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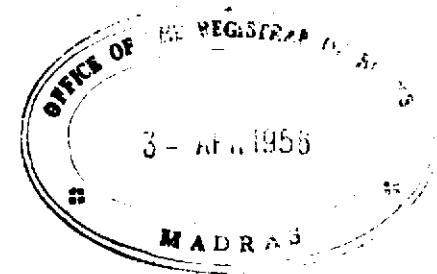
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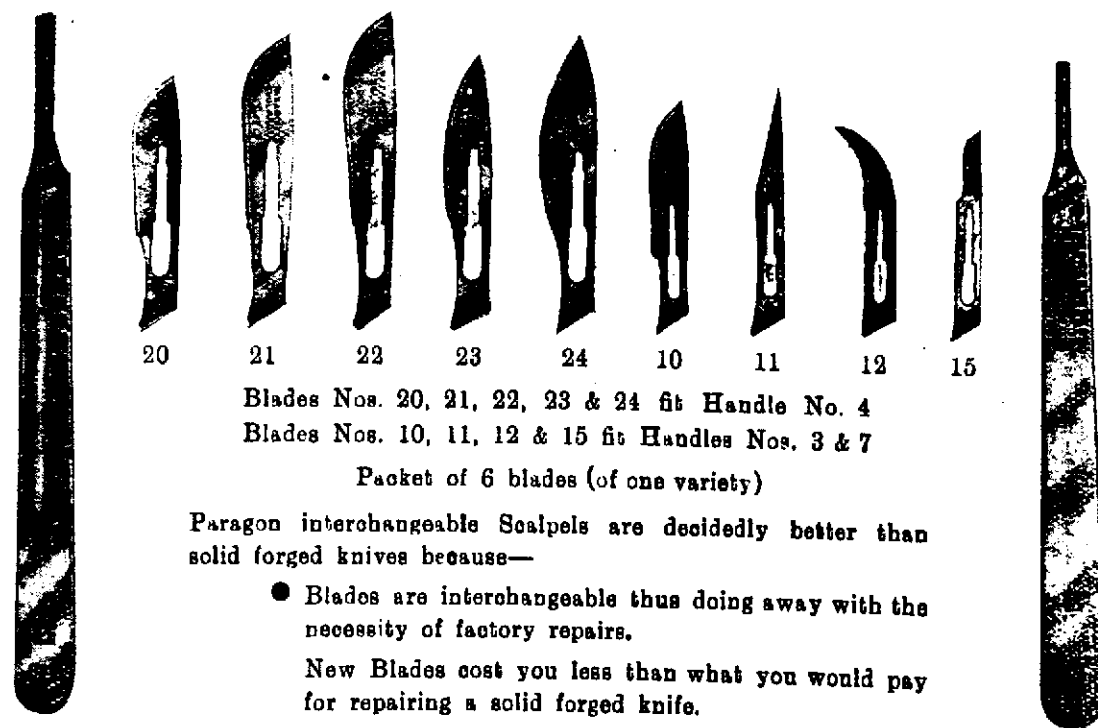
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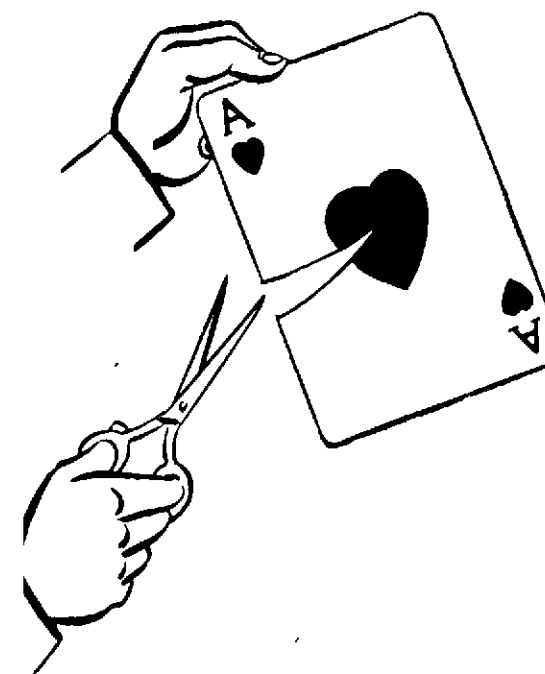
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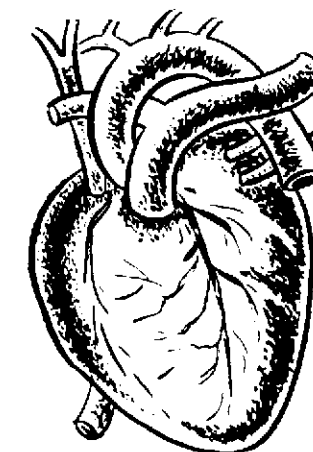
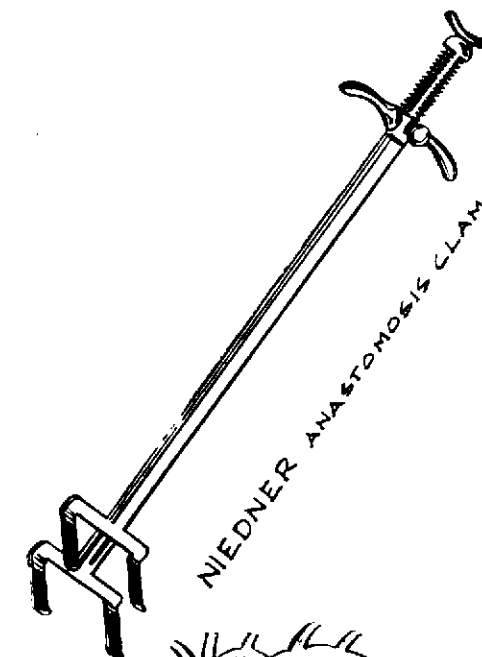


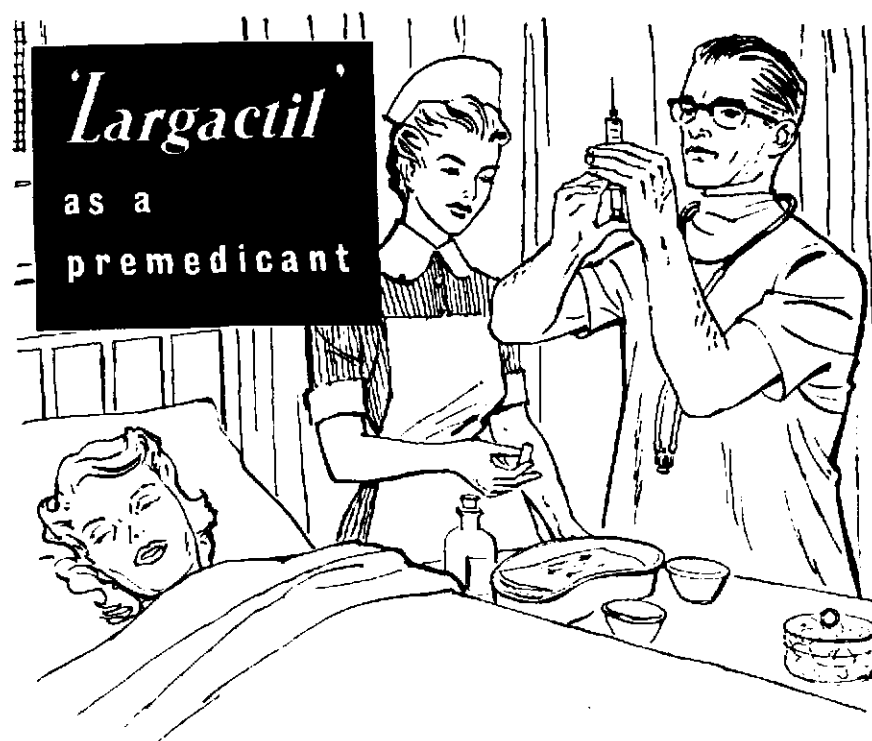
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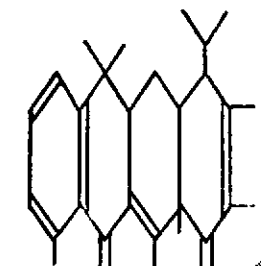
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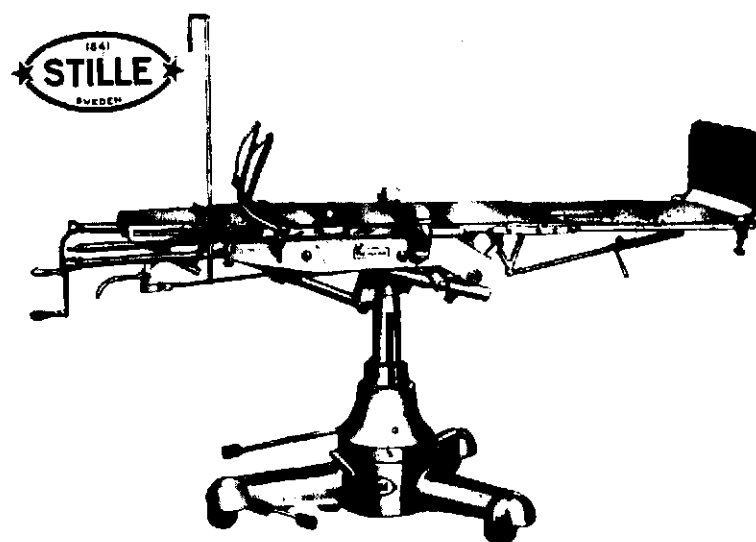
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Vol. XVIII

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No. 1

SARCOMA OF BONE*

(Observations on 150 cases, With Special Reference
to Incidence, Location and Pathology)

by M. V. SIRSAT, Bombay.

Sarcoma of bone forms 1 per cent of all malignant tumours seen at the Tata Memorial Hospital, Bombay. The purpose of this paper is to give a synoptical review of this relatively rare malignant neoplasm with special reference to the incidence, location and pathology of the different types of bone sarcomas encountered in this series.

MATERIAL AND METHODS

The material consists of 150 cases of bone sarcomas, documented in the Laboratories of the Tata Memorial Hospital, Bombay, during the period, March 1941 to August 1954. All the material has been verified histologically. In 77 cases, diagnosis was based on aspiration biopsy and the technique of paraffin block preparation was carried out in each instance. In a majority of cases the tissue obtained in the biopsy needle was sufficient for processing and preparation of a paraffin block. In a few instances, the aspirated material was frank blood; in such cases the blood clot was fixed in Bouin's fluid and processed in the usual manner. Tumour cells could be seen engulfed in the mesh-work of the clot (Fig. 4-A). In 56

BONE SARCOMA

HISTOLOGICAL CLASSIFICATION OF 150 CASES

MARCH 1941 TO AUGUST 1954

DEPARTMENT OF PATHOLOGY, TATA MEMORIAL HOSPITAL, BOMBAY.

ORDER OF INCIDENCE	HISTOLOGICAL CLASSIFICATION	NUMBER OF CASES							PER CENT OF TOTAL
		0	10	20	30	40	50	60	
1	EWING'S SARCOMA							66	44
2	OSTEOGENIC SARCOMA							42	28
3	CHONDROSARCOMA		9						6
4	MYELOMA (MULTIPLE)		9						6
5	RETICULUM CELL SARCOMA		9						6
6	MALIGNANT GIANT CELL TUMOUR		6						4
7	FIBROSARCOMA (PERIOSTIAL)		3						2
8	FIBROSARCOMA (MEDULLARY)		2						1.3
9	LIPOGENIC SARCOMA		2						1.3
10	CHORDOMA		2						1.3

Fig. 1.

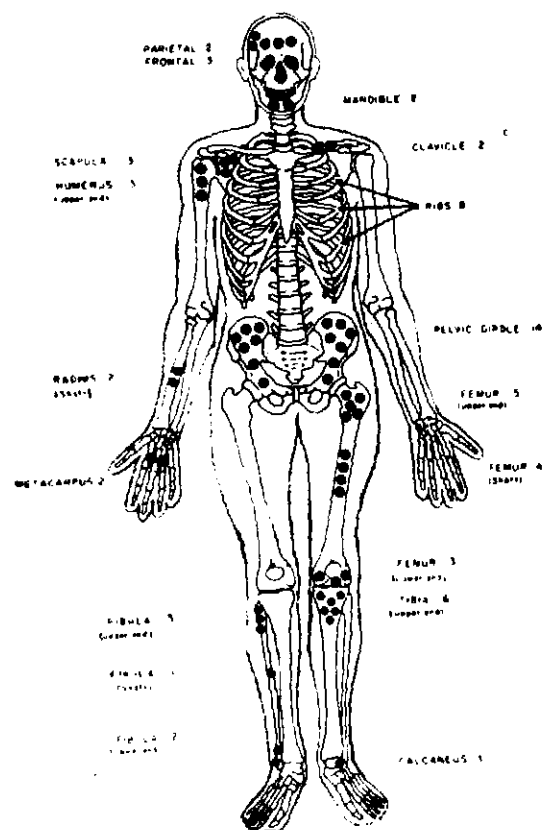
first in frequency and formed 44 per cent of the primary malignant bone tumours. Geschickter and Copeland²⁰ reported an incidence of 15 per cent, whereas Meyering³⁸ has recorded an incidence of 26.9 per cent for Ewing's sarcoma among pri-

mary malignant tumours of the bone. Table I compares the findings regarding age and sex incidence and location of the tumour in this series with five large series of Ewing's sarcoma reported in the literature.

TABLE I
EWING'S SAR

EWING'S SARCOMA

DEPARTMENT OF PATHOLOGY, TATA MEMORIAL HOSPITAL, BOMBAY



ANATOMICAL DISTRIBUTION OF EWING'S SARCOMA OF BONE IN 66 CASES
Fig. 3

cit) stated that such a finding emphasized that Ewing's sarcoma had a strong tendency to break through the cortex of a bone and spread into the surrounding soft tissue. Pain was a feature in 44 cases (66.6 per cent) and history of trauma was recorded in 22 cases (33.3 per cent). From a review of the literature, it is impossible to arrive at any conclusion concerning the role of injury in the development of a bone sarcoma. The consensus of opinion, however, appears to be, that in the majority of cases, injury focuses the patient's attention

to the region already the site of a neoplastic process.

Forty-one out of 66 patients reported to the hospital within 6 months and 10 patients came a year after the first complaint. The average duration of symptom was 7 months. The shortest duration was 1 month (5 cases) and the longest 2½ years.

TABLE II
DURATION OF SYMPTOMS IN
EWING'S SARCOMA

Months	No. of cases
1-3	24
4-6	17
7-9	9
10-12	4
Over 12	10

(Information not available in 2 cases)

Metastases:

Microscopical involvement of the lymph nodes draining the tumour area was present in 10 cases. Thirteen cases showed pulmonary metastases, while 15 showed roentgenographic involvement of other bones.

Roentgenologic Findings:

In this series the diagnosis of Ewing's sarcoma was made in 32 cases of roentgenologic examination. The consistent roentgenologic finding was destruction of the bone. There were no typical appearances as such of this lesion. The roentgenologic appearance of Ewing's sarcoma could be confused with any lesion of bone, from osteomyelitis to osteogenic sarcoma. Amongst many authors who have discussed the roentgenologic aspects of this tumour the following may be mentioned: Neely and Rogers⁴⁰, Swenson⁵⁵

varied from 8,000 to 20,000 per c.mm. An erythrocyte count of less than 4 million per c.mm. was found in 22 cases (33.3 per cent). Bio-chemical investigations, such as estimation of serum calcium, phosphorus, alkaline and acid phosphatase gave normal values.

Pathologic Features :

(A) *Gross description* : The description is based on 4 specimens of amputated limbs that were available for study : one each from the femur, tibia, fibula and the calcaneum. The tumour was ovoid or fusiform in shape (Fig. 4-B). In two specimens scattered areas of haemorrhage and necrosis within the tumour mass were seen. The medullary cavity contained tumour tissue in all the cases. Examination of the cut surface of the specimens showed that it had broken through the cortex. It was moist, grayish white and semi-transparent in appearance.

(B) *Microscopic description* : In the aspiration biopsy material the tumour cells were arranged in solid compact sheets. The nuclei were round or oval and vesicular. The chromatin was fairly granular. The cytoplasmic outlines were indistinct (Fig. 4-C). In amputated specimens, where multiple sections were obtained for study, the tumour showed pseudorosettes and the cells were seen surrounding the blood or the lymph capillaries to produce the characteristic perithelial arrangement (Fig. 4-D). Scattered areas of degeneration, necrosis and haemorrhage were seen within the tumour mass. Absence of intercellular reticulin, noted in all the cases, was a characteristic feature of the tumour. There was not a single instance where the tumour had produced osteoid tissue.

2. OSTEOGENIC SARCOMA

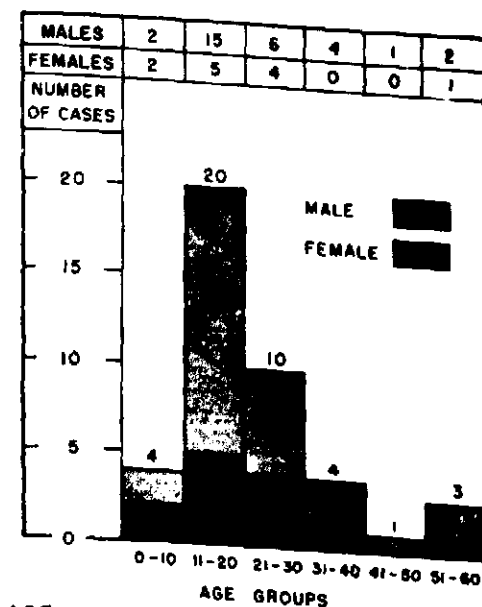
Histogenesis and Incidence :

Osteogenic sarcoma arises from cells which form bone, namely the osteoblasts. There were 42 cases diagnosed as osteogenic sarcoma in this series. The tumour stood second in frequency and formed 28

per cent of primary malignant tumours of the bone in this series. Ackerman and Regato¹ state that osteogenic sarcoma makes up about 30 per cent of all malignant bone tumours.

Age and Sex Incidence :

The highest incidence of osteogenic sarcoma in this series was between the ages of 11 and 20. Twenty-one (50 per cent) out of 42 cases occurred in this age group. The youngest patient in this series was 6½ years of age while the oldest was 57 years. The average age of the patient was 22.7 years. Forty, out of 86 cases reported by Cade⁵, were between the ages of 11 and 20. The sex incidence in the present series showed a definite preponderance of males. There were 30 males and 12 females.



metastases in the lungs. Six showed skeletal metastases and involvement of lymph nodes draining the tumour was observed in 3.

Roentgenologic Findings :

In 21 cases, a diagnosis of osteogenic sarcoma was made on roentgenograms. The changes of bone destruction and bone formation were usually observed simultaneously in a single bone. Bone destruction was seen as an area of rarefaction in the cortex or the medulla, whereas bone formation showed itself as condensed opaque areas. The 'sun-ray' appearance as well as the "reactive triangle" of Codman, when present, were considered typical of osteogenic sarcoma (Fig. 7-A).

Laboratory Findings :

In 22 cases the number of leucocytes varied from 8,000 to 20,000 per c.mm. The total erythrocyte count of less than 4 million per c.mm. was found in 11 cases. In 10 cases the blood count was not done. The significant change produced by osteogenic sarcoma, however, is a rise in serum alkaline phosphatase which is proportional to the extent of new bone formation. The significance of estimation of serum alkaline phosphatase is in following the course of the disease. After amputation alkaline phosphatase shows a tendency to come down to normal level (1.5 to 4 Bodansky units). If, after amputation, the alkaline phosphatase level remains high, it indicates the presence of metastases. In 18 cases where the estimation of serum alkaline phosphatase was carried out, 15 showed significantly high values upto 10 or more Bodansky units. The maximum level of alkaline phosphatase obtained in one case was 65.7 Bodansky units. This was in a girl aged 9, (no. G. 217) who had an osteogenic sarcoma at the lower end of the femur with multiple metastases in other bones.

Pathologic Features :

(A) *Gross description* : Twenty-three amputated limbs afforded opportunity for

detailed gross study : Eighteen were from the lower extremity (fifteen from the femur, two from the tibia and one from the fibula) and five from the upper extremity (humerus). In all instances the tumour was seen occupying the medullary cavity, partially or wholly. The cortex was destroyed in most instances, the tumour having found its way through the periosteal barrier into the surrounding muscular tissue. In a few instances, the tumour was found to have involved the neighbouring joint through invasion of its capsule. Fig. 7 shows a group of three amputation specimens illustrating gross pathological features.

(B) *Microscopic features* : The histologic pattern as observed in the present series of osteogenic sarcoma showed a marked variation. Two features, which were considered essential for histological diagnosis were however present in every instance. These were : (i) Presence of tumour cells which were large, atypical spindle shaped cells or pleomorphic in type, with a large number of giant cells ; and (ii) presence of stroma consisting of osseous or osteoid tissue (Fig. 8-A). In some, cartilagenous tissue undergoing calcification or osseous transformation was seen (Fig. 8-B). The metastases in lymph nodes also showed the capacity of the tumour cells to produce osseous stroma.

3. CHONDROSARCOMA

Phemister⁴⁷, and Lichtenstein and Jaffe³⁰ have given excellent accounts of this tumour, and stressed the histological features of diagnosis. These authors emphasised the necessity of distinguishing between chondrosarcoma and osteogenic sarcoma. Nine cases in this series of bone sarcoma are considered as chondrosarcomas and the relevant data concerning these is given in Table IV. Seven cases out of 9 were within the age group 3

TABLE IV
SUMMARY OF DATA ON 9 CASES OF CHONDROSARCOMA

S. No.	Case No.	Age (years)	Sex	Symptoms	Site	Duration	Roentgenologic findings	Diagnosis based on	Metastases
1.	5918	53	M	Swelling; pain; pathological fracture.	Femur (upper end)	1 yr.	X-ray plates not available.	Incisional biopsy	Nil
2.	13724	40	M	Pain; swelling; inability to walk.	Tibia (upper end)	6 months.	New bone formation and periosteal reaction.	Sections after amputation	i. Subcutaneous nodules on the forehead ii. Lung
3.	13760	45	M	Swelling.	4th Rib.	2 months.	Expansion of the chondral end of the rib.	Sections after excision	i. Rib ii. Lungs
4.	K1045	30	M	Swelling.	Femur (upper end).	20 yrs sudden growth 5 mo.	Chondrosarcoma probably arising from a benign exostosis	Sections after amputation	Lungs
5.	M1788	35	M	Swelling.	Fibula (lower end)	17 yrs	Large soft tissue shadow with ossification and slight periosteal reaction	Incisional biopsy	Lungs.
6.	M2319	32	F	Swelling; fever.	Femur (lower end).	2 yrs.	Multicystic appearance of the lower end of the left femur. Periosteal reaction and large soft tissue mass	Sections after amputation	Nil
7.	N4264	14	F	History of trauma; swelling; low fever.	Femur (lower end).	4 months	Large soft tissue mass with irregular sclerosis. Marked periosteal reaction with scattered bone debris in the soft tissue mass.	Sections after amputation	Nil
8.	F226	55	F	Swelling.	Clavicle	10 yrs sudden growth 2 yrs.	X-ray plates not available	Sections after excision	Nil
9.	4087	12	M	Pain; swelling; history of trauma.	Calcaneum	4 months	X-ray plates not available.	Sections after excision	Nil

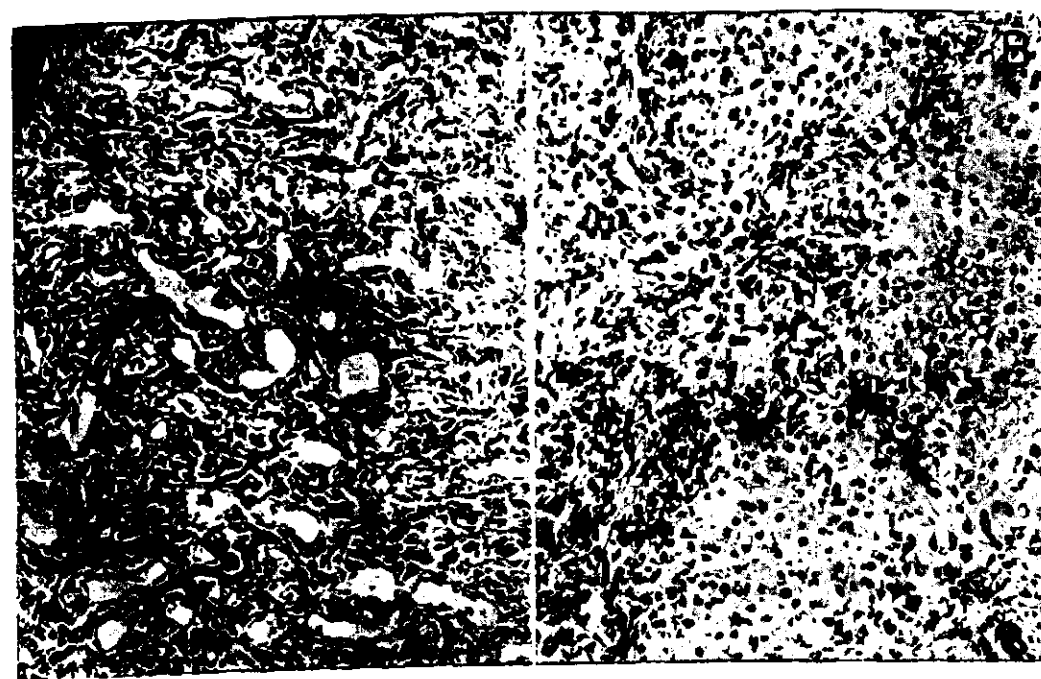


Fig. 8.

Photomicrograph of a field of an osteogenic sarcoma showing the intercellular osteoid matrix (A) (Path. no. B-926). A field from another case of an osteogenic sarcoma showing the formation of cartilage (B) (Path. no. G-1474).

TABLE V
SUMMARY OF DATA ON 9 CASES OF MULTIPLE MYELOMA

S. No.	Case No.	Age (years)	Sex	Symptoms	Presenting skeletal lesion	Duration	Roentgenologic findings	Diagnosis based on:	Involvement of other bones
1.	1648	46	M	Pain; swelling; loss of power and numbness in the lower limbs. Incontinence of urine	6th rib	6 months	Multiple punched out areas in the rib	Autopsy material	Vertebrae
2.	4792	60	M	Pain and swelling	Mandible	2 months	Well localised tumor of the ascending ramus of the mandible	Aspiration biopsy	Ribs and skull
3.	5282	53	F	Pain; swelling and history of trauma	Scapula	6 months	Marked destructive changes in the upper border of the scapula and acromion process	Aspiration biopsy	Humerus, femur, skull
4.	6108	53	M	Pain and swelling.	Sternum	6 months	Rarefied cystic destruction of the sternum	Aspiration biopsy	Ribs, vertebrae and skull
5.	11351	50	M	Pain and swelling	Clavicle	8 months	Osteolytic destruction of the left half of the clavicle	Incisional biopsy	Skull, sacrum and iliac bone
6.	1251	55	F	Swelling and history of trauma	Humerus (upper end)	5 months	Expanded osteolytic tumor involving the head of the humerus. Small osteolytic areas in the shaft	Aspiration biopsy	Ribs, clavicle and skull
7.	M105	42	M	Swelling and history of fracture	Humerus (upper end)	6 months	Complete destruction of head and shaft of the humerus	Aspiration biopsy	No information in absence of follow up.
8.	M2003	41	F	Pain and swelling	Ilium	3 months	Destruction of the right iliac bone	Aspiration biopsy	Sacrum
9.	N3141	63	M	Pain. Cough with expectoration Weakness	6th rib	6 months	Osteolytic areas in the ribs and left femur	Sections after excision	Ribs and femur



Fig. 9.

Unusual locations of metastatic deposits of chondrosarcoma in a male aged 40 (no. 1374; Table IV). The tumour was

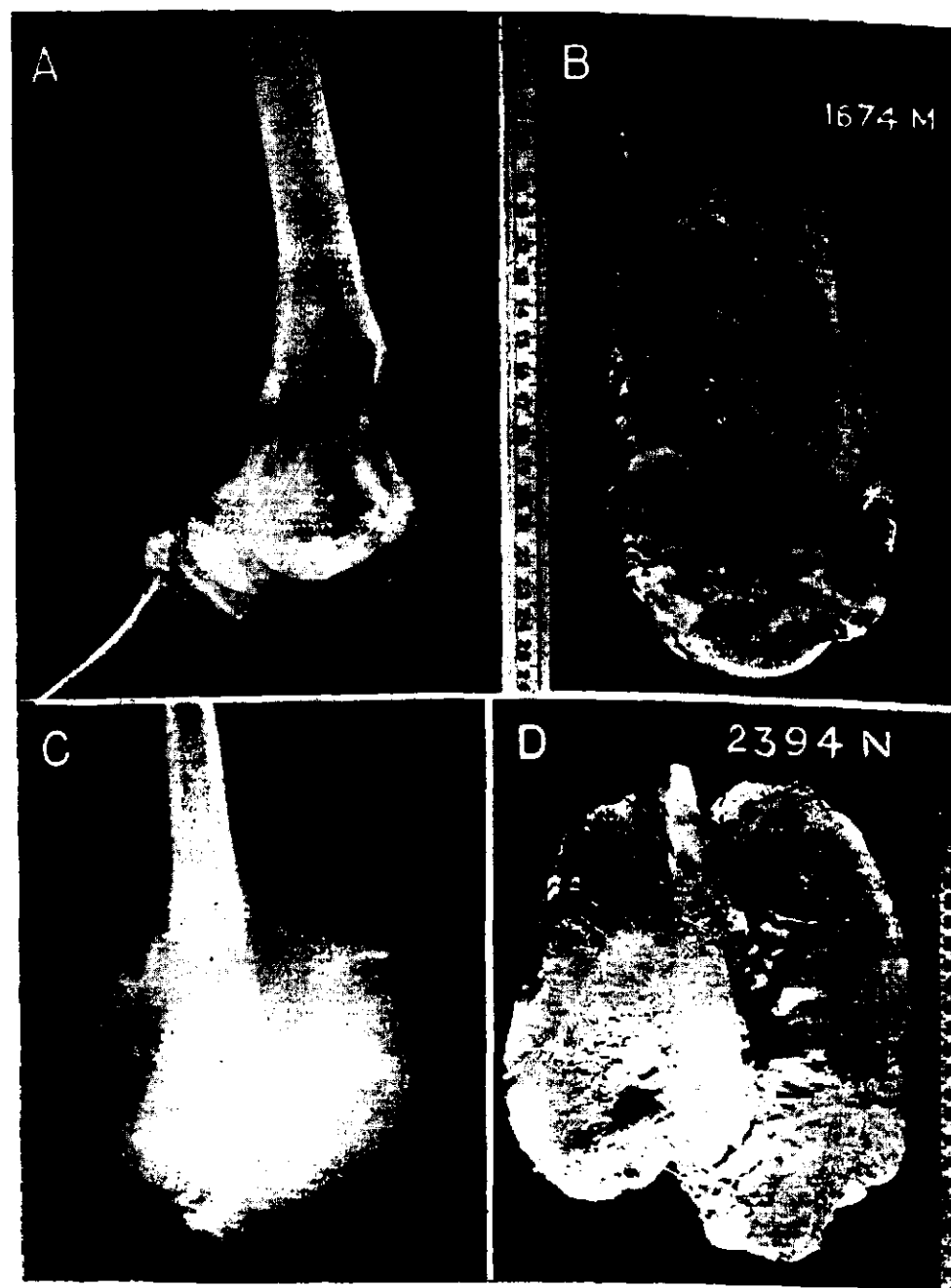


Fig. 10.

Roentgenograms of central (A) and peripheral (C) chondrosarcomas. Note the spotty calcification in skiagram (C). Specimens of the same cases. Sagittally cut surface of central (B) and peripheral (D) chondrosarcoma at the lower end of the femur. Areas of hyaline cartilage formed, the main mass of the tumour seen in (B). Note the characteristic large size of peripheral chondrosarcoma (D).



Fig. 10.

Photomicrograph (E) of typical histologic pattern in chondrosarcoma. Note the cells with double nuclei, many cells with large single hyperchromatic nuclei and vacuolated cytoplasm. (H & E stain x 480)

4. MULTIPLE MYELOMA

An excellent account on this subject is contained in the writings of Byrd and Heck³, Lichtenstein and Jaffe³², and Lumb and Prosser³⁴. It may briefly be said that multiple myeloma is a primary malignant tumour of the bone marrow and that in this tumour many bones are involved at one time. The disease however may also start in one bone and involvement of other bones may be subsequently discovered. The presence of Bence-Jones protein (found in 50 per cent) and a fatal termination are other noteworthy features of the tumour.

Age and Sex Incidence :

Multiple myeloma shows a predilection for persons in late middle age. All the 9 cases occurred between 41 and 63 years. Six were males.

Location :

The initial skeletal lesions as observed in 9 cases were distributed as follows : humerus and ribs in 2 cases ; and one each in the sternum, iliac bone, mandible, scapula and clavicle. Initially the disease was localised in a single bone as already stated,

and subsequently, other bones were affected. Table V shows the involvement of other bones. It is believed that the affection of multiple bones is not due to metastases but an expression of the multifocal origin of the tumour.

Roentgenologic Findings :

The principal roentgenologic characteristic of multiple myeloma was circumscribed areas of bone destruction. In none of

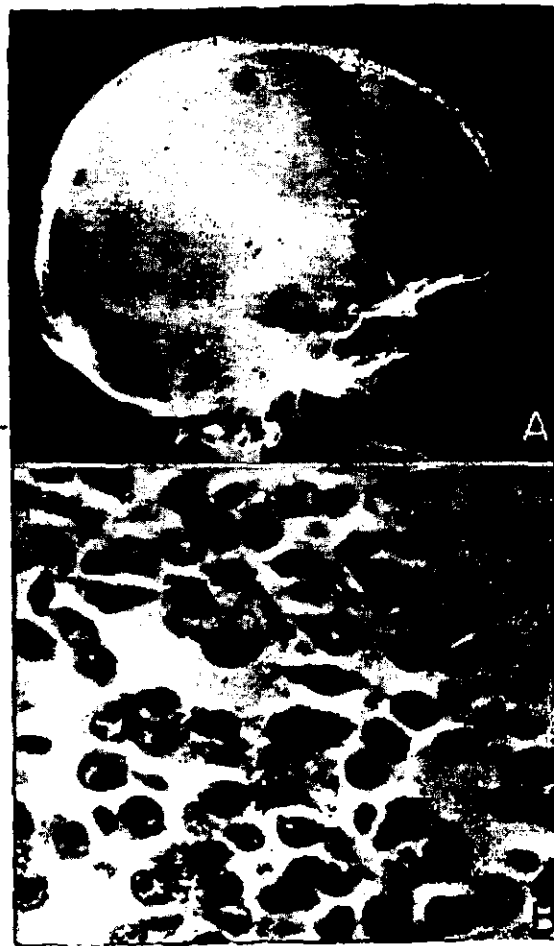


Fig. 11.

Roentgenogram of multiple myeloma involving the skull. Note typical punched-out areas of osteolytic destruction (A). Photomicrograph showing myeloma cells. The majority of the cells are plasma cells. The nuclei are seen pushed to the periphery (B). (H & E stain x 1000)

cent of the cases. In 6 out of 9 cases in which urine was examined for Bence-Jones proteins, 3 gave a positive result.

Another biochemical feature of significance is a rise in the total serum proteins. This is due to an increase of the serum globulin. Such an alteration of serum protein, when present, is of diagnostic significance. All six cases of this

series in which investigation was done showed an increase of total serum protein.

Microscopic description:

The usual classification of myeloma has been in four subgroups: plasmacytoma, lymphocytoma, myelocytoma and erythroblastoma. Geschickter and Copeland (*loc cit*) concluded that multiple myeloma was always of plasma cell variety. In all 9 cases in this series the tumour was found to be composed of plasma cells. The tumour cells were closely packed and occurred in solid sheets with little or no intercellular stroma. The individual tumour cells were uniform in appearance, with an eccentric nucleus which was about half the size of the diameter of the cell (Fig. 11-B). The chromatin was arranged in a spoke-like manner. The nuclear membrane was very distinct and each nucleus showed a prominent nucleolus. In most cases scattered among these cells were smaller cells which resembled lymphocytes.

5. RETICULUM CELL SARCOMA

The cytological and clinical characters of reticulum cell sarcoma of bone are so distinctive that it has rightly been included among primary malignant tumours of bone. After the study by Parker and Jackson⁴⁴, which stimulated interest in this tumour, a number of articles have appeared on the subject. Amongst the large series reported in the literature the following may be mentioned, Coley et al⁹ (37), Ivius and Dahlin²² (49), Mc Cormack et al³⁷ (25) and Valls et al⁵⁶ (10). The nine cases in this series include 5 cases which formed the material of a report by Khanolkar²⁵. Table VI, summarises the data obtained in 9 cases. All cases seen in this series were between 20 and 50 years of age. Eight were males and one female. The bones involved were mandible in 3 cases and femur, scapula and sternum in 2 cases each. Metastatic deposits to regional lymph nodes were observed in 5 cases and in 4 cases there was involvement of other bones which was considered a part of the systemic process.

TABLE VI
SUMMARY OF DATA ON 9 CASES OF RETICULUM CELL SARCOMA

S. No.	Case No.	Age (years)	Sex	Symptoms	Site	Duration	Röntgenologic findings	Diagnosis based on	Metastases
1	3910	30							

TABLE VII
SUMMARY OF DATA ON 6 CASES OF MALIGNANT GIANT CELL TUMOR

S. No.	Case No.	Age (years)	Sex	Symptoms	Site	Duration	Röntgenologic findings	Diagnosis based on	Metastases
1.	5343	24	M	History of trauma followed by pain and swelling	Tibia (upper end)	15 months	Expansion of bone with trabeculae interspersed in the swelling	Sections after amputation	Rt. lung 2 yrs after treatment
2.	11508	41	M	Pain, followed by swelling	8th rib	5 months	Expansion of the rib with breaking up of the tumor border	Sections after excision	Both lungs
3.	G3285	40	F	Pain, followed by gradually increasing swelling	Radius (lower end)	10 months	Marked globular expansion of bone with homogeneous ground glass appearance. No trabeculation	Sections after amputation	Nil
4.	J403	22	M	Pain, swelling and inability to move the left knee joint	Tibia (upper end)	5 months	Large osteolytic destruction	Aspiration biopsy	None at admission
5.	J437	23	M	Swelling, pain and inability to move the knee joint	Tibia (upper end)	5 months	Moderate expansion of bone with homogeneous tumor mass	Sections after amputation	Both lungs 4 months after operation
6.	L3273	22	M	Swelling	Radius (lower end)	2 years	Osteolytic destruction	Sections after amputation	Both lungs 3 years after operation

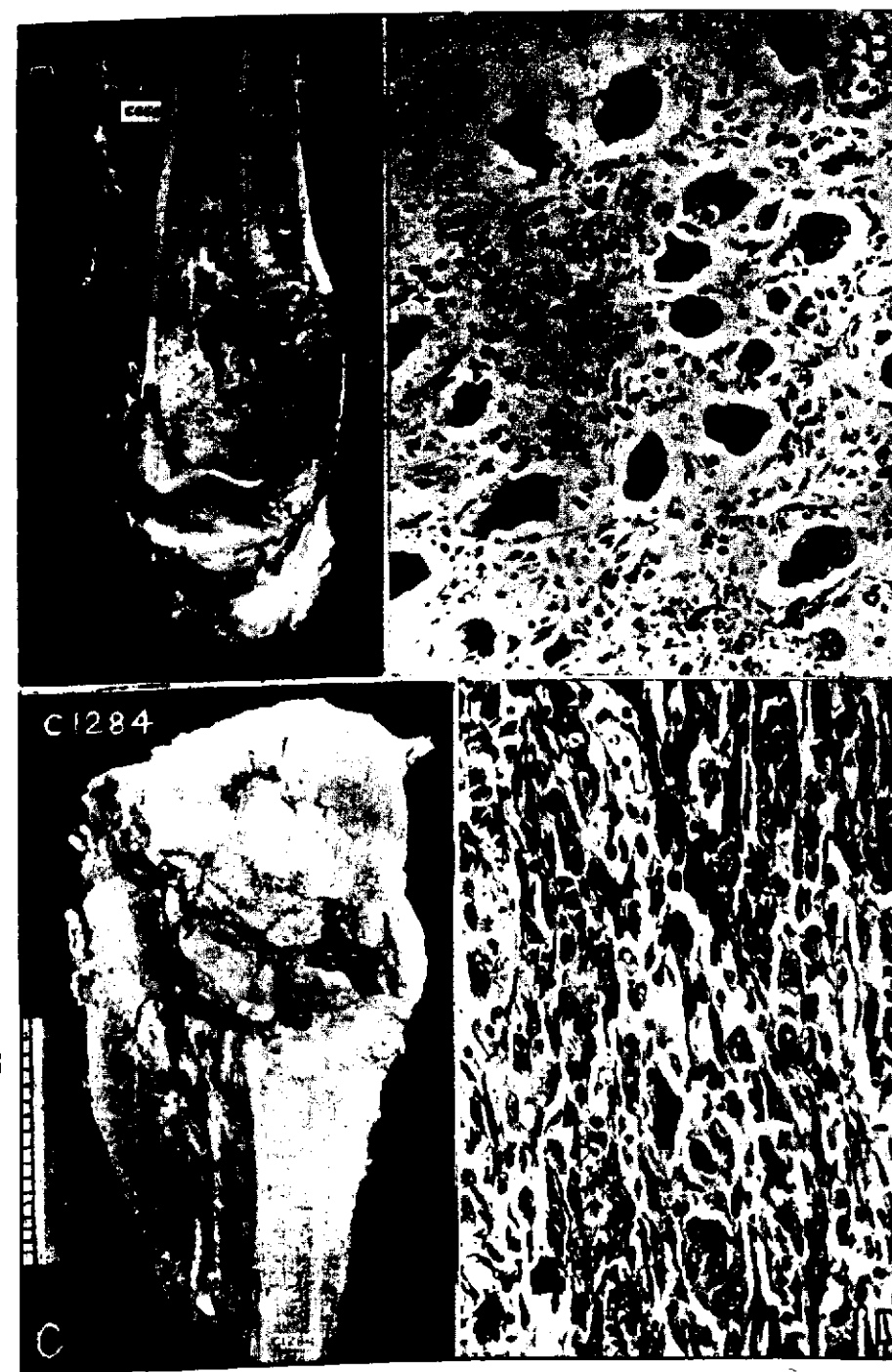


Fig. 13.

Specimen of giant cell tumour at the lower end of the femur. Note the tumour breaking through the periosteum (A). Photomicrograph (B) of sections through the tumour shown in (A). In certain instances, cited in the text, tumours with such a 'benign' histological appearance have metastasized in the lungs. Specimen (C) of the malignant giant cell tumour of the upper end of the tibia. Note the greyish opaque tumour occupying the medulla and destroying the cortex. The histological appearance of malignant giant cell tumour is seen in (D).

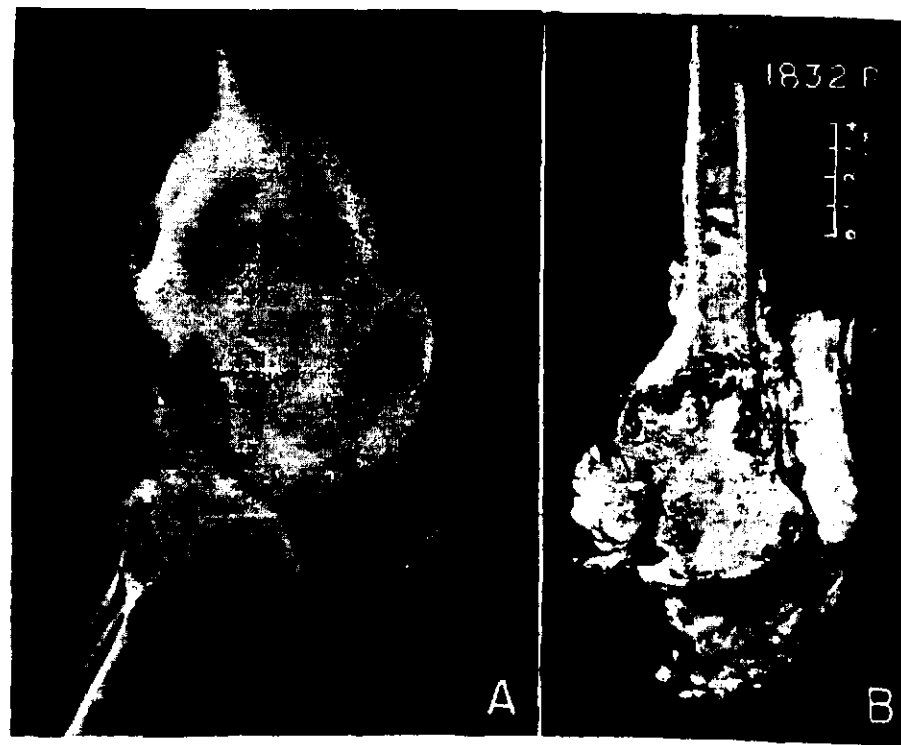


Fig. 15.

Roentgenogram of medullary fibrosarcoma showing a translucent tumour at the lower end of the femur (A). Specimen of the same case showing greyish tumour filling the marrow cavity. The cortical outlines cannot be made out (B).

Case 2: A Hindu woman aged 32, (no. P-3174) was admitted on June 29, 1954, with a swelling of the left knee joint, of 6 months' duration. Physical examination revealed a large swelling in front of the knee, in relation with the lower end of the femur. Roentgenologic examination showed a translucent tumour at the lower end of the left femur with marginal sclerosis in the upper end of the bone (Fig. 15-A). An aspiration biopsy was attempted but did not yield any material. A formal biopsy was therefore taken. The microscopical examination of this material showed a fibrosarcoma. Amputation of the limb was carried out.

Gross description :

The specimen was that of a limb amputated through the thigh. A sagittal section showed an ovoid tumour mass at the lower end of the femur filling the marrow cavity. The bone had expanded, and the cortical outline could not be made out (Fig. 15-B).

The tumour had extended out into the soft tissues and also into the joint cavity.

The microscopical characters of both the tumours were similar to those seen in periosteal fibrosarcoma described previously.

9. LIPOGENIC SARCOMA

This tumour was recognised first by Ewing, who in 1928, reported two cases from the Memorial Hospital, New York. Subsequently Duffy and Stewart¹², Fender¹⁶, Rehbock and Hauser⁴⁹, and Stewart⁵³ published additional cases of lipogenic sarcoma. The characteristics of the tumour are that it is slow growing, cranial metastases are a common feature and that it is very sensitive to radiation. Brief histories of the two cases are as follows.

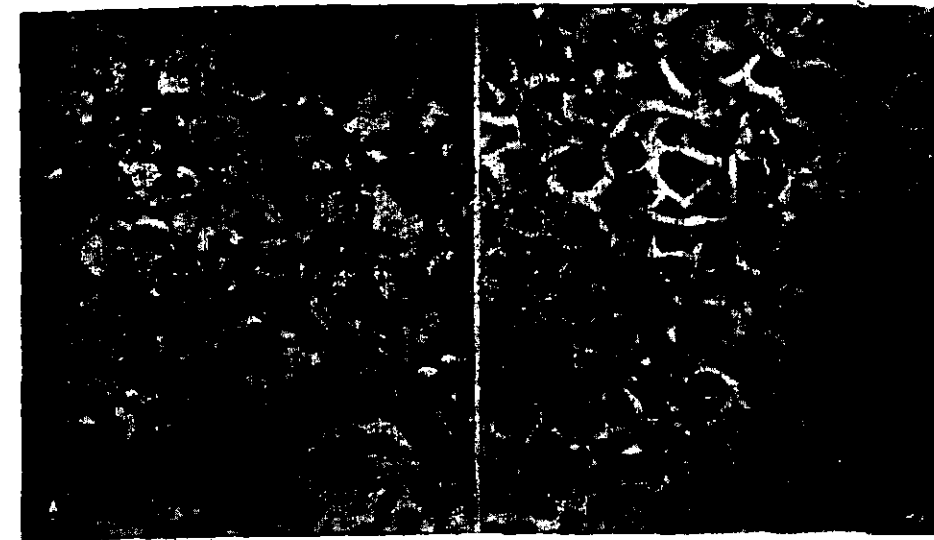


Fig. 16.

Photomicrograph of liposarcoma showing groups of cells with clear or vacuolated cytoplasm. The nuclei seen slightly pushed to the periphery (A). The tumour cells showing alveolar grouping (B). (H & E stain x 500, x 500)

Case 1: A woman, aged 26, (no. 3208) was admitted to this hospital in October 1942, complaining of pain on the outer aspect of the left buttock. Clinical examination revealed tenderness along the left iliac crest. There was an ill defined mass

tics. Penicillin did not prove very effective in this case but there was good response to streptomycin therapy. However they had isolated aerobic Actinomyces from their case.

Our thanks are due to Professor R. M. Kasliwal, Principal, S.M.S. Medical College, and Controller, Attached Hospitals, Jaipur for allowing us to publish this report.

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Received for publication on 18-6-'55.

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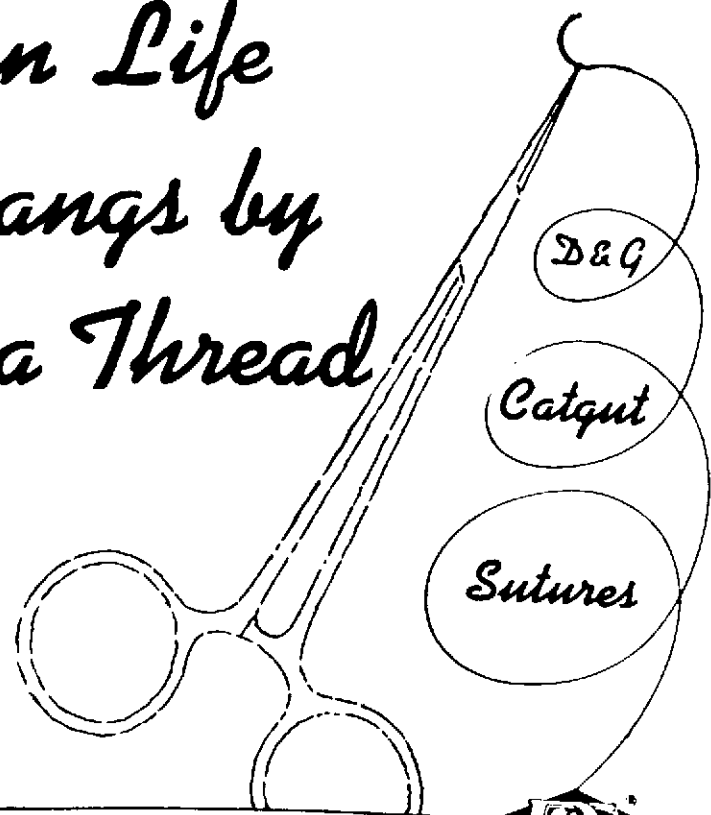
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