in the prone position, yields satisfactory results, as in this position, due to gravity, the radio-opaque material can flow forward easily into the tracheobronchial tree (Fig. 9) Cardullo and Berens¹³ recommend an aqueous fluid of 35% Diodrast which has a low viscosity for this purpose. Repeated roentgenographic studies may be necessary, and even if these are negative a fistula is not necessarily ruled out.

Case Reports

Mr. M. K. N., aged 59 years, was admitted on June 14, 1956 complaining of cough with expectoration containing blood and dysphagia of over 2 years' duration. He used to get violent attacks of coughing associated with the expulsion of ingested food. Such attacks always occurred after taking liquids but seldom after solid food.

More often the sputum contained food particles. He had been having recurrent attacks of fever and severe flatulence. There was no history of trauma to the chest, or of ingestion of foreign bodies or caustics.

The patient was emaciated and illnourished with a raw tongue and septic gums. He was dehydrated and anaemic. There was clubbing of the digits and the breath was fetid. There was fullness of the epigastrium due to air in the stomach. Auscultation revealed rales over the left lower lobe. Plain x-ray of the chest showed reticular markings over the left lower lobe.

Bronchoscopy revealed red and inflamed mucous membrane of the left lower lobe bronchus with blood-stained secretions and pus. No fistula was seen. During oesophagoscopy, an opening about 2-3 mm. in diameter was seen on the left lateral wall of the oesophagus 37 cms. from the incisor teeth. Similar openings, three in number, but smaller in size were noted near the bigger one. The mucous membrane of the lower end of the oesophagus and the cardia was reddened.

Bronchography, done with Diodrast, showed bronchiectasis of some of the segments of the left lower lobe. Part of the Diodrast which was injected into the bronchial tree was seen in the oesophagus. A lipiodol swallow showed a fistula running into the bronchus of the left lower lobe and a cavity in the lung besides the fistulae (Figs. 3 & 4). Ultimately barium was used for an oesophagogram. The barium was seen in the left bronchial tree (Fig. 5).

On August 18, 1956, with the patient in the right lateral position, the pleural cavity was entered in the 7th intercostal space. The posterior basal segment of the left lower lobe was adherent to the oesophagus. The lower end of the oesophagus was mobilised



Fig. 3 & 4

First case : Oesophagogram done with lipiodol delineating the bronchoesophageal fistulae and also a small abscess cavity. Arrow pointing to one of the fistulae.



MKN 39286.16-6-56

Fig. 5

First case: Oesophagogram done with thin barium, showing the barium escaping into the bronchi. Arrow pointing to the bronchi.

to a distance of about ten centimetres. The lung was carefully separated from the oesophagus and in doing so numerous small fistulous communications were found between the oesophagus and the posterior basal segment of the left lower lobe. There was no evidence of any tumour. A cuff of oesophageal mucosa around the fistulae was excised leaving a defect 8 cms. in length in the mucosa of the oesophagus. A Ryle's tube was passed into the stomach and the opening in the oesophagus was closed with interrupted cotton sutures. The bronchiectatic left lower lobe was excised by individual ligation of the hilar structures and the chest was closed leaving a drainage tube. The patient had two litres of blood during the operation.

He was not given anything by mouth for 4 days post-operatively in view of the oesophageal repair. His post-operative course was smooth. All his symptoms abated and cough was not precipitated by swallowing of liquids. An oesophagogram taken with thin barium swallow 6 weeks after the operation showed a normal oesophagus (Fig. 6).

The resected specimen consisted of the left lower lobe and a few fistulous tracks

with a cuff of the oesophageal mucosa. The number of fistulae was twelve to fifteen and their length varied between 1 cm. to 2.5 cms. The widest of the fistulae was 3 mm. in diameter. They occupied a linear narrow area in the wall of the oesophagus about 7 centimetres long. The left lower lobe was bronchiectatic and there was some chronic pneumonitis. The tubular structures were lined with stratified squamous epithelium with a few mucous glands. There was much chronic inflammatory infiltrate.

Second Case.—Mr. M. C., a young man of 30, was admitted on January 18th, 1958, with the chief complaint of cough on swallowing liquids, of 8 months' duration. He was

having cough with expectoration for the last 5 years but it was not associated with swallowing. He was treated symptomatically for this complaint and underwent tonsilectomy in 1953 without any relief.

His complaint started with an attack of Flu' in July, 1957. In the beginning, he was getting severe bouts of cough and some times vomiting immediately after swallowing solids or liquids. He used to have sleepless nights on account of the annoying cough, which continued even after the recovery from the Flu' for about 3 to 4 months. Recently, he had developed a feeling of irritation in the mid-sternal region on coughing.

The patient was a young man, well built and nourished. Chest examination revealed occasional rales and rhonchi over the right basal region. Heart sounds were normal. His blood pressure was 110/80. The other systems were normal.

Lipiodol swallow showed a fistula connecting the lower oesophagus and right basal bronchus. Bronchogram showed the fistulous track and bronchiectasis of right basal segments (Fig. 7).

Oesophagoscopy revealed a small opening about 3-4 mms. in diameter on the right lateral wall at a distance of 40 cms. from the upper incisor teeth. Bronchoscopy did not show any abnormality.

On February 5th, 1958, with the patient in the left lateral position, the chest was entered in the 7th intercostal space. The right basal segments which were consolidated and adherent to the chest wall, were mobilised. The oesophagus above and below the fistula was mobilised. The fistula which was about a centimetre in width, was divided on the lung side and closed with cotton sutures. The oesophageal end of the fistula was excised along with a small cuff of the



Fig. 6

First case : Post-operative oesophagogram done with thin barium, showing a normal oesophagus with no fistulae.

oesophageal mucosa and the opening in the oesophagus closed with a few interrupted cotton sutures. Then a right lower lobectomy was done by ligating the hilar structures individually. Finally the chest was closed leaving two drainage tubes. The patient had about 1500 c.c. of blood during the operation.



Fig. 7

Second case: A: Bronchogram done with Dionsil showing the fistulous tract and oil in the oesophagus B & C: Oesophagogram done with lipidol delineating the fistula. Arrow is pointing to the fistula.

During the post-operative period he developed bronchopleural fistula with empyema. On February 28th, 1958, empyema drainage was done, and in order to reduce the size of the empyema pocket a right phrenic crush was done on March 3rd 1958. Finally when the patient was discharged on April 20th, 1958, he was free of the symptoms and was able to swallow liquids and solids without any difficulty.

Histological study of the fistulous track showed imperfectly stratified squamous epithelium near the oesophageal end and respiratory epithelium near the lung, and the surrounding lung tissue showed well marked diffuse pneumonitis with many macrophages.



Fig. 8

Lipidol injected into the bronchi of the resected right lower lobe showing bronchiectasis.

Discussion

It is believed that latent congenital fistulae between the oesophagus and tracheobronchial tree may be more common than is generally thought. In almost all the cases of oesophagobronchial fistulae reported, the symptoms have appeared surprisingly late in life. Jackson and Coats (Quoted by Mullard, K. S.⁷) believe that the late onset of symptoms is due to a fold of membrane occluding the fistula in the new born and breaking down later on. In 1929, Negus (quoted by Mullard, K. S.⁷) showed to the

Royal society of Medicine a specimen of the oesophagus of a man aged 45 years, who died from cancer of the lung. There was a congenital opening passing downwards from the trachea to the oesophagus. At the oesophageal end there was a valve like hood of mucous membrane. There had been no symptoms during life.

The mucous membrane of the oesophagus normally moves downwards within muscular coat with the bolus on deglutition. In the presence of a fistula the mucous membrane gets firmly adherent to it and this will cause a fold of mucosa to develop and override the orifice of the fistula as the bolus passes, giving some protection against entry of food particles into the fistula. In our cases there was no fold of mucous membrane seen over the oesophageal orifices of the fistulae. They were well defined openings with thickened margins.

Oesophagotracheobronchial fistulae are sometimes associated with bronchiectasis or abscesses of the lung, which are the result of recurrent attacks of infection of the bronchial tree. The fistulae sometimes may not be associated with chronic suppurative disease of the lungs. Berglund¹⁴ records a case who had practically no symptoms.

The symptoms of oesophagotracheobronchial fistula with an otherwise normal

oesophagus consist of choking and coughing, coincident with the ingestion of food, particularly liquids. The sputum frequently contains particles of ingested food. In infants, cyanosis and respiratory arrest may occur following feedings. A chronic cough with expectoration and recurrent attacks of fever occur as a result of pneumonitis and bronchiectasis which may develop from the repeated aspiration of foreign material into the air passages. The lungs may also be subjected to acid regurgitation from the stomach through the fistula.

In oesophagotracheobronchial fistula with atresia of the oesophagus the symptoms are dramatic as with the first feed, the newborn infant usually becomes choked and cyanosed. But when the oesophagus is patent, the symptoms may not be of sufficient severity to prompt early diagnosis or the infant may maintain a fair degree of nutrition and the condition remain unrecognised and untreated, masquerading as an acute recurring pneumonitis, or a faulty mechanism of deglutition. It is suggested that patients with pneumonitis which is refractory and recurrent in nature should have besides bronchoscopy and oesophagoscopy, an opaque meal swallow examination in the prone position (Fig. 9). Haight⁵ reports a case of oesophagotracheal fistula which was missed because the opaque meal was not given in the prone position.

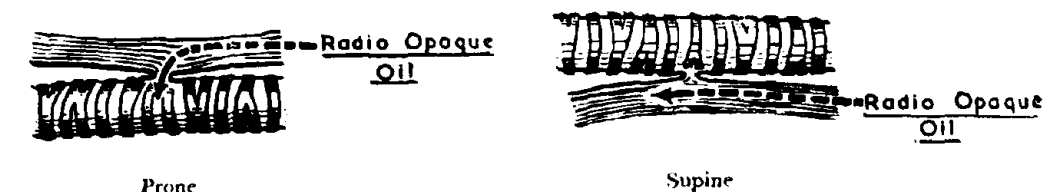


Fig. 9

Gravity Assists the entry of the Radiopaque Oil into the trachea in the Prone Position.

TABLE I
A Brief Account of the Reported Cases of Oesophagobronchial Fistulae in Literature

Serial	Author	Year	Age	Sex	Age of onset of symptoms	Symptoms	Duration	Fistula communicating with oesophagus and	Associated lung pathology	Treatment	Result
1	L. H. Clerf ¹⁴	1933	23	F	16	Cough on swallowing	7	Oesophagobronchial fistula	Nil	Cauterization with Silver Nitrate	Good
2	Moersch H. J. and Schmidt H. W. ¹⁹	1937	31	F	23	Coughing out particles of food	8	Right lower lobe bronchus	—	Excision of fistula	Expired
	Moersch H. J. and Schmidt H. W. ¹⁹	1937	52	M	Childhood	Strangulation and dyspnoea on drinking	Since Childhood	Left lower lobe bronchus	—	Excision of fistula	Good
3	L. H. Clerf and others ¹⁶	1943	61	F	60	Dry cough especially provoked by liquid feed, mild digestive disturbances, fever, slight haemoptysis	9 months	Right bronchus, Fistulous opening in oesophagus 30 cms. from incisors teeth	Nil	Sclerosing with NaOH and Ag. No. 3 crystals	Good
	L. H. Clerf and others ¹⁶	1943	66	M	57	Cough provoked by liquid feed, and inability to sleep on right side, cough even on swallowing saliva	32 months	Right bronchus, Fistulous opening in oesophagus 31 cms. from incisor teeth	Nil	Sclerosing with NaOH and Ag. No. 3 crystals	Good
4	S. Bergland ¹⁴	1947	62	M	—	Had pain of gall stone type and inability to drink liquids	—	A branch of Right lobe	Nil	No treatment given since patient had no associated symptoms	—
5	Mullard K. S. ⁷	1948	54	M	43	Cough with purulent sputum and coughing ingested food particles	6 months	Left main bronchus	Chr. non-specific inflammatory changes	Excision of fistula with left pneumonectomy	Good
6	Morton D. R. and others ¹⁸	1950	26	M	Adolescence	Cough with expectoration worse after liquid feeds, weight loss, regurgitation of food.	Several years	Posterior basal segment of right lower lobe	Saccular B'tasis of posterior basal segment of right lower lobe	Excision of fistula and right lower lobe	—
7	Berman J. K. and others ¹⁷	1952	40	F	Childhood	Cough, haemoptysis, fever, chills, extreme weakness and emaciation, dyspnoea, cyanosis	Since Childhood	Basal bronchus of left lower lobe	Bronchiectasis of left lower lobe with multiple abscesses	Excision of Fistula only. Due to fall of Blood Pressure further operation abandoned. During a	Good

8	A. Duprez and others ¹⁶	1952	18	F	Childhood	Chronic productive cough and cough immediately after drinking liquids	Since Childhood	Middle lobe bronchus	Bronchiectasis	second sitting, left pneumonectomy with division of an associated P. D. A. and aberrant artery leading from descending aorta to basal branch of the left pulmonary artery was done	Good
	"	1953	41	M	Childhood	Lung abscess in 1925, cough with purulent expectoration occasionally stained with blood	Since Childhood	Left lower lobe bronchus	Bronchiectasis	Excision of fistula, middle and right lower lobe	Good
	"	1953	33	F	8	Cough. Had right lung abscess in 1952 with empyema	25	Right lower lobe bronchus	Bronchiectasis	Excision of the oesophageal diverticulum and the fistula with left lower lobe	Good
9	Mullard K. S. ⁷	1954	54	F		Bad taste in the mouth and regurgitation of food	5 months	Right superior segment of the left lower lobe		Excision of fistula and right lower lobe	Good
	A. Bjorklund and others ⁸	1956	45	M	Childhood	Persistent cough since childhood worse after drinking liquids	Since Childhood	Parenchyma of left lower lobe	Bronchiectasis of left lung	Excision of the fistula alone	Good
11	(a) Khan M. J. and Bhatt P. A.	1958	59	M	39	Cough with expectoration containing food particles, cough precipitated by fluid drinks, dysphagia, severe flatulence and recurrent attacks of fever	20 years	Multiple fistulae running between the oesophagus and the left lower lobe	Bronchiectasis of left lower lobe	Excision of a strip of the mucosa of the oesophagus containing the multiple fistulous openings and left lower lobectomy	Good
(b)	"	1948	30	M	29	Cough on swallowing fluids and vomiting. Sleep disturbed due to cough. Retrosternal discomfort	6 months	Right lower lobe bronchus	Bronchiectasis	Excision of fistula and the bronchiectatic lung	Good

It is considered that the fistulae in the cases presented were probably congenital in origin because of the long duration, the absence of history of injury to the oesophagus, and the fistulae being well defined tubular structures.

The first case presented is unique in that, as far as we aware, it is the only case reported with multiple fistulous communications between the oesophagus and the bronchial tree. Although only part of the basal segments were involved, the whole lower lobe was excised in view of the possible contamination of the wound from the oesophageal operation.

The correction of oesophagobronchial fistula of whatever aetiology by an appropriate method is imperative. The recurrent pneumonitis which is present in these cases is a definite indication for operation even though the majority of patients are in an emaciated condition with nutritional deficiencies.

The fistulae have been successfully treated by several authors. Judd¹⁵ and others closed a high tracheoesophageal fistula resulting from a bullet wound through a cervical incision. Clerf¹⁶ and others successfully sclerosed the fistula opening, with beads of sodium hydroxide and silver nitrate through an oesophagoscope. We decided on excision of the fistulae with a cuff of the oesophageal mucosa and a left lower lobectomy since this lobe was bronchiectatic. Bjorklund⁶ and others had to excise the fistula only, due to a fall of blood pressure, during operation but at a second sitting, performed a left pneumonectomy for bronchiectasis and divided an associated patent ductus arteriosus and also an aberrant artery leading from the descending aorta to the basal branch of the left pulmonary artery. Haight⁷ excised the fistula through an

extrapleural approach for fear of post-operative leakage from the suture lines. Simple ligation of the fistula or division of the fistula is an inadequate procedure and the chances of recurrence are high. Preferably, excision of the fistula with a part of the lung involved should be done.

Only about fourteen cases of oesophagobronchial fistulae have so far been reported in the literature and in every instance the fistula was a solitary one as in our second case. A brief account of the reported cases is given in the accompanying table, (Table I).

Some of the technical points in this operation deserve special mention. The lower end of the oesophagus and the lung are approached through an incision in the 7th or 8th intercostal space. The fistula is preferably removed with a cuff of oesophageal mucosa and the defect produced in the oesophagus is closed longitudinally with interrupted non-absorbable sutures, so tied that the knots fall inside the lumen of the oesophagus. After the oesophageal repair, the area is covered with a fold of pleura to prevent leakage or to lessen the chances of pleural contamination, should leakage occur. We believe it is safer to avoid segmental resection in these cases, since the field of operation is theoretically contaminated after the oesophageal repair.

Summary

Two cases of congenital oesophagobronchial fistulae with an otherwise normal oesophagus associated with bronchiectasis of the lower lobes have been presented. The first case, aged 59 years had symptoms for over 20 years and the second for eight months. Both had typical symptoms of choking and coughing coincident with the ingestion of food, particularly liquids. The first case had multiple fistulae whereas the

second one had only one fistula. Diagnosis was confirmed in both cases by oesophagogram and bronchogram when the fistulae were delineated. Excision of the fistulae with the linear segment of the oesophageal mucosa bearing the openings of the fistulae and the bronchiectatic left lower lobe resulted in complete recovery in the first case. In the second case excision of the

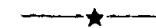
fistula with a lower lobectomy resulted in complete relief of symptoms, though post-operatively the patient developed empyema, which yielded to drainage.

A brief account of all cases of broncho-oesophageal fistulae reported in the literature is given. Some of the technical points regarding the operation have been mentioned.

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ACUTE CHOLECYSTITIS IN CHILDHOOD

BY

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Acute cholecystitis is a fairly common abdominal emergency met with in surgical practice. The typical patient is "A fat, fertile, female of forty". For long the occurrence of cholecystitis with or without gall stones in young patients was not recognised. Gibson (1722) recorded the first case of cholecystitis in childhood. Still (1899) reported 20 cases of biliary calculi in children. Kellog (1923) reported 64 cases, and subsequently Beals (1928) collected 124 cases. Potter (1928) by collecting a total of 226 reported cases created interest in the subject. In 1938, he added 206 additional cases, thus making a total of 432 cases. But 25 per cent of these were diagnosed only on clinical grounds, and a few others had only congenital abnormalities of the biliary tract. This showed that the condition was infrequent though not a surgical curiosity. Ulin et al (1952) added one more case to their previous reported series of 30 cases, thus making a total of 326 proved cases in the literature. Glenn and Hill mention that 30 more cases of cholecystitis in children have been collected in the 1948-1953 period. Kohle and Jackson (1953) have reported 2 cases of cholelithiasis in negro children. Colin and Walker (1957) mention 24 additional cases, reported in the previous 10 year period, in the English literature.

Gall bladder disease in the young can be divided into three distinct groups, as follows:

1. Infancy and very early childhood, when congenital lesions of the biliary system e.g. atresia are found commonly.

2. Late childhood, when cholecystitis with or without cholelithiasis occurs due to the intercurrent infections so common at this age. Inflammation rarely proceeds to suppuration.
3. Following puberty (15-20 years). The incidence and clinical picture are as in the older age group, due to the interplay of similar etiological factors.

From the scanty Indian literature available on this disease, we presume that cholecystitis and cholelithiasis in children, in our country, must be very very rare. In view of this we are presenting a case of acute cholecystitis with perforation in a male child of 3 years.

Case-Report

N. V. a Hindu, male child, aged 3 years, was admitted under our care on 29-10-57 at 12-40 p.m. for right sided abdominal pain of 1 day's duration. The child was constipated for 3 days and had 102°F temperature for the last 24 hours. There was no nausea, vomiting, or jaundice. There was no history of dysentery or typhoid. The child was crying all the while and would not allow proper examination. On physical examination there was generalised abdominal tenderness, with guarding and rigidity on the right side, equally in the upper as well as the lower quadrants. There was slight abdominal distension. Few peristaltic sounds were audible. Liver and spleen were not palpable and rectal examination was negative. There was no jaundice or any glandular enlargement. Tongue was furred and the temperature was 102°F.

Cardiovascular and respiratory systems were normal. The clinical diagnosis was acute appendicitis. The child was kept under close observation. As the condition did not improve by evening, it was decided to do a laparotomy.

Pre-operatively, gastro-intestinal decompression, antibiotics and intravenous infusion were started.

A laparotomy was carried out by a right mid-paramedian incision under general anaesthesia. On opening the peritoneal cavity, free fluid was found along with plastic peritonitis over the loops of the small bowel. The ileo-coecal junction, appendix and lower part of ileum were normal. There was no evidence of Meckel's diverticulum. At that stage some greenish fluid was seen coming from the upper part of the right para-colic gutter. In view of this the gall bladder region was explored and the gall bladder was found to be enlarged and acutely inflamed with a perforation $\frac{1}{4}$ " in diameter, at the tip of the fundus. Greenish turbid purulent bile was pouring out from the perforation. Plastic peritonitis was present in the surrounding area. No evidence of stone, stricture or gland was found in the region of the cystic duct. With a diagnosis of perforated empyema of the gall-bladder, a routine cholecystectomy was performed without common bile duct exploration. Appendix was not removed to avoid further operative shock. Wound was closed in layers, after draining the gall-bladder bed by a corrugated rubber drain through a separate stab incision.

Post-operatively gastro-intestinal decompression, intra-venous infusion and antibiotics were continued. Tetracycline by the parenteral route was administered for the first seven days, it was subsequently switched to the oral route. During this period

penicillin and streptomycin were also given parenterally. Distension and temperature gradually settled down after four days, when oral feeding was started. Calcium pantothenate 25 mgms, 8 hourly was given on the 2nd and 3rd post-operative days. The drainage tube was removed on the 6th day, and the sutures on the 11th day; all antibiotics were then discontinued. The wound healed well and the patient was discharged after complete recovery.

Pathology Report

Specimen of the gall-bladder $3\frac{1}{2}$ " x $\frac{3}{4}$ " showing general congestion of the serous surface with a small oval perforation about $\frac{1}{4}$ " in long diameter at the tip of the fundus. The margins of the perforation show necrosis surrounded by an area of congestion. The general serous surface shows deposits of fibrin, and a few small large-pinhead size yellowish brown areas of suppuration. On opening, the mucous membrane shows general congestion and swelling of the wall. At a few places in the wall small discrete abscesses are also seen.

Diagnosis

Acute cholecystitis with suppuration and perforation (Fig. 1)

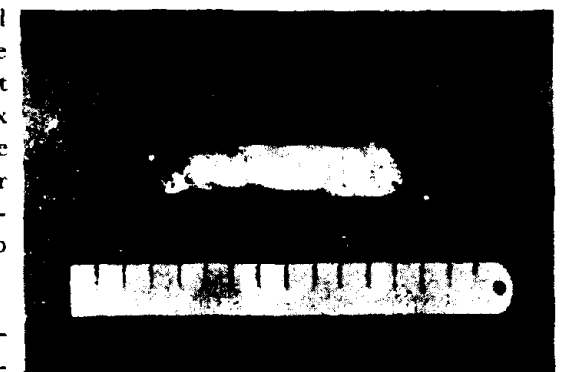


Fig. 1.
Specimen of Acutely inflamed Gall-bladder showing perforation (Marked by Pin) at the fundus (shown by arrow). (The scale shown in the picture is in centimeters).

Follow-Up

After one year the child was perfectly well, and had no abdominal symptoms.

Discussion

Ulin (1951) in his critical analysis of 326 cases of cholecystitis in childhood found the ratio of males to females to be 3:2. The incidence of this disease in children under the age of 5 years is extremely rare. Isolated cases have been reported by Tempest (1950), Snyder et al (1952), Wellauer (1950) etc. In the report of 12 cases by Heringman and Aiken (1947) there was not a single case below the age of 5 years. The present case was in a male child aged 3 years. The coloured races are far less vulnerable to this disease as shown by Potter (1928) and Decamp and Oschner (1952). That in itself may be a factor for the low incidence of gall-bladder disease in Indians.

The etiological factors which cause gall-stones and cholecystitis in childhood, are not well understood. A number of factors probably play a role in the production of this disease. The association of cholelithiasis with cholecystitis is very significant in adults. Glenn and Hill (1954) record that 90-92% of cases of cholecystitis have associated gall stones. In children this combination is present in only 52-63 per cent of cases. Ladd and Gross (1953) however, suggest that gall stones are commoner than cholecystitis in children. However, where such an association is present particularly in long standing cases, it is difficult to decide whether gall-stones or the inflammation was the primary lesion.

Griffin et al (1954) report that the incidence of carcinoma of the gall bladder in the younger age group is the same as in the adults, about 2 per cent.

The incidence of gall stones in cases of haemolytic anaemia is well known. Hence in the investigations in young children with

gall stones, it is necessary to remember sickle cell anaemia (Mintz et al 1955) acholuric jaundice (Colin et al, 1957) and erythroblastosis foetalis (Lightwood et al, 1946) as important causative factors. Starling (1939) by his experimental work suggested that the agglutinins in bile by causing precipitation, form a nucleus for the stones. All the authors agree on the importance of the role of various infections in the pathology of cholecystitis, such as typhoid, scarlet fever, respiratory and gastro-intestinal infections etc. Bonta et al (1952) have reported a case of cholecystitis in which *S. oranienburg* was the causative organism.

This would give an impression that there should be a large number of cases of cholecystitis among children, which is not borne out by the number of reported cases. In our country the incidence of typhoid fever, and other exanthemata is very high, though the same is not true of cholecystitis in children. This leads us to conclude that infection is only an association rather than an important causative factor. In our case there was no evidence of any previous infection.

Another factor of importance is the intestinal infestations such as *ascaris lumbricoides*, *giardia lamblia* etc. Woodpower and Johnston (1930) have reported a case of perforated empyema of the gall bladder, associated with *ascaris lumbricoides*. Similarly, Lowenberg and Mitchell (1938) have incriminated *giardia lamblia* as another causative factor. In the present case stool examination at a later date did show the presence of *giardia lamblia* although, its etiological significance is indeterminate. Foreshall and Rickham (1954) have found that congenital malformations of the cystic duct *e.g.* stricture, or its splitting into numerous minute channels, are important causative factors. Similarly blockage of the cystic duct by an acutely inflamed cystic gland, may also lead to the same *i.e.* acute cholecystitis as shown by Jones (1951).

Experimental work of Pines and Rabinovitch (1954) confirm the general conception that blockage of the cystic duct, associated with impaired blood supply to the gall bladder would result in its perforation. Gangrenous cholecystitis or perforation in adults is rare, the incidence of the latter being only 6% as reported by Pines and Rabinovitch (1954). Potter (1938) found only 17 children with gangrenous or perforated gall bladder. Fifteen of these were secondary to typhoid fever. The most vulnerable site for perforation is the fundus because it is the thinnest and a relatively avascular, part of the gall bladder, which would give way to increased intra-cystic pressure in the presence of cystic duct obstruction. In other cases perforation is caused by local vascular thrombosis, or an acute inflammatory or suppurative process. In our case the latter two factors played the decisive role in causing the perforation.

Jaundice is quite often associated with cholecystitis and in adults, it is quite often due to common duct stones. The incidence of jaundice associated with cholecystitis in children is 26-45%; as compared to 8-10% in adults. But the incidence of common duct stones in children is only 6% as compared to 17% in adults. (Ulin et al 1952). Thus jaundice in children is not always due to common duct stones but is more often due to acute inflammatory processes adjacent to or involving the duct. Although the commoner cause of jaundice in children is hepatocellular disease, the presence of gall stones in cases of jaundice should not be missed in occasional cases. The surgical interference in cases of hepatocellular jaundice is ill-advised and may prove fatal.

In the present case the child came to us for right-sided abdominal pain, tenderness, guarding and fever of 24 hours' duration.

There was no previous history of infection. The usual clinical picture in children resembles that in adults. Non-availability of a proper history and the child's inability to localise accurately the pain, makes the diagnosis rather difficult. The low index of suspicion adds further to the difficulty. And hence most of these cases are misdiagnosed as acute appendicitis and our case was no exception. Only at a laparotomy, was the correct diagnosis made. We are in full agreement with others that exploration of the gall bladder region must be made a routine, if the appendix is found to be normal. Every child with upper abdominal pain, acute or recurrent, with or without dyspepsia, must be investigated for gall bladder disease or peptic ulcer. The various aids in the diagnosis of this condition are (1) A scout film of the abdomen, and (2) Cholecystography on sub-acute or chronic cases.

Gross (1953) advised cholecystostomy as the safer operation for acute cholecystitis because of the technical difficulties, but in the majority of the reported series Cholecystectomy has been the treatment of choice, both in cholelithiasis and cholecystitis. Children can stand the latter procedure without undue risk. In our case also we did a cholecystectomy. Absence of any technical difficulty and the uneventful convalescence appear to justify the procedure. Early operation, improved surgical technique and anaesthesia, fluid therapy and antibiotics have played no small role in improving the prognosis of this condition. Zaslow (1954) found that intravenously administered oxytetracycline was excreted from the liver, in therapeutically effective concentrations, irrespective of the degree of liver damage, in contrast to other antibiotics. Exploration of the common bile duct is not of great importance in children since the incidence of chole-docholithiasis is only 6%.

In conclusion, though gall bladder disease in childhood is not very common, its importance should not be under-rated, and the condition must be kept in mind in acute abdomen or recurrent upper abdominal pain in children.

Summary

(1) A case of perforation in an acute suppurative cholecystitis in a male child of 3 years is presented.

(2) The literature on the subject is reviewed. No definite etiological factor is postulated.

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FOREIGN BODIES IN THE MALE URINARY BLADDER

BY

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Foreign bodies of all descriptions have been found in the urinary bladder of females, but they are less commonly encountered in the male.

Two cases of foreign body in the male urinary bladder are being described, each one representing a different clinical pattern.

Case Reports

Case 1.—G. H. aged 32 years was admitted to hospital on 8-10-55, complaining of queer feelings in his legs and discomfort in his rectum. He gave a vague history of having been drinking for 24 hours and had passed out unconscious three weeks ago. On coming round he was told that he had swallowed a piece of wire for a bet.

Physical Examination revealed nothing abnormal.

X-ray Examination revealed a loop of wire in the pelvis possibly in the sigmoid colon. (Figs. 1 & 2).

Sigmoidoscopy upto 21 cms. did not reveal any foreign body.

Barium Enema showed that the wire was outside the sigmoid colon (Fig. 3).

At operation under G. A. Pentothal, relaxants gas O_2 (Dr. Tyrrell). The abdomen was opened through a right paramedian incision. Palpation of the duodenum, jejunum and ileum did not show any foreign



Fig. 1
Pre-operative X-ray.



Fig. 2
Photograph after removal of F.B.

body. Careful palpation of caecum, ascending colon, transverse and descending colon and sigmoid also revealed no evidence of foreign body. There was no trace of any exudate or adhesions to suggest that the wire had pierced the alimentary tract. The wire loop was felt inside the bladder which was free from adhesions. It was brought towards the fundus and two skin clips were used to grip it. After packing the intestine, the bladder wall was incised on the foreign body and a wire loop $4\frac{1}{2}$ " long, insulated and very pliable, was removed. The opening in the bladder was closed in layers with non-chromic catgut. Appendicectomy was also performed and the abdomen was closed in layers.

His post-operative period was uneventful; the patient complained of scalding micturition for 24 hours only.



Fig. 3
Barium Enema showed that the wire was outside the sigmoid colon.

Case No. 2.—H.D.B. aged 64 yrs. admitted on 28-12-55 with frequency of micturition and a painful swelling in the left scrotum.

On examination the patient was found to have left epididymo-orchitis with all the constitutional signs and symptoms. The patient was put on streptomycin $\frac{1}{2}$ gm. b.d. and responded to it rapidly. His urine contained R.B.Cs. and a growth of streptococcus faecalis.

I.V.P. revealed no abnormality.

Cystoscopy showed a piece of glass in the region of the trigone. Repeat cystoscopy was performed to confirm this finding after four days. The foreign body was still present.

At operation under spinal anaesthesia (Dr. E. M. Chivers) suprapubic cystostomy was carried out to remove the foreign body—a piece of glass $\frac{1}{4}$ cm. $\times$ $\frac{1}{2}$ cm. The bladder was closed in layers with non-chromic catgut.

His post-operative recovery was uneventful.

Comment

Foreign bodies may gain access to the urinary bladder through wounds, and injuries incurred during war, civilian accidents, surgical mishaps and through the urethra. The majority of these foreign bodies enter the bladder *via* the urethra.

A list of articles, by no means complete, which have been found in the bladder:—

e.g. matches, hairpin, straight pin, knitting needles, string, tar, wax candles, lamp wick, pipe stems, collar buttons, fountainpen clips, pencil stubs, glass rods, thermometer, tooth brush handles, straws, barks of certain trees (slippery elm), 3 caudal vertebrae of a squirrel and a hog's penis. To this list may be added the chewing gum sticks used for masturbation and electric cable wire.

Introduction of foreign bodies has been done for the sake of exciting erotic sensations. In females it has also been practised for procuring illegal abortion, and the foreign bodies are accidentally introduced into the bladder. The low I.Q. and their perverted curiosity are responsible for many cases in the females. The short wide expansile urethra facilitates the introduction of foreign bodies.

In males, one would imagine that the tortuosity and length of the male urethra would be a deterrent to the introduction of foreign bodies into the bladder. Nevertheless, cases are on record where glass rods chewing gum and electric cable wire probably used for masturbation have been found as foreign bodies.

Case reports from U.S.A. show that chewing gum is a favourite with those who indulge in masturbation. A case has been described by Gill (1933) where a certain gentleman practised the art in company with three others. Unfortunately he lost his chewing gum!

Surgical accidents like losing the tips of urethral or ureteric catheters have been responsible for a few cases.

Cases are known where gauze packs left inadvertently at operation have worked their way into the bladder from the general peritoneal cavity.

Swallowed foreign bodies, especially when sharp, may reach the urinary bladder by working their way across the wall of the alimentary canal and eventually reaching the bladder. In most of such instances tell-tale signs of the course taken by the foreign body are left in the form of adhesions.

Penhallow (1932) described the course a sharp foreign body could take without

leaving any trace of such a course because the track may be extraperitoneal (Fig. 4).

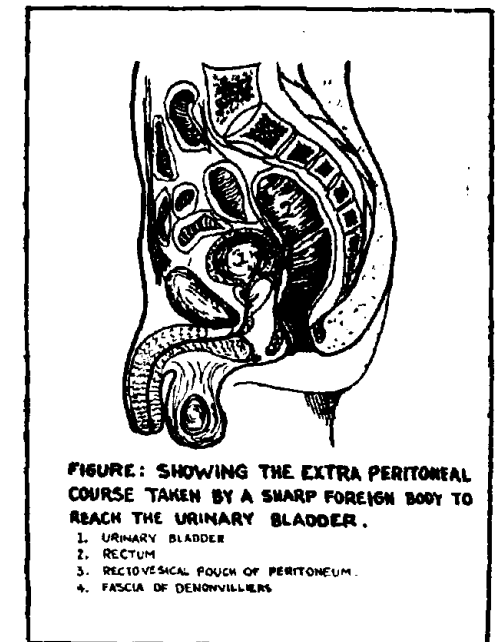


Fig. 4

The most interesting feature of all those cases with foreign bodies introduced *via* the urethra is that they are found in the bladder as if pulled by some traction from inside, possibly at the time of orgasm. The only exception has been the case of Garshweiler (1933) where a chewing gum calculus was found partly in the posterior urethra and partly in the bladder.

It is well recognised that these patients suffer with acute urinary symptoms—pain, dysuria, frequency, haematuria and even pyuria. It is surprising, however, to find that a large number of patients, especially females, never develop urinary symptoms.

On cystoscopic examination the bladder mucosa nearly always shows changes of acute

cystitis. Stone formation is all too frequent, phosphatic incrustation occurring most readily over rubber, metal and other rough foreign bodies. In the first case reported, the patient completely denied any urinary symptoms, except for the first 24 hours of his post operative period.

The second patient had signs and symptoms of acute urinary infection as well as acute epididymo-orchitis.

Treatment

Three ways of removing foreign bodies from the urinary bladder are recognised :—

1. *Solvents* like carbon tetrachloride and high grade gasolines have been used to dissolve substances like chewing gum. This has not always succeeded.

2. *Cystoscopic* removal has been practised with success more than once. Operating cystoscopes are essential.
3. *Operative removal* through a suprapubic cystostomy is not advised as a primary procedure in all foreign bodies. If all other methods fail there is no other choice.

In this first patient a laparotomy was performed because of a misleading history.

In the second case the bladder was opened because an operating cystoscope was not available.

Summary

Two cases of foreign bodies in the male urinary bladder are reported. Both patients probably introduced the foreign body themselves.

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ORTHOPAEDIC SECTION

TRANSFER OF THE TIBIALIS POSTERIOR IN FOOT-DROP DEFORMITIES

BY

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The transfer of the tibialis posterior tendon for correction of foot deformities has not been a popular operation in the past. For a long time, in cases of paralysis of the foot, due to poliomyelitis various types of operative procedures have been frequently employed. Transfer of the extensor hallucis longus to the first metatarsal, of the extensor digitorum communis to a more lateral position and of the peroneus longus or brevis or both to one of the cuneiforms, have all given satisfactory results in properly selected cases.

Until very recently the use of the tibialis posterior muscle as an active force for dorsiflexion of the foot had received little attention. It was frequently observed to be a deforming factor either producing or accentuating a varus position of the foot and in many instances the tendon was severed or lengthened to overcome the deformity. Excellent reviews of tendon transplantations by Peabody and by Carpenter make no mention of the use of the tibialis posterior tendon as a transfer for dorsiflexion of the foot, although Peabody describes sectioning it as "security against varus imbalance." For cases of paralytic equinovarus, Goldner and Irwin have stressed the importance of either lengthening or transplanting the tibialis posterior tendon. Les Mayer in 1937 advised the Campbell bone-block operation in cases of paralysis of all the dorsiflexors and the peronei. As a modification the transfer of the tibialis posterior to the outer border of the foot was also suggested. However,

this was not favoured as the tibialis posterior has to wend a rather circuitous course over the medial surface of the tibia and therefore the result may be unsatisfactory because of probable adhesions and also because the curving line of traction interfered with the strength of dorsiflexion required. Putti reported a method of transfer of the tibialis posterior through the interosseous membrane.

The reason for the unpopularity of the tibialis posterior transfer in the treatment of drop-foot is the difficulty of re-education. It has always been considered difficult or even impossible to re-educate properly a pro-gravity muscle for an antigravity function or *vice versa*. We have been able to demonstrate, that provided special care is given in the matter of post-operative re-education, it is regularly possible to develop a proper muscle co-ordination following a tibialis posterior transfer.

It is not uncommon to come across drop-foot deformities with the loss of all the dorsiflexors and the peronei following paralysis of the lateral popliteal nerve as in leprosy, in injury to the nerve and in poliomyelitis. A very large number of leprosy cases studied in the Orthopaedic Research Unit at Vellore have shown a variety of patterns of paralysis when the lateral popliteal nerve in the region of the neck of the fibula is paralysed. The commonest one is paralysis of the tibialis anterior, extensor hallucis, extensor digitorum and the peronei group of muscles. The remaining unparalysed

muscles in the leg are therefore, the gastrocnemius and soleus, the tibialis posterior, the flexor hallucis and flexor digitorum. These muscles plantarflex the foot and the toes, and produce inversion of the foot.

Thus the muscles controlling eversion and dorsiflexion of the foot are paralysed. Clawing of the toes may also be present because of the loss of the intrinsic muscles of the foot.

There are therefore, three paralytic deformities of the foot in leprosy, drop-foot, inversion of the foot and clawing of the toes. These deformities may be associated with ulceration and may in fact predispose to ulceration. In the drop-foot ulceration usually occurs under the metatarsal heads, whereas in the inverted foot ulceration may be seen on the lateral border of the foot. A mild degree of clawing of the toes predisposes the tips of the toes to ulceration, while in the more severe degree of clawing ulcers may occur under the metatarsal heads.

Since the inception of the Unit in 1950, the transfer of the tibialis posterior tendon to the dorsum of the foot has been performed on 7 cases of poliomyelitis, 1 case of injury to the nerve and 108 cases of leprosy. The purpose of this paper is to describe the operative technique as followed by us and to report the functional results obtained in these patients who have been followed-up long enough for evaluation. We have used both the interosseous and circumtibial routes in these operations to bring the tendon to the dorsum of the foot.

Principles of the Tibialis Posterior Transfer.—The tendon transfer cannot be expected to produce positive correction of a fixed deformity. Therefore, any structural equinus, varus or other deformity should be dealt with before tendon transfer, by corrective plaster, lengthening of the tendoachillis or subtalar arthrodesis as the case may be.

Forward transfer of the tibialis posterior tendon serves two purposes. It removes a dynamic deforming factor and aids in active dorsiflexion of the foot.

When the tibialis posterior tendon is transferred to the dorsum of the foot, it is important to make a direct line of pull and to insert the tendon at the optimum point in the foot so that it produces dorsiflexion without causing an inversion or eversion deformity. The path of the tendon should be smooth and gliding and should not interfere with the excursion of the tendon during its action. The tendon anchorage into the bone should be as effective as a normal tendon insertion and should be fixed at a high tension. It has been noticed at our Unit that these factors greatly influence the success of post-operative results.

Before operation the patient should be given exercises which would enable him to distinguish the contraction of the tibialis posterior muscle. The exercise used in our Unit consists of making the patient sit on a chair with the paralysed leg lying on the knee of the other leg. This makes the lower part of the paralysed leg horizontal. The patient is then instructed to lift up his foot in a vertical direction. This involves the movement of inversion and brings the tibialis posterior muscle strongly into play.

Description of the operation: Preparation.—This operation should only be performed on a foot which has no open sore or ulcer and it should be reserved for cases in which ulceration has been healed for a full month. All scabs should be removed, toe nails should be cut short and the foot should be thoroughly scrubbed twice daily for two days before operation. On the morning of the operation, the leg should be washed and scrubbed and shaved and covered with a sterile towel. In the operation theatre the leg should be re-scrubbed with soap and

water and painted with iodine for a full minute before re-painting with spirits.

The operation is performed with or without a tourniquet. It is found that if the head of the table is kept lower than the foot, the field is sufficiently bloodless and it is thought that there is less incidence of post-operative haematoma when there has been no tourniquet.

Anaesthesia.—General or spinal anaesthesia should be used for this operation because the highest incisions are likely to be through sensitive skin in leprosy cases. Deep anaesthesia is not necessary.

Operation.—An incision is made immediately below the medial malleolus and running forward to the tuberosity of the navicular. The tibialis posterior tendon is identified and divided near its insertion.

The end of the tendon is usually thickened and bulbous. It should be trimmed down to even thickness so that it can be pulled through the tendon sheath.

A longitudinal incision is made on the medial side of the leg just behind the tibia, running from about 3" above the tip of the malleolus up to about 6" above the tip of the malleolus. The tendon of the tibialis posterior is identified at the lower end of this wound. It should be clearly defined and pulled out of the wound (Fig. 1). It is easy to tear some of the fibres of the tendon if it is not completely defined before being pulled.

The end of the tendon is now grasped in a Kocker's forceps and pulled well out of the wound. With blunt dissection all its attachments to bone or fascia are separated right up to the top of the wound and beyond. (Fig. 2).



Fig. 1

Shows the incision over the medial aspect of the leg. (The proximal incision is shown a little higher than usual in this case).



Fig. 2

Shows the full length of the tendon after its division from its insertion and after being pulled through the proximal wound.

At this point a decision must be made as to whether the tendon is to be transferred around the tibia into the dorsum of the foot or between the tibia and fibula by the interosseous route. (Fig. 3) If the interosseous



Fig. 3
Shows the interosseous space after retraction of the Flexor Digitorum muscles.

route is preferred, the interosseous space should now be felt with the tips of the fingers to see whether the bones are sufficiently far apart to allow the tendon and part of the muscle to pass freely between them. If the interosseous space is narrow it must on no account be used. The tendon will become adherent and may even suffer necrosis if this is done, nor should any attempt be made to widen a narrow interosseous space. If the space is of adequate width and if this route is preferred another incision is made 4" long on the anterior aspect of the leg, running proximally from a point about 4" above the tip of the medial malleolus. (Fig. 4). The incision is parallel to the

anterior margin of the tibia and about half inch to its lateral side. Care is taken to avoid injuring the large veins. Transverse branches are divided between ligatures. The plane of dissection is found between



Fig. 4
Shows the incisions over the dorsum of the foot and the anterior aspect of the leg.

the tibialis anterior and the tibia and this plane is deepened by blunt dissection by the fingers down to the interosseous membrane between the tibia and fibula. It is important that this membrane should be fully and clearly exposed by suitable deep retractors. A segment of the interosseous membrane is excised from the whole length of the wound. Special care should be taken not to injure the posterior tibial vessels which lie immediately behind this membrane.

Now a curved incision is made on the dorsum of the foot from about the region of the ankle to the base of the second metatarsal. The curve may be medial or lateral and

the flap of skin is lifted exposing the tendon of the extensor hallucis and extensor digitorum. The deep fascia between these tendons is incised exposing the dorsalis pedis vessels. These vessels may be retracted laterally or medially and the bones deep to them identified.

A pair of forceps inserted through the anterior leg incision and through the interosseous membrane may now grasp the end of the tendon and pull it through into the anterior incision. Care should be taken to see that the muscle now lies in an easy position with no sharp angles, twists or constriction points (Fig. 5).

A tunnelling forceps is passed from the incision on the dorsum of the foot, deep to the retinaculum, to appear in the anterior leg incision (Fig. 6). The point of the forceps will be found usually to lie lateral to

the tibialis anterior and deep in the leg. No attempt should be made to bring the point of the forceps more superficially but the tendon of the tibialis anterior should be passed behind the belly of the tibialis anterior and into the jaws of the forceps. It is then withdrawn into the wound on the dorsum of the foot and again the exploring finger should make sure that the muscle belly and tendon are lying unconstricted and with an easy curve.

When the interosseous space is found to be narrow, and in cases where the surgeon may prefer the circumtibial route the following method is used.

Circumtibial route.—A probe or forceps is passed up from the incision on the dorsum of the foot to join the medial incision on the leg. No anterior leg incision is needed. The forceps making the tunnel should be kept



Fig. 5
The end of the tendon is being pulled through into the anterior leg incision. Note that this is taken lateral to the Tibialis Anterior muscle.



Fig. 6
The tunnelling forceps is passed from the dorsal incision to grasp the end of the tendon which lies deep in the anterior compartment of the leg.

strictly subcutaneous and should not be allowed at any point to scrape against the bone of the tibia (Fig. 7). The tunnel



Fig. 7

Circumtibial route. The tunnelling forceps passed subcutaneously from the incision on the dorsum of the foot to the medial leg incision is seen grasping the end of the tendon.

should cross the anterior surface of the tibia and appear at about the middle of the leg incision. The end of the tibialis posterior tendon is grasped and drawn down this tunnel into the foot. Traction should be maintained on the tendon of the foot while the surgeon re-arranges the tibialis posterior muscle in the leg through the incision. He should see that the tendon is not too sharply angulated around the tibia and that it runs in as straight a line as possible. He should see that the tendon is not in any place in contact with bare bone.

The foot is now dorsiflexed and the tendon pulled down to see how far it will comfortably reach. The point of insertion of the tendon

on the dorsum of the foot should be chosen with care. For feet with a tendency to inversion a somewhat lateral position may be chosen.



Fig. 8

The point of insertion of the tendon being tested by grasping the ligament over the cuneiform bones with a pair of pointed towel clips. Note the end of the tibialis posterior tendon already brought into the wound.

For feet with a tendency to eversion the point should be more medial. A preliminary test may be made by grasping the ligaments on the dorsum of the foot with a pair of pointed towel clips and pulling upwards to imitate the action of the tendon and observing its action on the foot (Fig. 8). Commonly, the point of insertion is on the middle cuneiform bone.

At this point a hole is chiselled into the bone in an oblique direction, being superficial proximally and running distally in the foot rather transversely than vertically. The hole may be $\frac{3}{8}$ " deep and big enough to accommodate the full thickness of the



Fig. 9

Diagrammatic representation showing the method of insertion of the tendon into the bone.

tendon. Two small holes are drilled from the surface of the bone to meet the bottom of the chiselled hole. These small drill holes may be conveniently made with a stout pair of towel clips (Fig. 9). They should be placed as widely apart as possible and their openings on the surface of the bone should be about half inch apart, and through ligament if possible.

A strong suture is now passed in a zig-zag fashion up and down the tendon with both ends emerging from the end of the tendon (the Bunnell type of suture). 30 gauge stainless steel wire or stout linen thread or nylon may be used for this purpose. The two free ends of the suture are now threaded through the drill holes already made in the bone so as to emerge through the dorsal surface (Fig. 10).

At this stage we usually hold the ends of the wire in a clamp and proceed to close all other incisions before finally fixing the tendon. This is because it is easier to sew up the wounds if the foot does not have to be held in dorsiflexion all the time. The tourniquet is released and haemostasis is

obtained. The skin incisions are closed with continuous stainless steel wire, 35 gauge.

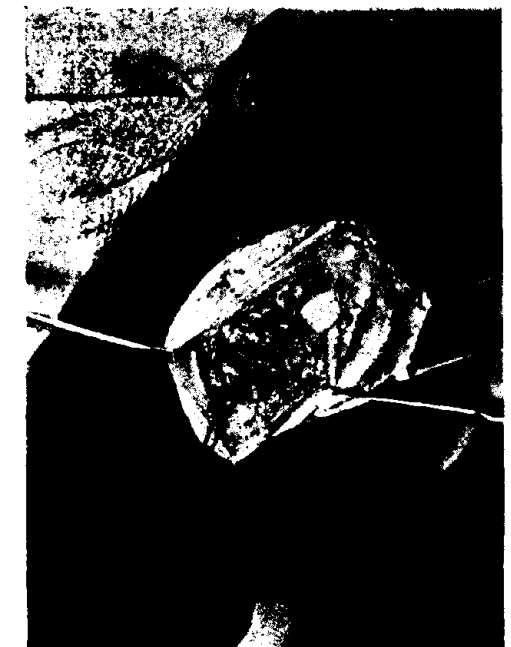


Fig. 10

The two free ends of the suture (in this case black linen was used) threaded through the drill holes in the bone after suture of the tendon.



Fig. 11

The final position of the tendon in its new insertion with maximum dorsiflexion of the foot.

The foot is now dorsiflexed by an assistant while the tendon is pulled into the hole that has been prepared for it in the bone and the two wires are tied or twisted together and cut short and tucked in towards the bone to prevent a projecting point. It is to be noted that the tendon is sutured at a high tension (Fig. 11).

Following repair of the drop-foot, the patient is often left with a toe-drop. To prevent this, the extensor digitorum longus tendons should be pulled upon in the wound on the foot until the toes are level with the foot. In this position the tendons are stitched to the newly fixed tibialis posterior tendon or to the ligaments on the dorsum of the foot by a single cotton suture, having first roughened the tendons. The extensor digitorum longus tendons may also be shortened by plicating them. The wound on the dorsum of the foot is sutured with continuous stainless steel wire and the dressings and



Fig. 12

The foot in plaster cast after operation with a wooden sole-plate incorporated. Another type of sole plate and rocker is also shown.

bandages applied. During this process and during the plastering, the foot is held in dorsiflexion above a right angle by an assistant.

A bandage is applied over cotton pads and the foot put into a plaster extending at least two-thirds up to the knee. A wooden sole-plate and rocker is incorporated in the plaster cast. The patient is not allowed to walk until after four days. The stitches are not removed until the plaster is removed 6 weeks later (Fig. 12).

When the foot is removed from plaster the patient is given a back slab. If he has practised using the tibialis posterior before operation, then it will not be difficult for him to dorsiflex his foot after the operation. He must master this movement both in bed and standing up before he is allowed to walk. At our Unit in Vellore, weight bearing exercises are usually started about 10 days after the foot has come out of plaster. During his first walking steps and for several days thereafter he must be watched to make sure he does not slip back into his old drop-foot, high-stepping gait. The results of the operation are excellent only if a proper re-education is carried out (Fig. 13).



Fig. 13

A post-operative foot showing range of dorsiflexion.

In cases where there is undue mobility of the foot, stabilisation of the foot with a triple arthodesis operation combined with a tendon transfer of the tibialis posterior has been found to obviate possible valgus or varus deformity.

Follow-up material.—An analysis of the evaluations done on 39 unselected cases with a follow-up period ranging from 3 months to 27 months has shown that 25 of the cases were done by the interosseous route and 14 by the circumtibial method. A preliminary assessment was made of each of the two methods of operation according to range of post-operative active movement of the foot from maximum dorsiflexion to maximum plantarflexion and the gait was also assessed to see whether it was normal, mildly high-stepping or high-stepping. Finally, an overall assessment was made by which the results were classified as Excellent, Good, Fair and Poor. These assessments are as follows.

Interosseous Route (25 Cases) Range of active movement				
Age: 30—25	25—20	20—15	15—10	
4%	24%	32%	4%	

Gait				
Normal	Mild High-stepping	High-stepping		
44%	52%	4%		
Overall Assessment				
Excellent	Good	Fair	Poor	
20%	48%	28%	4%	
Circumtibial Route				
<i>(14 Cases) Range of active movement</i>				
Age: Over 30	30—25	25—20	20—15	15—10
36%	21%	14%	29%	—
Gait				
Normal	Mild High-stepping	High-stepping		
79%	21%	—		
Overall Assessment				
Excellent	Good	Fair	Poor	
36%	57%	7%	—	

It should be observed here that this follow-up study of the tibialis posterior transfer operations was done in the course of a follow-up study conducted for hand operations and therefore the report submitted here does not cover all the operated cases.

Summary

The transfer of the tibialis posterior tendon to the dorsum of the foot to correct drop-foot deformity is a useful and effective type of operation. The two methods in which this operation has been performed have been

described in detail. The details of a brief and preliminary follow-up study on 39 unselected cases has also been included in this study. It is hoped that there will be a much more widespread use of this operation.

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**RECURRENT DISLOCATION OF THE ELBOW*****A Case Report**

BY

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Recurrent or habitual dislocation of the elbow is a rare disability. A recent dislocation of the elbow is sometimes very unstable; recurrence must be prevented by splinting and control radiographic examinations are required every few days until this danger has passed. A survey of the literature revealed only a few reported cases of this rare disability in the last eighty years, since Albert described the first example in 1881 (Sommer, 1928). The surprising feature of these few cases is the variety of attributable causes and the number of operations designed to remedy this disorder—twelve including modifications.

In view of the rarity of this condition and the success of the relatively simple operative procedure employed, publication of these cases seems justifiable.

Albert (1881) reported the case of a ten year old boy with an epicondylar fracture. No operation appears to have been performed for the recurring posterior dislocation. Bloch's (1900) and Heusner's (1894) cases, although different types of dislocations, had certain features in common, including a traumatic origin, a shallow trochlear notch and an old avulsion fracture of the lateral epicondyle. Von Rehn (1924) discussed the only reported anterior dislocation which he cured by a plastic operation on the front of the capsule. Peritz (1924) classified the causes of recurrent dislocation of the elbow and described a case of a twelve year old idiot boy, who had an old fracture of

medial condyle of humerus with disturbance of growth, a small ulnar notch and laxity of ligaments. Sorrel (1935) and Knoflach (1935) described and treated a case each of recurrent dislocation of the elbow resulting from laxity of ligaments but with no congenital defect, while Milch (1936) described bilateral recurrent dislocations in a boy of twelve years with congenital shallow trochlear notches. Gosman (1943) reported a fifteen-year old boy who had sustained dislocations since the age of three; there was no congenital abnormality but all the joints were hypermobile. Reichenhein (1947) described an ingenious and physiological operation which he devised because he was unaware that any other procedure had been described. The biceps tendon was cut near its insertion and sutured to the tough periosteum on the anterior aspect of the coronoid process by two silver wire sutures. Wainwright (1947) used a flat cortical graft in the coronoid region for a recurrent posterior dislocation. Von Stampflemohr (1949) reported a female patient aged thirty-four years with a shallow trochlear notch. Kapel (1951) reported two patients with recurrent posterior dislocation, one of which he operated on and cured by constructing cruciate ligaments from strips of biceps and triceps tendon passed through a drill-hole in lower end of humerus. This operated case has been followed for seven years without any recurrence. It has the merit of being quite simple technically with little risk of the serious loss of motion which might be anticipated in any procedure attempting to change the joint contours.

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Hall (1948) reported on a case of recurrent dislocation of the elbow in a boy of ten-years with good operative results. Spring (1949) operated on a case of recurrent dislocation of elbow. He plicated the capsule and further stabilised the joint by constructing new collateral ligaments from strips of triceps tendon and fascialata. After two years, there was no recurrence, and full painless movements of the elbow and power was normal. Jens (1949) reported and treated a boy of twelve-years on similar line to Spring's technique, with good results.

Case Report

A Hindu male aged thirty years was admitted in the K. E. M. Hospital, Bombay on 14-2-57 complaining of pain, tenderness and swelling in the region of right elbow—fracture of head of right radius. He gave history of accidental fall on the same day about three hours before admission. In addition he complained of pain in left shoulder and there were abrasions on left wrist and the front of left knee. Incidentally, it was discovered that the patient had recurrent dislocation of left elbow—duration of about 8 months, attributed by the patient to a fall from the cot. Examination revealed a fairly built and well nourished individual. The blood pressure was 125/78 mm. of mercury. The excision of fractured head of right radius was performed on 22-2-57 under general anaesthesia. While under the effect of anaesthetics during the operative excision of fractured head of right radius, it was incidentally discovered that the patient had got dislocation of left elbow joint. There were no signs of violence and the dislocation could be reduced easily. The radiographs, both antero-posterior and lateral views, were taken of the dislocated joint, which confirmed the clinical diagnosis. The

lateral view showed a shallow trochlear notch of the ulna.

The diagnosis of recurrent posterior dislocation of the left elbow was confirmed on the next day from the patient's history. The patient attributed this rare disability to a fall from the cot about eight months back followed by swelling in left elbow region which subsided in a week without any recognised treatment. The dislocation used to occur once in three to four weeks, associated with shooting pain on ulnar aspect of the left forearm and little finger and also tingling in the left little finger. There was slight wasting of the left hypothenar eminence, but no wasting anywhere else, *viz.* forearm muscle or in biceps or triceps muscle. Flexion-extension movements of the left elbow were of normal range, there was no abnormal lateral mobility. In normal (undislocated) state, there was no weakness of left arm and the patient used to carry on with his normal duties. After the diagnosis was confirmed, it was decided to cure this rare disability of recurrent posterior dislocation by an operative procedure. The operation performed was King's modification of Reichenheim's operation for recurrent posterior dislocation of the elbow.

Pre-operatively certain investigations were carried out. The urinalysis showed absence of albumin, sugar or casts. The red blood cell count was 4.5 millions per c. mm. and the hemoglobin was 14.6 grams per cent. The radiographic findings were as mentioned before. The operation of the transposition of the biceps tendon, as was described by King of the Australia, was performed by one of us (A. K. T.) on 12-4-57. Anaesthesia was induced with intravenous pentothal and maintained with gas and oxygen and ether. A pneumatic tourniquet was applied to the left upper arm



Fig. I
Recurrent dislocation of left elbow; Shallow trochlear notch.



Fig. III
Full flexion is present after operation.



Fig. II
After Operation.



Fig. IV
Final result showing the range of extension.

after perfect exsanguination of left arm. The coronoid region was displayed by Honry's exposure of the left cubital fossa. The biceps tendon was isolated and severed near its insertion. A drill hole was made in the front of coronoid process in antero-posterior direction and the hole was enlarged with bone awl. The dislocated elbow (humero-ulnar) joint was reduced perfectly with the elbow joint in 90° flexion and the tendon of biceps brachii was passed through the hole in the coronoid process and stitched to the soft structures over the back of olecranon with chromic catgut, exposed through a small posterior incision. The wounds were closed with the elbow in position of 60° of flexion, and an above elbow plaster cast was given in the position of acute flexion, leaving a small window for radial artery palpation at the wrist.

Post-operatively, injections of crystalline penicillin (one lac units 3 hourly) were given for a week. The finger movements were started from the very first day of operation, and a close watch was kept on radial pulse. The plaster cast was removed after seven weeks and the stitches were removed at the same time. Then the left arm was put in plaster slab at acute angled flexion for further three weeks. The elbow movements were started about ten weeks after the operation. The shoulder movements were practised right from the beginning.

There was slight gaping of the wound at one extremity of the incision. The skin around the gaping wound was excoriated. The unhealed wound was dressed regularly. The pain was moderate to start with after the operation but it completely subsided after sixth post-operative day. There was neither wound infection, nor post-operative fever, nor discharging sinus. Some amount of wasting of the biceps brachii muscle was noticed when plaster was

removed, which was remedied by exercises and movements. The patient was not allowed to lift up heavy objects for the first three months.

The patient was discharged from the ward on 17-6-57 with the wound healed, and a stable elbow with some limitation of elbow movements. The patient is followed regularly since his discharge from the ward. After his discharge the patient resumed his job as a vaccinator in a municipal vaccination centre. He last attended our out-patient department on 3-7-58 and his movements were stable, painless and full except for the limitation of last 10° of extension. There was no paraesthesiae. The biceps muscle was acting efficiently with no appreciable wasting. The patient was very happy and satisfied.

The movements of the elbow joint were started about ten weeks after the operation. The movements recovered gradually to start with, but later on the progress of recovery was rapid, and upto date the movements and the function of the left elbow joint are nearly normal. The supination and pronation of left forearm are unaffected.

Range of Movements

Post-operative period	Short of full extension by	Short of full flexion by
10 weeks	85°	65°
12 weeks	60°	50°
14 weeks	55°	30°
20 weeks	40°	20°
33 weeks	20°	16°
Today	10°	0

In short, then, this type of habitual or recurrent posterior dislocation of the elbow joint, a rare disability, seems to result from an injury which produces an avulsion fracture of the epicondyle with resulting ligamentous laxity. This may be due in some measures, as in this reported case, to

Inadequate initial treatment. Associated with this is a shallow semilunar notch which may be either a predisposing abnormality, of congenital origin, or it may develop as the result of reported luxations.

In this reported case, follow-up examination one year after operation showed normal movement except for extension, which was limited for the last 10 degrees. There is no recurrence of disability and the power of left elbow is normal.

Summary

A case of recurrent dislocation of the left elbow, treated at the K. E. M. Hospital, Bombay 12, is presented with a short historical background and discussion.

Acknowledgement

We are thankful to Dr. S. G. Vengsarkar, M.D., F.C.P.S., Dean, K. E. M. Hospital and Seth G. S. Medical College, Bombay, for permission to publish this case.

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RECONSTRUCTION OF THE THUMB IN POLIOMYELITIS

BY

KARAM SINGH GREWAL, Ludhiana.

Hand is the most important member of the body through the agency of which we earn our living, and express our intelligence through writing and deciphering works of art. There are two main functions of the hand namely to hold objects (grasp) and to do pincer movements of the hand as used in writing and painting. The grasping movements are instinctive and are for purposes of doing gross work whereas the pincer movements are for intelligent and creative work as art. Out of the two the latter has developed late in man though grasp is a powerful movement developed in almost all primates.

The most important member of the hand is the thumb which executes 50% of the function of the hand (Slocum and Pratt).

Index finger no doubt is important for pinching but can be replaced by other fingers, the middle and ring fingers being important substitutes. The little finger is the least important of fingers and naturally the weakest also.

As a general rule the hand reconstruction is useful in direct proportion to the functional efficiency of the elbow and shoulders. If shoulder and elbow are flail the hand even if functioning well loses much of its value. Therefore every effort should be made to provide at least flexion of the elbow and stability to the shoulder.

The opposition mechanism of the thumb is usually lost in poliomyelitis and this is its most important function. Opposition is the

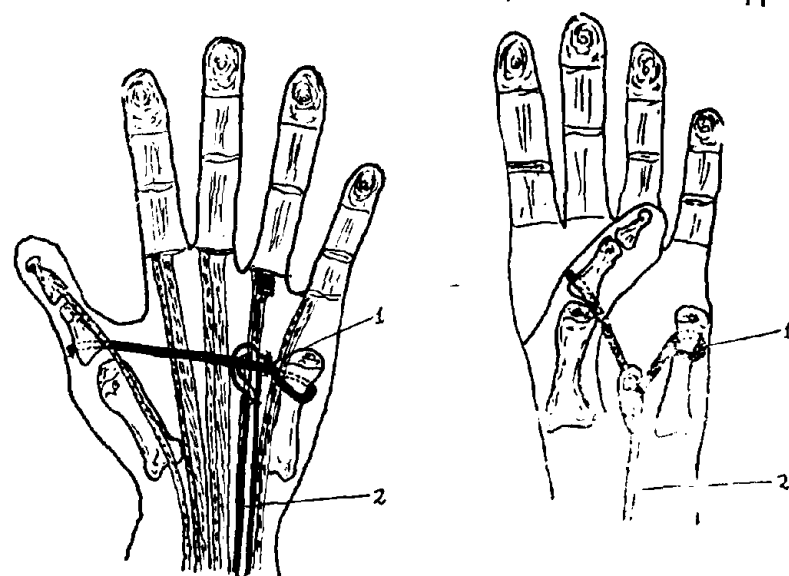


Fig. 1

Thumb in opposition After operation.

1. Palmaris Longus Tendon (Graft). 2. Flexor Digitorum Sublimus Tendon of Ring Finger.
T—TENDON OPERATION

Shows the Modified T-Tendon operation. The left hand picture shows the Palmaris Graft lying in front of the flexor Tendon and sublimis Tendon looped round. The right hand picture shows the opposed thumb when the sublimis Tendon contracts.

movement of the thumb which consists of the following components; (1) Abduction at the carpometacarpal joint. The muscles involved are abductor pollicis longus and brevis; and Extensor pollicis longus and brevis which stabilise the metacarpophalangeal and interphalangeal joints. (2) Rotation of the thumb produced by the opponens pollicis and the lateral head of the flexor pollicis brevis. Without the opponens and flexor brevis there would be no rotation without the adductor the grip would be weak. For efficient opposition the wrist must be stabilized by the flexor and extensors of the wrist. If the wrist muscles are deficient and the wrist is unstable it may have to be fused in 30—35° dorsiflexion before attempting the reconstruction of the thumb or the fingers.

The important movement in opposition is the abduction, forward rotation and adduction of the thumb as a whole. If abductor is functioning but the opponens is not and the adductor is weak we advocate the tendon T operation of Bunnel (Fig. 1). But instead of the horizontal limb of the T passing under the flexor group of tendons it is passed in front of the flexors subcutaneously. The tension of this graft should be such that the palm is arched and the thumb stands forward and rotated internally at the end of the operation. The tendon is fixed at the ulnar side of the base of the thumb on one side and to the neck of the 5th metacarpal on the other side. The tendon should be fixed through holes made by an awl into these bones. The vertical limb of the T is provided by the tendon of the flexor digitorum longus of the ring finger which also is fixed to the middle of the horizontal graft under tension by means of strong silk. This graft provides a good forward movement to the thumb for grasp and holding round objects but does not provide pinching movements. The result is seen in Fig. 2 A & B.



Fig. 2-A

Shows the thumb lying in the plane of the fingers.

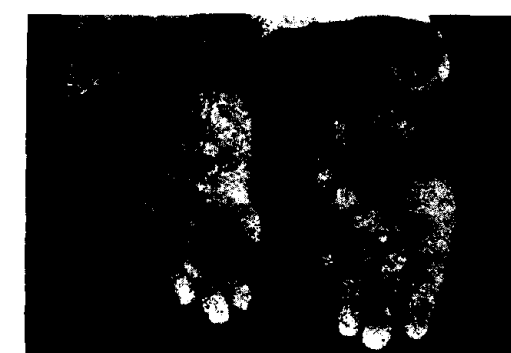


Fig. 2-B

Shows the thumb opposed to the base of the little finger.

Another operation which gives good opposition to the thumb in almost similar circumstances is the tendon graft of flexor digitorum sublimus of ring finger from below the flexor retinaculum. The tendon is cut as low as possible through a $\frac{1}{2}$ " incision along the distal palmar crease opposite the ring finger. It is rerouted subcutaneously outwards and downwards over the thenar eminence into a small incision along the ulnar border of the proximal part of the 1st phalanx of the thumb passing from the dorsal surface of the metacarpophalangeal joint. The tendon is now fixed through an awl hole on the ulnar half of the base of the phalanx. The abducted and rotated position

of the thumb is maintained for three weeks. The static movements of the tendons inside the plaster are encouraged from the beginning. At the end of three weeks the plaster is removed, and the stitches are out. The transplant is further exercised. The thumb function is obtained in six weeks or so. This operation is based on pulley action advocated by Bunnel and Irwin and the pulley is provided by fascia below the flexor retinaculum.

The transplant that effectively provides both the pinching and the grasping movement is a transplant of the tendon of flexor digitorum sublimus which is rerouted from a pulley in the vicinity of the pisiform bone (Fig. 3). This pulley may be usefully made of the intact tendon of the flexor carpi ulnaris. The free end of the flexor digitorum sublimus tendon is passed under the lower end of the tendon of the flexor carpi

ulnaris and is then rerouted subcutaneously over the thenar eminence into an incision $1\frac{1}{2}$ " long along the anterolateral border of the thumb with its middle at the metacarpophalangeal joint. The free end of the tendon is then split into two. Both the free split ends are then passed through awl holes along the ulnar border of the neck of the 1st metacarpal bone and the base of the 1st phalanx and stitched to themselves by strong silk. The tension of the transplant should be sufficient to hold the thumb well forwards and in abduction. The pulley in the vicinity of the pisiform bone may be formed by a small loop made from the radial half of the lower 2" of the tendon of flexor carpi ulnaris or even from the lower 2" of the tendon of the palmaris longus the free end of each is stitched to the pisiform bone in each case. For all practical purposes the intact tendon of flexor carpi ulnaris is better as there is very little chance of

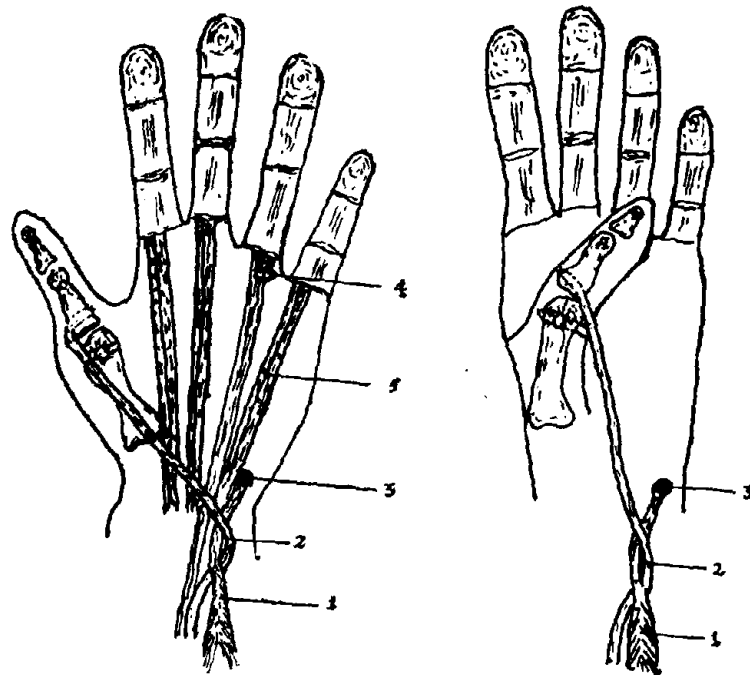


Fig. 3

Operation for Restoring opposition in the Thumb following opponens paralysis.
(1) Flexor carpi ulnaris Tendon. (2) Flexor dig. sublimus Tendon of ring finger. (3) Pisiform Bone.
(4) Cut end of flexor dig. sublimus Tendon. (5) Flexor dig. sublimus and profundus Tendons.

adhesions. The other pulleys may get adherent to the transplant and may defeat their own purpose.

In all we have done 10 operations and therefore no statistical value can be attached to such small number of operations. But it brings out some points. (1) The fingers must be working well before a graft for opponens is contemplated. The fingers of this patient (Fig. 4-A, B & C) are hyperextended at the interphalangeal joints due to weakness of flexor muscles. Arthrodesis



Fig. 4-C

The patient is holding a glass of water.

of terminal phalanges may improve function.

(2) The results are better if the extensor pollicis longus and abductor pollicis longus are working well (Fig. 5-A, B & C). Fig. 6-A & B in another patient show excellent result.

(3) The wrist muscles must be working. A flail wrist is a contraindication to any active surgery at the fingers. The wrist must be fused before doing anything lower down.



Fig. 4-A

Shows the transplant working.

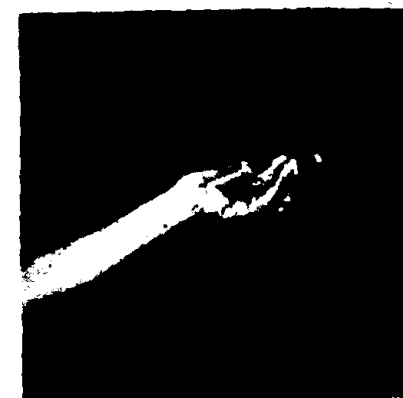


Fig. 4-B

Shows the hyperextension of the terminal phalanx of the thumb.



Fig. 5-A

Shows a good pinch.

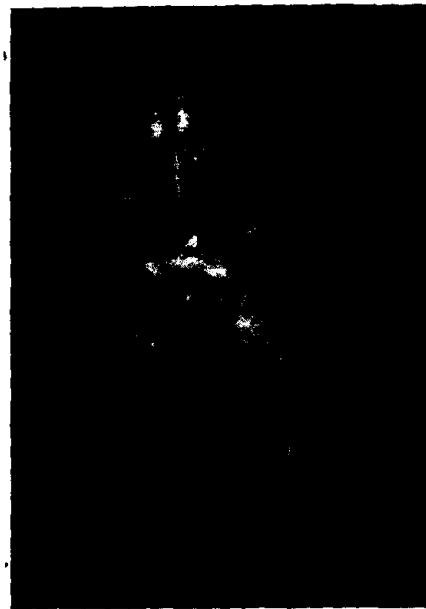


Fig. 5-B
Patient is holding a glass of water effectively.



Fig. 5-C
The thumb is fully rotated in opposition.



Fig. 6-A & B
Show excellent opposition of the thumb.

(4) T tendon transplant though did not induce actual opposition of the thumb, brought the thumb quite in front of the m to hold objects. The grasp was however weak.

(5) With the graft of the tendon of the flexor digitorum sublimus of the ring finger from below the flexor retinaculum the thumb will be able to hold objects between and the index finger. The thumb also is

opposable to other fingers. The grasp again is weak.

(6) The graft of the tendon of the flexor digitorum sublimus from above the flexor retinaculum looping round the tendon of the flexor carpi ulnaris was decidedly more useful both for holding round objects and pinching movements between the index finger and the thumb and is recommended strongly.

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PRELIMINARY RADIOLOGICAL OBSERVATION ON RELATIONSHIP OF LOWER HUMERAL EPIPHYSIS WITH ITS SHAFT*

BY

D. P. GHOSH, West Bengal.

The case reported below prompted us to investigate the relationship of lower humeral epiphysis with its shaft in a number of cases.

Case Report

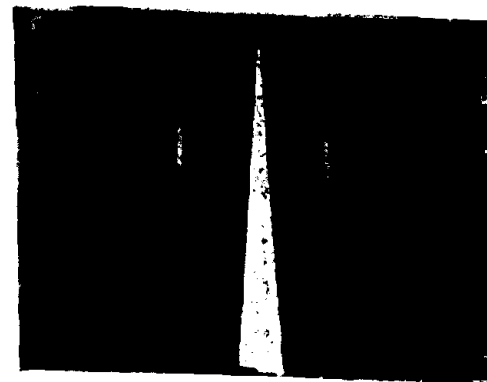
A boy of 11 years was admitted to Central Hospital, Asansol on 15-10-57 with history of direct injury of Rt. elbow at its back as a result of a fall.

On examination.—There was a generalised swelling around the elbow. Active movements of the joint were restricted by some degrees, but passive movements, though painful, were full and free. There was no fracture clinically of the bones of the elbow joint.

Rt. elbow was x-rayed on 17-10-57 and apparently no bony injury was noticed. Lateral skiagram of the elbow showed that 2/3 of lower humeral epiphysis was in front of the anterior humeral line. As a result of this finding the case was diagnosed as "forward displacement of lower humeral epiphysis" and the elbow was immobilised in full extension by an anterior plaster-of-paris slab.

To be sure that we are right in our diagnosis we took on 19-10-57 a true lateral skiagram of the normal left elbow for comparison with the injured right elbow

(Fig. 1). Both the skiagrams were taken in the identical positions. It was observed that 2/3 of lower humeral epiphysis in normal elbow (Lt. side) was lying in front of the anterior humeral line.

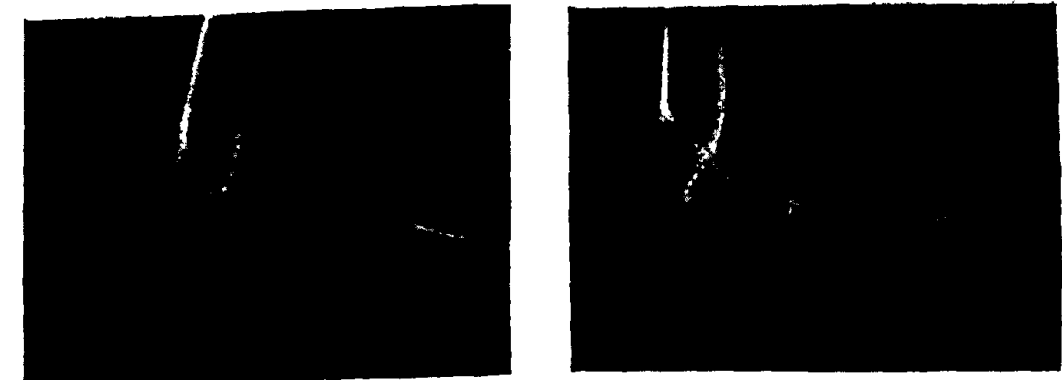


Lt. Fig. 1 Rt.

Skiagram of the case (Chart-1 Case No. 1) which prompted us to investigate the subject matter of this paper. Injured right elbow (right-hand-side picture) is compared with normal left elbow (left-hand side-picture).

As a result of this finding our previous diagnosis was revised. We took out the Plaster-of-Paris slab and the injured elbow was put in collar-and-cuff sling and the patient was discharged on 19-10-57 with advice. After 10 days sling was discarded and active movements of the joint were started. In couple of days full painless active movements of the joint were achieved.

*The paper was presented before the Orthopaedic Section of the Association of Surgeons of India at the Annual Conference held at Visakhapatnam in the last week of December, 1958.



Lt. elbow Fig. 2-A & B Rt. elbow
Skiagrams of a typical normal case (Chart 1-Case No. 36) showing both elbows.

Present Investigation—Material and Method

We selected those cases who were admitted to or attended hospital for diseases other than those of elbows. There were of good general health. None of them gave past history of injury of elbows. Age varied from 1 to 14 years and it was checked up either from horoscope or from school. Number of subjects x-rayed was 55.

After repeated thorough scrutiny, only those cases in which true or nearly true lateral picture of elbow at right angle position came out are considered here and they comprise only 40 out of original 55 cases. There were 30 males and 10 females. Twenty-three subjects belonged to Bihar, 16 to Bengal and 1 to Punjab.

Every effort was made to x-ray elbows flexed at right angle in true lateral position. In all cases both elbows were x-rayed but only true or nearly true lateral pictures are considered here.

In 30 cases both elbows were x-rayed to our satisfactions; in 10 cases x-rays of one side or the other either could not be taken or discarded due to their not being true or nearly true lateral.

To measure anterior tilt of the lower humeral epiphysis first the axis of the lower humeral epiphysis is ascertained by passing a line through its centre at right angle to the line drawn at the base of the epiphysis; next, the long axis of the humerus is determined by dropping a line down the front of the shaft of the humerus and we will call it 'Anterior Humeral Line.' It is found that when the axis of the lower humeral epiphysis meets the anterior humeral line, an angle is formed and we will call it 'Lower Diaphyseal-Epiphyseal Angle.' This angle indicates the anterior tilt of the lower humeral epiphysis. It is also noticed that a certain portion of the mass of the epiphysis lies in front and certain portion lies behind the anterior humeral line.

Observation

Total number of angles measured are 70 in number out of which 34 angles belong to the Right side and 36 angles to the left side (Chart No. I).

Difference between angles on right and left sides varies from 1° to 22.5°. It is noted that there is difference of 10° or less between angles on right and left sides in 14 instances and difference of 5° or less in 16 instances.

CHART I

Serial No.	Case No.	Age	Sex	Province	Angle		Mass in front of Ant. Humeral line
					Rt.	Lt.	
1	1	11	M	Bengalee	50	55	
2	2	5	M	"	57	44	3/4
3	3	8	M	Behari	44	49	4/5
4	6	1	M	"	36	43	1/2
5	7	9	F	"	56	54	1/3
6	8	9	F	"	×	46	3/4
7	12	8	M	Bengalee	42	52	1/2
8	13	3	M	Behari	×	49	2/3
9	15	7	M	"	55	50	2/3
10	18	10	M	Bengalee	58	52	2/3
11	20	6	M	Behari	58	×	3/4
12	21	4	F	"	51	×	2/3
13	22	7	M	Bengalee	57	39	3/4
14	23	2	M	Behari	47.5	70	2/3
15	25	7	M	"	×	65	Almost whole mass (left), 2/3 3/4 (Rt.)
16	26	9	M	"	×	40	2/3
17	27	14	M	"	79.5	71	2/3
18	28	9	M	"	76	56	2/3
19	29	10	M	"	52	56	3/4 (Rt.), 2/3 (Lt.)
20	30	11	F	"	63	64	4/5 (Rt.), 3/4 (Lt.)
21	31	12	M	"	40	43	4/5
22	32	4	M	Bengalee	55	59	3/4
23	33	10	M	Punjabee	×	36	Almost whole mass
24	34	8	M	Bengalee	49	53	1/2
25	35	5	F	"	47	44	4/5
26	36	9	M	Behari	49	52	3/4
27	38	8	M	Bengalee	44	×	4/5
28	39	4½	M	"	45	×	Almost whole mass
29	40	7 years 2 months	M	"	×	30	Rt. 4/5 (more)
30	41	8	F	Behari	45	51	3/4
31	42	6	F	"	52	64	4/5
32	43	10	M	"	37	30	Almost whole mass
33	44	8	F	"	45	51	2/3
34	46	1 year 6 months	M	"	50	47	4/5
35	49	6	F	Bengalee	47	49	Rt. almost whole mass, Lt. ½
36	50	5 years 3 months	M	"	63	70	4/5
37	51	12	M	Behari	52	49	Almost whole mass
38	52	3 yrs. 9 m. 16 d.	M	Bengalee	65	53	4/5 (more)
39	54	3 yrs. 5 m. 9 d.	F	"	41	36	Rt. 4/5
40	55	4 yrs. 10 m. 19 d.	M	"	50	53	2/3
							4/5 (more)

Discussion

Mean lower diaphyseo-epiphyseal angle on the right side is 51.7° minimum being 36° and maximum 79.5°.

Mean lower diaphyseo-epiphyseal angle on the left side is 50.1° minimum being 30° and maximum 71°.

Combined mean angle is 50.5°.

Out of 70 lower humeral epiphyseal masses one-half to almost whole of 69 epiphyses lie in front of the anterior humeral line; in only one (Case No. 6) 1/3 of the mass lies in front of the line.

There are nine angles from 30° to 40°, twenty-six angles from 41° to 50°, twenty-three angles from 51° to 60°, nine angles from 61° to 70°; and three angles from 71° to 79.5° (Chart No. II).

Chart II

Angles in Degrees		No. of Angles
From	To	
30°	40°	9
41°	50°	26
51°	60°	23
61°	70°	9
71°	79.5°	3

From a few cases in our present series we find (i) that in x-raying elbow lower end of the humerus should be at true or nearly true lateral position irrespective of the position of the elbow joint itself at 0° (full extension), or 45° or 90° flexion (ii) that if lower end of the humerus is either rotated medially or laterally to an extent of 10° to 20°, lower diaphyseo-epiphyseal angles as well as the amount of epiphyseal masses alter.

We are carrying further work on these two points.

We could find no reference about (a) lower diaphyseo-epiphyseal angle (b) the definite amount of mass of lower humeral epiphyses lying either in front or behind the anterior humeral line either in available standard books on Surgery and Radiology except in Watson-Jones' "Fracture and Joint Injuries" or journals in English language as available with us.

In McGregor's "A Synopsis of Surgical Anatomy" there is mention of "lower humeral angle" which is 60°. This angle is formed by the long axis of the humerus passing through the middle of the shaft and the axis of the lower humeral end. He lays great importance in restoring this angle in the setting of separation of the lower humeral epiphysis, intercondylar, and dicondylar fractures. He does not mention whether this is his finding in children or in adult.

According to Watson-Jones': (a) anterior tilt or lower diaphyseo-epiphyseal angle is normally about 25°; and (b) one-third or less of the lower humeral epiphyseal mass lies in front of the anterior humeral line.

Our radiological observation on 70 normal elbows is quite different from that of Watson-Jones. We find that (a) Lower diaphyseo-epiphyseal angle is 50.5° instead of 25°; and (b) ½ to almost whole lower humeral epiphyseal mass lies in front of the anterior humeral line instead of 1/3 or less.

Acknowledgment

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MANAGEMENT OF TRAUMATIC PARAPLEGIA*

BY

K. S. BOSE, Calcutta.

Before the last World War, patients suffering from traumatic paraplegia were usually doomed and the prognosis as regards life and limb were hopeless. In spite of constant and careful nursing, bed sores and urinary infection were inevitable and often fatal. If these early hazards of life were overcome, the patient usually spent the rest of his life as a total wreck and invalid—a burden to himself, his family and the community.

Since the establishment of paraplegic centres with proper organization and specialised treatment and nursing during and after the last world war, it has been possible to restore a healthy, useful and independent life to the unfortunate victim of spinal injury. The present changed outlook and better prognosis, are due to two main factors in the management of paraplegic patients. The first is the early and efficient treatment of the bladder which is perhaps the most important single aspect of the patient as a whole. The second equal, if not more important factor is the regular *two hourly* 'rolling' of the patient to protect the skin and prevent stasis in the bladder. This rolling or turning of the patient is only possible with early operative fixation in 'unstable' fractures of vertebrae by plating the spinous processes to restore stability. The 'turning frame' devised by Stryker also serves the purpose by stabilising the patient as a whole.

The ultimate functional result is determined by the extent of damage to spinal cord and roots of cauda equina, apart from

the vertebral injury as revealed by skiagram. A thorough assessment of the patient by neurological examination is helpful to differentiate the root damage from cord damage. The cord damage is irreparable. The lumbar roots of the cauda equina, lying alongside the lower end of the cord may escape serious injury in the common type of thoracolumbar fractures and some recovery is then possible (Root escape). The function of lumbar roots is to provide the balance and stability of the lower limbs and trunk. This is of great value in walking because enough hip and knee movements may remain to save the patient from having to swing his lower limbs helplessly on crutches.

Bladder Management

The damage to lumbosacral segments of the cord lying opposite the level of 9th Dorsal and 1st Lumbar vertebrae sustained commonly, cause loss of voluntary control of the bladder and bowel. Bladder overdistension and prevention of infection are the cardinal principles in the bladder management. These are provided efficiently by indwelling catheter as recommended by Holdsworth and Hardy from their extensive and wide experience in U. K. The long term aim is the establishment of automatic emptying. This is very effective and of value to the patient, only when the bladder has a reasonable volume. The bladder has to be prevented from shrinking commonly caused by infection and irrational low suprapubic catheterisation.

*Paper Read at Medical College Reunion, Calcutta, Silver Jubilee Session.

The indwelling catheter was condemned by Thomson Walker (in 1917) as a potent cause of infection but was selected by Kidd (in 1919) as the quickest and best method for use in paraplegia. Page (1952) drew attention to the irritant effect of red rubber catheter and the relative absence of urethritis with a latex catheter. Adams (1953) pointed out the need for a small catheter which would allow escape of urethral discharge. Foley's 18 french latex catheter serves the purpose ideally and its retention by a balloon dispenses with constrictive strapping around the penis. This with regular twice daily clearance of bladder debris by a syringe of canny Ryall type and mild antiseptic lavage helps to combat infection along with systemic antibiotics. Aseptic handling is essential and catheterisation is to be treated as a surgical operation.

Trial periods without catheter for bladder re-education and development of reflex micturition is started as soon as spinal shock recover. The catheter is clamped for a period upto three hours with the object of educating the bladder to periodic reflex action.

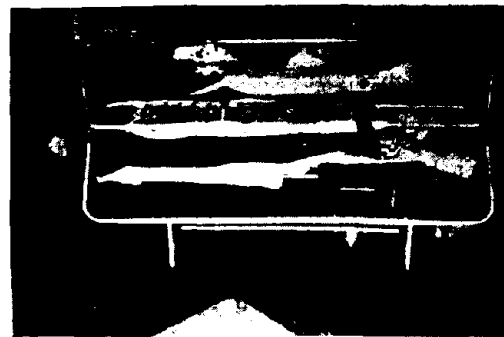


Fig. 1

Photograph showing patient in supine position on Stryker Frame.

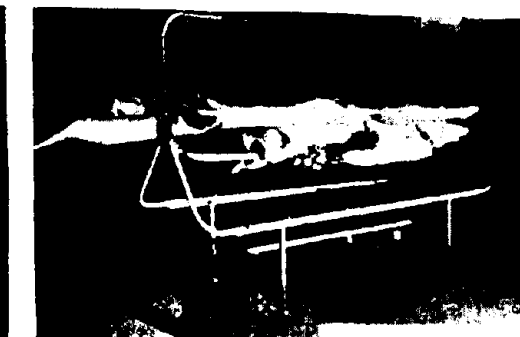


Fig. 2

Photograph showing patient in prone position on Stryker Frame.

Catheter drainage with trial periods is continued until the volume of residual urine is less than 20% of the total volume. This routine is to be continued until reflex evacuation or evacuation by manual compression and straining is well established i.e. a 'social' bladder is obtained. Riches (1954) advocates a delay of even 48 hours after injury for any catheterisation as by this time many cases of spinal concession and incomplete lesion will recover and the need of any form of bladder drainage will be avoided. The other useful method in the management of bladder in paraplegia is a high suprapubic catheterisation (Riches (1947), Donovan (1949), Pratter (1947). Tidal drainage, if properly worked, help in the development of tone and automatic bladder. Munro (1943) does not advocate this in the early phases as this may encourage a condition of retention with automatic overflow.

Bowel Management

Bowel function is disturbed and often neglected in management. The judicious use of aperients, laxatives, enemas and manual evacuation, singly or in combination, help in developing a reflex habit or control by straining.

Vertebral Injury

'Stable' fractures as compression fractures of vertebrae are innocuous. 'Unstable' fractures of spine where inter-spinous and other ligaments are torn, generally cause paraplegia. The unstable types are the flexion fractures of cervical spine and recoil injuries of cervical spine (the so-called 'tear drop' fractures) and 'slice' fracture caused by violent torsional injuries of lumbodorsal and dorsal spine. They should be carefully handled and stabilised early to prevent further damage to cord and nerve roots during management. Stability of fracture helps turning of the patient, movements of limbs, early sitting up and ambulation, with the prevention of common complications of paraplegia.

Early stability by plaster jacket in paraplegic patients is not feasible nor desirable. The other alternative arrangements are 'Stryker' frame and operative plating of spinous process as advocated by Holdsworth. This is an easy, safe and effective procedure and must be done early before the development of bedsores.

In the management of recent spinal injury with paraplegia, early and energetic treatment by a team of surgeons, physicians, physio therapist, occupational therapists and specialist nurses, better in organised centres, is essential to prevent complications, to assist in the development of compensatory

mechanisms and to promote every possible recovery of nerve function.

Bad and haphazard initial treatment result in various other complications as gross angulation of spine, stiffness of joints, contractures, deformities, deep pressure sores and scars, spastic gait, vesical stone formation and 'unsocial' bladder which seriously delay and prevent rehabilitation of the patient.

The operation of laminectomy in the management of the chronic paraplegic patients is of some value. In the common type of vertebral injury sustained in 1st Lumbar vertebrae where cord ends, laminectomy has certainly helped in the general improvement of the patient, in relieving his spasticity and bladder dysfunction in certain number of our cases. In our experience, this is a comparatively simple procedure, worth its trial. Other special bladder operations to improve emptying as resection of bladder neck, division of pudendal nerves in pelvis, alcohol injections in these, tendon division may be used as adjunct.

In conclusion, I would like to point out the value of intensive rehabilitation programme in the management of traumatic paraplegia. Exercises to develop power and usefulness of the uninvolved muscles and reeducation in balance and ambulation are essential. Use of braces, calipers and vocational training as soon as 'wheel chair' stage is reached are also advocated.

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OBITUARY

Dr. C. R. Krishnaswami was born on the 18th November, 1892. He was educated at the Board High School at Chittoor and the Madras Christian College and he graduated in medicine in 1917 from the Madras Medical College. He joined the Madras Medical Service in 1918 and after



serving for about two years he resigned from the service and became the chief assistant to Dr. S. Rangachari in his private nursing home in Madras and continued in that capacity till 1930 when he started his own nursing home in the city. He spent over two years in the United Kingdom and after his return to India he secured the M.S. degree in 1933. He was an Honorary Surgeon in the Government Stanley Hospital, Madras before he was offered an Emergency Commission during the Second World War as a Recognized Specialist in Surgery in 1942. After demobilization from war service in 1946 he was appointed as an Honorary Surgeon in the Government General Hospital which post he held till

he retired in 1952 at the age of 60. He continued his private practice till a few months before his demise on the 7th October, 1958.

He was a prominent Freemason and took a keen interest in public affairs. He was a voracious reader with considerable literary attainments. Noted for his frank and forthright views on questions affecting public welfare, his articles in the press on a variety of topics served to spotlight the ills of society. In his death the profession has lost a luminary and the public a lovable doctor.

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THE XXI ANNUAL CONFERENCE

The 21st Annual Conference of the Association of Surgeons of India will be held at the Medical College, Jaipur, during the last week of December, 1959. At the Conference, the following subjects will be discussed :—

1. **Reconstructive Surgery in Peripheral Vascular Diseases.**

by Dr. R. Nigam, Nagpur & Dr. P. K. Sen, Bombay.

2. **Use of Radio-active Isotopes in Surgery.**

by Dr. (Miss) P. Parvathi, Calcutta & Dr. S. R. Mukherjee, Calcutta.

Besides this, a few short papers will also be read at the Conference. Further details about the Conference will be announced later.

SUBJECT FOR DISCUSSION AT FUTURE MEETINGS

22nd Meeting (1960)

1. **Reconstructive Surgery of the Biliary Tract.**

by Dr. S. J. Mehta, Bombay.

2. **Clinical and Experimental Studies in Keloids.**

by Dr. K. K. Ghosh & Dr. J. L. Sinha.

23rd Meeting (1961)

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.

Supplement (February, 59 issue). The Title of a Short paper on "Treatment of Complete Prolapse Rectum" read by Col. S. Rameshwar on the 28th December 1958 at the XX Annual Conference of the Association of Surgeons of India held at Visakhapatnam, was omitted to print in the Supplement (Proceedings of the XX Annual Conference of the A. S. I.) which was circulated along with the February 1959 issue. The omission is regretted.

ORTHOPAEDIC SURGERY SECTION

NOTICE

The next Regional Meeting of the Orthopaedic Section will be held in Delhi on the 29th and 30th of August, 1959. The subject for long paper is a symposium on "Congenital Club Foot" and the participants in the Seminar are :—

1. Dr. M. Natarajan, Madras,
2. Dr. M. T. Mehta of Ahmedabad,
3. Dr. B. N. Sinha, Lucknow,
- & 4. Dr. B. Mukopadhaya, Patna.

Members who wish to read short papers are requested to intimate their desire (Submitting a summary of their short papers) either to Dr. B. Mukopadhaya, Khuda Bux Library Road, Patna-4, or Dr. R. P. Chakravorty, Irwin Hospital, New Delhi, on or before 30th June, 1959.

SUBJECTS FOR FUTURE MEETINGS

1959. (Annual Meeting)

Surgical Treatment of Spondylolisthesis.

Opener : Dr. K. S. Bose, Calcutta.

Seconder : Dr. B. Mukopadhaya, Patna.

1960. (Regional Meeting)

"Old Fractures of the Neck of the Femur."

Opener: K. T. Dholakia, Bombay.

Seconder: Drs. B. N. Sinha, Lucknow & A. K. Gupta, Kanpur.

1960. (Annual Meeting)

Replacement Arthroplasty of the Hip.

Opener: Dr. Talwalkar, Bombay.

Seconder: B. Mukopadhaya, Patna.

1961. (Regional Meeting)

Partial Synovectomy of the Knee.

Opener: Dr. M. T. Mehta, Ahmedabad.

Seconder: Dr. A. K. Gupta, Kanpur.

1961. (Annual Meeting)

Supra-condylar fractures of the elbow.

Opener: Dr. A. K. Mukherjee, Calcutta.

Seconder: Dr. Ranga Reddy, Hyderabad.

* * *

AUSTRALIAN ORTHOPAEDIC ASSOCIATION

The Australian Orthopaedic Association holds its next Annual meeting in the month of October in Melbourne, Victoria.

Members of the Orthopaedic Section of the Association of Surgeons of India, who are anxious to read a paper at the above meeting are requested to contact the Programme Secretary Mr. Peter Williams, 417, St. Kilda Road, Melbourne, Victoria (Australia).

* * *

THORACIC SURGERY SECTION

A Sectional meeting of the Thoracic Surgical Section of the Association of Surgeons of India will be held at the Christian Medical College Hospital, Vellore, on Friday and Saturday, July 24 and 25, 1959. All members of the Association of Surgeons of India are welcome and further information will be sent to anyone enquiring from the Dept. of Thoracic Surgery, Christian Medical College Hospital, Vellore (S. India).

—★—

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The accepted thesis shall be the property of the Association and shall be published in the *Indian Journal of Surgery*. It shall not be published elsewhere without the permission of the Editorial Board. The rejected theses may, if of sufficient merit, be published in the *Indian Journal of Surgery*, and only if not so published shall it be open for the authors to publish it elsewhere.

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The thesis should be type-written on one side of the paper only and should not contain the name or other indication of the identity of the author. Three copies should be submitted.

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A. VENUGOPAL,
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