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Bone lesions: Benign, malignant and inflammatory; A Histopathological study

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Abstract
Background: The spectrum of bone lesions include inflammatory, neoplastic, degenerative and metabolic diseases. Histopathology is a confirmatory evidence for bone lesions and helps arrive at a diagnosis and plan further prognosis and management. A proper execution from technique (radio-guided or surgical), choice of sections from the lesion and proper management of specimen is the requirement for accuracy of diagnosis and further management.
Aims and objectives: To analyse the histo-pathological spectrum of bone lesions and co relating it with demographic details and radiological findings.
Results: 100 bone biopsies received in the Department of Pathology between September 2015 to September 2017. They were routinely processed after decalcification. Out of 100 cases, 55 non-neoplastic lesions and 45 neoplastic lesions were reported. Around 10 cases were inconclusive due to inadequacy of biopsy sample. Osteochondroma was the most common benign lesion. Osteosarcoma and chondrosarcoma were the most common malignant lesion, with equal incidence. Chronic osteomyelitis was the most common non neoplastic lesion. The lesions occurred most commonly below the age group of 20 years with a male preponderance. Femur was the most common bone involved and metaphysis was the most common anatomical site of lesion.
Conclusion: A detailed histo-pathological interpretation of bone lesions, along with history, radiological and other relevant investigations are important for the patient's treatment and the further management including the follow up.

Keywords: Bone lesions, histopathology, avascular necrosis, osteochondroma

Introduction
Bone', has been enshrined on the earth since long years. Numerous attempts of bone discovery are owed to the remnants in the fossils [1, 2].
"Human osteology is the study of bones [2].
Anatomically, bones can be grouped as long bones, flat bones, short bones and irregular bones. Long bones include femur; flat bones include pelvis; short bones include hand and feet and irregular bones include wrist, ankle and spine [2].
The human bone is affected by various pathological conditions which comprise of; degenerative diseases, inflammatory diseases, metabolic diseases and neoplastic lesions. Neoplastic lesions constitute; benign, malignant and metastatic lesions [3].
Diagnosis of bone lesions is a great challenge to a practising pathologist and requires a comprehensive support of clinical, laboratory, radiological and histo-pathological correlation. The need for accurate demographic details, like, age, gender and the affected site becomes important, for the simple reason that many benign lesions mimic malignant lesions and vice versa [3, 4].
The Histopathologist is indispensable in diagnostic orthopaedics, since, the further management, treatment and follow up lies on his accurate interpretation [3, 4].
This study is aimed at analysing the spectrum of bone lesions and co-relating it with demographics, clinical history, radiological findings and histopathological interpretation.
The study was performed at a tertiary care centre

Methodology of study
The study was prospective comprising of 100 bone lesions, which included both resection

and biopsy samples received in the Department of Pathology, in a Tertiary hospital and Research centre, between the years, September 2015 to September 2017. The clinical details of all the cases were reviewed for the following data: patient's age, gender, clinical history, radiological findings and other relevant investigations.

The specimens received at the Department of Pathology were subjected to gross examination including their external surface and cut surface and processed for microscopic examination.

Sections of 3-5mm thick were made and fixed primarily in 10% buffered formalin. Following this, decalcification in 5% nitric acid for a period of 2 days was followed as a basic protocol. The tissues were processed by adding increasing concentrations of alcohol and paraffin blocks were prepared. The sections were stained with haematoxylin and eosin. Special stains were done wherever possible.

Exclusion criteria: Bone marrow biopsies and other primary tumours invading the bone.

Results

The type of specimens that were received in the Department of Pathology included bone curettage (40%), excisional biopsy (34%), core needle biopsy (16%), wound debridement with bony bits (4%), bone shaving, excision and curettage, amputation, partial excision, open biopsy and reamed material each constituting 1%.

Out of 100 cases studied, 55 were non- neoplastic lesions and 45 were neoplastic lesions. Out of 55 non neoplastic lesions studied, 70.9% constituted inflammatory bone lesions, 25.5% constituted metabolic bone lesions and 3.6% constituted necrotic bone lesions. Among the neoplastic lesions, 78% constituted benign bone lesions and 22% constituted malignant bone lesions. The gender distribution of all the lesions constituted 59% males and 41% females in the ratio 1.4:1 (Male: Female). The most common age of occurrence constituted below the age of 20 years (39%); between 21-40 years (21%), 41-60 years (24%) and above 60 years (16%).

Table 1: Age and gender distribution of bone lesions

Bone lesions	Age in years				Gender		Total
	< 20 years	21-40 years	41-60 years	>60 years	Male	Female	
Neoplastic Lesions							
Benign	27	7	1	0	19	16	35
Malignant	1	2	5	2	6	4	10
Total	28 (62.3%)	9 (20%)	6 (13.3%)	2 (4.4%)	25 (55.5%)	20 (44.5%)	45
Non-Neoplastic Lesions							
Necrotic	0	1	1	0	1	1	2
Metabolic	0	3	1	10	4	10	14
Inflammatory	10	13	13	3	30	9	39
Total	10 (18.3%)	17 (30.9%)	15 (27.2%)	13 (23.6%)	35 (63.6%)	20 (36.4%)	100

Neoplastic benign bone lesions comprised of 35 cases. Osteochondroma was the most common lesion (48.5%), followed by fibrous dysplasia (14.2%), giant cell tumour (8.6%), aneurysmal bone cyst (8.6%), osteoid osteoma (2.9%), simple bone cyst (2.9%), chondroblastoma (2.9%), chondromyxoid fibroma (2.9%) and one case of bi-lesion; aneurysmal bone cyst with giant cell tumour (2.9%). 2 cases were inconclusive (5.6%). They occurred most commonly below the age of 20 years (77.1%), followed by 20% between 21-40 years and 2.9% between 41-60 years. Males were more frequently affected than females in the ratio of 1.25:1.

Table 2: Age and gender distribution of benign bone lesions

Benign bone lesions	Age in years				Gender		Total
	< 20 years	21-40 years	41-60 years	>60 years	Male	Female	
Osteochondroma	12	4	1	0	9	8	17
Osteoid osteoma	1	0	0	0	1	0	1
Giant cell tumour	2	1	0	0	0	3	3
Chondroblastoma	1	0	0	0	1	0	1
Chondromyxoid fibroma	1	0	0	0	0	1	1
Fibrous dysplasia	4	1	0	0	3	2	5
Simple bone cyst	1	0	0	0	1	0	1
Aneurysmal bone cyst	3	0	0	0	2	1	3
Giant cell tumour with Aneurysmal bone cyst	1	0	0	0	1	0	1
Inconclusive	1	1	0	0	1	1	2
Total	27 (77.1%)	7 (20%)	1 (2.9%)	0	19 (54.2%)	15 (42.8%)	35

Neoplastic malignant bone lesions comprised of 10 cases. Of which, osteosarcoma and chondrosarcoma constituted 30 % each, followed by plasmacytoma (20%), Ewing sarcoma and lymphoma constituting 10% each with sex ratio of M: F: 1.5:1. 50% of the malignant neoplastic lesions occurred in the elderly age group between 40 to 60 years of life. The second most common age group affected was below the age of 20 years, which was Ewing sarcoma.

Table 3: Age and gender distribution of malignant bone lesions

Malignant bone lesions	Age in years				Gender		Total
	< 20 years	21-40 years	41-60 years	>60 years	Male	Female	
Osteosarcoma	1	1	1	0	2	1	3
Chondrosarcoma	0	0	3	0	1	2	3
Plasmacytoma	0	0	1	1	1	1	2
Lymphoma	0	0	0	1	1	0	1
Ewing sarcoma	1	0	0	0	1	0	1
Total	2 (20%)	1 (10%)	5 (50%)	2 (20%)	6 (60%)	4 (40%)	10

The non-neoplastic bone lesions consisted of necrotic, metabolic and inflammatory lesions. Necrotic bone lesions occurred commonly in the older age group above 60 years of age with an equal incidence of lesions in both males and females in the ratio of 1:1. In this study, only 2 cases of avascular necrosis of the bone were diagnosed.

Osteoporosis was the only metabolic bone disease reported under the study. Out of 14 cases, 10 cases occurred after the age of 60 years, followed by 3 cases in the age group of 41 to 60 years. They occurred predominantly in females with a gender ratio of; male: female: 0.25:1. However, one biopsy remained inconclusive due to sample inadequacy.

Out of 39 cases of inflammatory bone lesions, chronic osteomyelitis constituted 12 cases, followed by 11 cases of acute osteomyelitis. Tubercular osteomyelitis constituted 7 cases and actinomycotic osteomyelitis constituted 2 cases. 7 cases remained inconclusive due to sample inadequacy and the patient's financial constraints didn't permit further follow up. They occurred commonly in males; Male: Female:-3.3:1. However, Tubercular osteomyelitis occurred more commonly in females with the sex ratio of M: F 0.75:1.

Table 4: Age and gender distribution of non-neoplastic bone lesions

Bone lesions	**Age in years**				**Gender**		**Total**
	< 20 years	**21-40 years**	**41-60 years**	**>60 years**	**Male**	**Female**	
Necrotic							
Avascular necrosis	0	1	1	0	1	1	2
Metabolic							
Osteoporosis	0	0	3	10	3	11	14
Inconclusive				1			
Inflammatory							
Acute osteomyelitis	4	1	6	0	10	1	11
Chronic osteomyelitis	1	4	5	2	12	0	12
Tubercular osteomyelitis	3	4	0	0	3	4	7
Actinomycotic osteomyelitis	0	2	0	0	1	1	2
Inconclusive	1	2	3	1	4	3	7
Total	9 (16.3%)	14 (25.5%)	18 (32.7%)	14 (25.5%)	34 (61.8%)	21 (38.2%)	55

The most commonly involved bone was the femur. Metaphysis was the most commonly involved anatomic site constituting 51 cases. Neoplastic bone lesions were seen commonly involving the metaphysis constituting 27 cases, followed by epiphysis 9 cases; diaphysis 1 case and meta-diaphysis 4 cases. Chronic osteomyelitis commonly affected the metaphysis constituting 8 cases; followed by acute osteomyelitis constituting 8 cases. Tubercular osteomyelitis occurred most commonly in the spinal vertebra (5 cases). 2 cases occurred in the metaphysis of the femur. 2 cases of avascular necrosis were seen to involve the head of femur. 14 cases of osteoporosis arose from the head of the femur.

Imaging studies (X ray) was performed on all the patients. 61 cases were lytic, 11 cases were sclerotic and 6 cases were both lytic and sclerotic. CT scan and MRI scan were limited and performed based on the limitations of the patient.

Table 5: Site distribution of non-neoplastic bone lesions

Anatomical site						**Bone involved**				
	E	**M**	**D**	**E-M**	**M-D**	**Femur**	**Tibia**	**Humerus**	**Fibula**	**Others**
Non-Neoplastic										
Avascular necrosis						2				
Osteoporosis						13				
Acute osteomyelitis	3	8				7	2			2
Chronic osteomyelitis	3	8	1			8	2		1	1
Tubercular osteomyelitis		2					2			5
Actinomycotic osteomyelitis		2				2				
Inconclusive	2	4		1		5	3			
Total	8	24	1	1		37 (67.2%)	9 (16.3%)		1(1.8%)	8 (14.5%)

Table 6: Site distribution of neoplastic lesions

Anatomical site						Bone involved				
Lesion	**E**	**M**	**D**	**E-M**	**M-D**	**Femur**	**Tibia**	**Hume us**	**Fibula**	**Others**
Osteochondroma	4	13				8	7	2		
Osteoid osteoma		1				1				
Giant cell tumour	2	1				1	1		1	
Simple bone cyst					1			1		
Aneurysmal bone cyst		2		1		2	1			
Chondroblastoma				1		1				
Chondromyxoid fibroma	1					1				
Fibrous dysplasia	1	2			2	3	2			
Giant cell tumour and aneurysmal bone cyst		1				1				
Osteosarcoma		3				3				
Chondrosarcoma		2			1	2		1		
Plasmacytoma										2
Lymphoma	1						1			
Ewing sarcoma			1							1
Inconclusive		2				2				
Total	9	27	1	2	4	25 (55.6%)	12 (26.7%)	4 (8.8%)	1 (2.3%)	3 (6.6%)

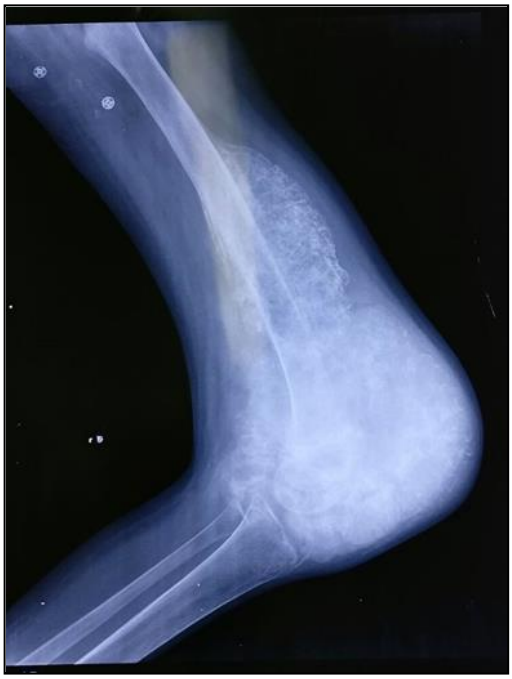

Plate 1: X-Ray Femur- AP View Osteosarcoma: An ill-defined lesion extending from the metaphysis of femur showing elevation of periosteum, invasion into the cortex and soft tissue extension.

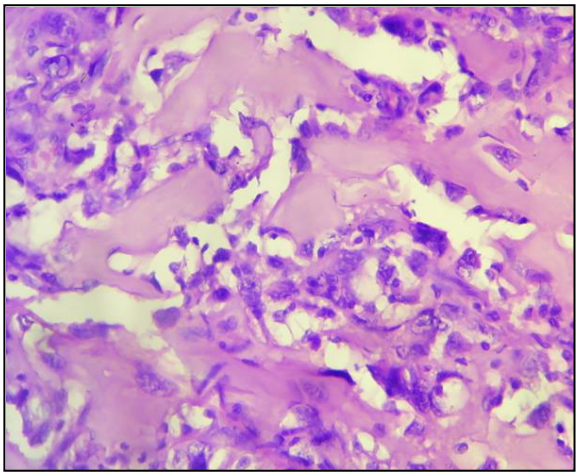

Plate 2: Microscopy: osteosarcoma: Pleomorphic spindle cells showing hyperchromatic nuclei and anisonucleosis. Malignant osteoid (Arrow head) is seen rimmed by tumour cells. [H and E 40X]

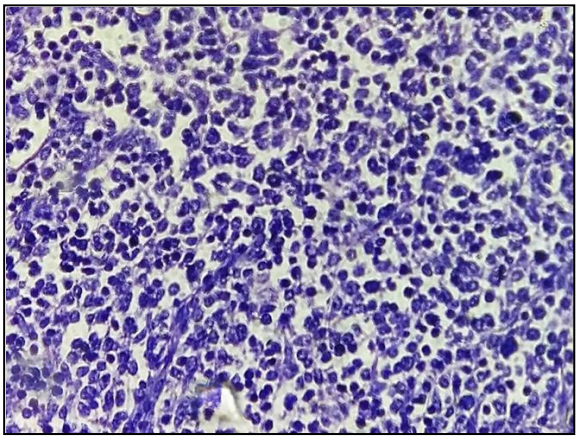

Plate 3: Microscopy: Primary Bone Lymphoma- Monomorphous population of lymphoid cells having coarse chromatin and irregular nuclear margin. [H and E 40X].

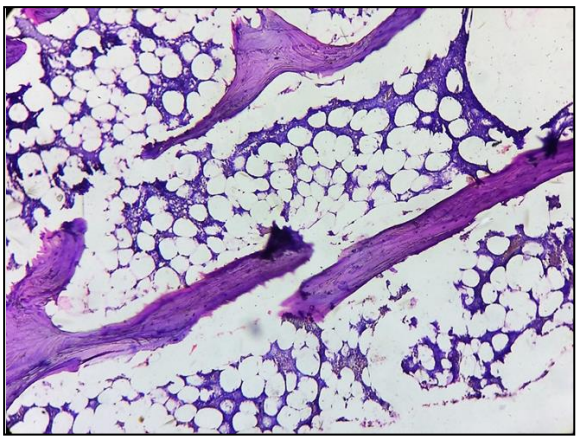

Plate 4: Microscopy: Osteoporosis: Thinned out lamellar bone with scanty marrow and increase in mature adipocytes. [H and E 10X]

Discussion

Literature studies conducted by other institutions comprised of different sample sizes. Bone lesions constitute small proportion of lesions in the population. The demand for definitive demographic details, history, radiological information and histo-pathological evaluation attribute very significantly for diagnosis. There are instances where various clinical entities mimic their counterparts; such as, traumatic and pathological fractures, Ewing sarcoma and

osteomyelitis and others. Histopathology plays a significant role in diagnosing bone lesions to help differentiate clinical entities and play a role in further management and prognosis [5].

This study was conducted in a tertiary care hospital. It was aimed at analysing the spectrum of bone lesions with their clinico-pathological features to find out the relative incidence correlating with the age, gender, radiological imaging and anatomical sites of occurrence.

In the present study, non-neoplastic lesions were more common than neoplastic lesions. The entire spectrum of lesions occurred more commonly in the younger age group, <20 years, with a male preponderance (M: F-1.4:1).The most common bone affected was Femur and metaphysis of long bones was the commonest site of anatomical lesion. In similar studies conducted by Sunita A et.al, Modi D et.al and Rao et.al; the features co related well with the present study [3, 4, 6].

In the present study, benign bone lesions were more common than malignant lesions. Osteochondroma was the most common lesion occurring in the younger age group <20 years with a male preponderance. This was followed by fibrous dysplasia, giant cell tumour, and aneurysmal bone cyst. In similar studies conducted in the past by, Hathila R et.al and Rhutso et.al, similar findings were documented [7, 8].

Osteosarcoma and chondrosarcoma were the most common malignant lesions, constituting 3 cases each. Chondrosarcoma occurred more commonly in the age group of 41 to 60 years, with metaphysis of the femur being the most commonly affected anatomical site and males more commonly affected. According to the study conducted by Settakorn et.al, there were similar findings documented [9]. In a study conducted by Katchy K C et.al, the occurrence of the lesion was equal in both males and females with a sex ratio of 1:1 and involved the vertebrae most commonly [10].

Osteosarcoma occurred in three age groups in the present study. One occurred below 20 years, one between 21 to 40 years, another case at 60 years; they showed a male preponderance and affected the metaphysis of the femur. In a study conducted by Rhutso Y *et al*, they showed a male predominance with two age peaks; one at 10 years and the other at 30- 40 years [8]. In a study conducted by Reddy et.al, the lesion occurred most commonly in the metaphysis of long bone [11]. The other malignant lesions were Ewing sarcoma, which involved the spinal vertebra followed by plasmacytoma and lymphoma.

In the present study, chronic osteomyelitis was the most common non-neoplastic lesion affecting 12 patients. They commonly involved the metaphyseal end of the femur. Tubercular osteomyelitis was seen to commonly involve the spine with a female preponderance. In studies conducted by Patel et.al and Modi *et al*, tuberculous osteomyelitis was the most common non neoplastic lesion [6, 12]. The other non-neoplastic lesions were osteoporosis and avascular necrosis which most commonly involved the head of the femur.

Conclusion

Review of literature showed that there have been several studies done in the past, on various aspects of benign, malignant and inflammatory lesions. Whereas,many studies have been confined to bone tumours alone. There are limited studies describing the various inflammatory and metabolic lesions. These limitations led to difficulties in finding out the exact incidence and distribution of few such lesions. However, in orthopaedic practise, histopathology too plays a very significant role. The essential elements starting from demographic details, history, and radiology play a significant role in interpretation. The demographic history, clinical details and radiological observations made in our study co related well with previous literature studies. The final conclusion rests on the fact that, with a combined collaboration of clinical-radiological and pathological interference, a profound diagnosis and treatment can be benefitted.

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