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Histopathological spectrum of bone lesions at tertiary care hospital

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Abstract
Background: Bone lesions are less commonly encountered lesions, and they pose a definitive diagnostic challenge. A spectrum of pathological bone lesions can be presented in any form from inflammatory to neoplastic conditions. Diagnosis of all bone lesions is made by radiological modalities like plain X-ray, CT scan, MRI and bone scintigraphy. Histopathological examination of these lesions is important to identify the morphological features and make a diagnosis.
Aim and Objectives: To study histopathological features of bone lesions and correlate them with age, site and type of lesions.
Material and Methods: The study was carried out at tertiary care hospital from August 2022 to June 2024. A total of 93 bone lesions were analyzed. Bone biopsy was performed after detailed clinical and radiological examination. After fixation, decalcification, processing and H & E staining, histopathological diagnosis was made.
Results: Out of 93 cases, 42.4% bone lesions were found in <25 years with male predominance. The incidence of non-neoplastic lesions was 72.04% and neoplastic lesions was 27.95%. Amongst neoplastic lesions, incidence of benign tumors was 22.54% and malignant lesions was 5.40%. Chronic osteomyelitis was most common cause of non-neoplastic lesions, while giant cell tumor was most common cause for benign neoplastic lesions and osteosarcoma and chondrosarcoma were most common cause of malignant bone lesions.
Conclusion: Though bone tumors are less common, if viewed in perspective of clinic-radiology and histopathology, correct diagnosis can be made.

Keywords: Bone lesions, osteomyelitis, giant cell tumor

Introduction
Bone is made of osteoid, fibrous tissue, cartilage and marrow elements, hence lesion can develop from any of these tissues [1]. A spectrum of pathological bone lesions can present in any form from inflammatory to neoplastic conditions [2]. Benign and non-neoplastic lesions are more common than malignant lesions. The histopathologist plays a vital role to guide for a diagnosis and prognosis of patients with bone lesions. The relevant data on age, gender and site of lesion are necessary for the establishment of diagnosis [3]. Some benign processes such as osteomyelitis can mimic malignant tumors, hence biopsy aids in yielding more accurate results in such lesions.
Primary bone tumors are relatively uncommon and account for <0.5% of all world cancers [4]. Secondary bone tumors with primary tumors in lungs, kidney, thyroid, breast, gastrointestinal tract produce lytic lesion [5]. Bone is the third most common site of metastatic disease. Carcinomas are much more likely to metastasize to bone than sarcomas. The axial skeleton is seeded more than the appendicular skeleton, partly due to the persistence of red bone marrow in axial skeleton. The ribs, pelvis and spine are normally first bones involved and distal bones are rarely affected. The bone lesions can affect population of any age group. These lesions clinically present as pain, swelling, restriction of movement and also have tendency to progress quickly. To establish an accurate diagnosis, an integrated approach in the form of clinical data, radiograph and histology is necessary.

Materials and Methods
The study was conducted at tertiary care hospital, focusing on the patients with radiologically apparent bone diseases. A total of 93 patients diagnosed with bone lesions via radiological

imaging were selected for inclusion in the study.

Patients presenting in the orthopaedic OPD with symptoms such as pain, swelling, pathological fracture were considered for study. A detailed history was taken which mainly included demographic details (Age, sex, place of residence, occupation), as well as clinical symptoms like fever, weight loss, cough, haemoptysis or history suggestive of systemic involvement. All patients underwent a comprehensive physical examination including both general and systemic examination.

In all patients, X-ray of affected bone had been taken while CT scan and MRI were done according to the need and recommendation of the orthopaedic surgeon. Pathological investigations included routine CBC, ESR, and urine examination in all patients. For selected patients, additional tests such as sputum, body fluid examination, serum calcium and alkaline phosphatase were conducted. Biopsy for histopathology was performed in all patients to confirm the diagnosis of lesions. Biopsy was obtained using various methods including scrapping, incision or excision method.

In laboratory, soft tissue specimen were fixed in 10% formalin, while bone was adequately fixed in 10% buffered formalin and then decalcification was achieved by placing the specimens in 10% nitric acid for 24 hours. After that, tissues were processed through increasing concentrations of alcohol, followed by embedding in paraffin and blocks were prepared. After cutting with microtome, sections were stained with Haematoxylin and Eosin stain. The slides were examined under microscope, the final diagnosis was categorized into inflammatory, benign and malignant lesion accordingly.

Results

A total of 93 cases of various bone lesions were examined histopathologically. The findings revealed that the lesions were more prevalent in males (67.74%) compared to females (32.26%), with male-to-female ratio of 2:1(Table-1). In terms of age distribution, 37 cases (42.4%) were found in patients under 25 years of age (Table-2).

Among various inflammatory lesions, chronic osteomyelitis was most common, followed by acute osteomyelitis (Table-3). In the category of benign lesions, giant cell tumor was most frequently encountered (Table-4). For malignant lesions, osteosarcoma and chondrosacrcoma were most common types (Table-5).

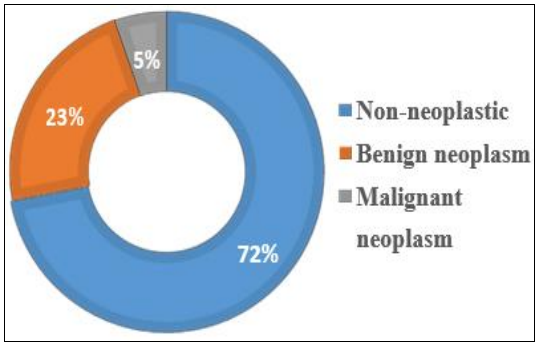

Fig 1: Proportion of different bone lesions

Table 1: Gender distribution of the lesions of bone

Bone lesions	Non-neoplastic	Neoplastic		Total
		Benign	Malignant	
Male	45	15	3	63
Female	22	6	2	30
Total	67	21	5	93

Table 2: Age wise distribution of bone lesions

Age (years)	Non-neoplastic	Neoplastic		Total
	Benign		Malignant	
<25	28	9	2	39
25-50	22	7	2	31
>50	17	5	1	23
Total	67	21	5	93

Table 3: Distribution of various inflammatory lesions

Various inflammatory lesions	No. of cases
Acute osteomyelitis	16
Chronic osteomyelitis	34
Koch's inflammation	4
Osteoarthritis	2
Synovitis	1
Other	10
Total	67

Table 4: Distribution of benign lesions

Various benign lesions	No. of cases
Aneurysmal bone cyst	4
Osteochondroma	3
Langerhans cell histiocytosis	1
Ossifying fibroma	1
Osteoma	4
Osteoblastoma	2
Giant cell tumor	6
Total	21

Table 5: Distribution of various malignant lesions

Various malignant lesions	No. of cases
Osteosarcoma	2
Chondrosarcoma	2
Synovial sarcoma	1
Total	5

Discussion

The bony lesions represent a small proportion of all the lesions that exist in the population [6]. The histological diagnosis is crucial for bone lesions as conditions can be confusing clinically, such as osteomyelitis and Ewing's sarcoma, pathological fracture and traumatic fracture, osteoblastoma and osteosarcoma, tuberculosis and malignancy [7].

In the present study, the most common age group of all bone lesions was under 25 years, with 39 cases of bone lesions were identified, including 28 non-neoplastic lesions, 9 benign neoplastic lesions and 2 malignant neoplastic lesions. Out of 93 total cases of bone lesions, non-neoplastic lesions were most frequent (67 cases). This distribution pattern is consistent with findings reported by Rhutso, *et al.* and Sunita A Bamanikar *et al.* [8, 9].

Age	Present study	Rhusto *et al.*	Sunita *et al.*
<25	41.93%	69.03%	58.41%
25-50	33.33%	26.33%	26.96%
>50	24.73%	4.64%	14.63%

Gender	Present study	Rhusto *et al.*	Sunita *et al.*
Male	67.74%	54.83%	56.10%
Female	32.25%	45.16%	43.90%

Lesion	Present study	Rhusto *et al.*	Sunita *et al.*
Benign	80.76%	82.29%	84.15%
Malignant	19.23%	17.71%	15.85%

Key histopathological features of bone lesions

Inflammatory lesions

Once in a bone, the bacteria proliferate and induce acute inflammatory reaction. The entrapped bone undergoes necrosis within first 48 hours, and the bacteria and inflammation spread within shaft of bone and may percolate throughout the haversian systems to reach the periosteum.

Lifting of periosteum further impairs the blood supply to the affected region and both the suppurative and ischemic injury may cause segmental bone necrosis, the dead piece of bone is known as sequestrum.

After the first week chronic inflammatory cells become more numerous and their release of cytokines stimulate osteoclastic bone resorption, in growth of fibrous tissue and deposition of new bone in periphery. When the newly deposited bone forms a sleeve of living tissue around the segment of devitaized infected bone, it is known as involucrum. Thus, in cases of pyogenic osteomyelitis large areas of necrosis, focal area of haemorrhage and acute inflammatory cells are found. In case of tuberculous osteomyelitis, the presence of epitheloid cells and caseation necrosis were inevitable. Few langhans giant cells and evident granuloma could be seen.

Benign neoplastic lesions

Giant cell tumor

These are large, red brown tumors that frequently undergo cystic degeneration. They are mostly composed of uniform oval mononuclear cells that constitute the proliferating component of tumor. Scattered within this background are numerous osteoclast type giant cells having 100 or more nuclei (Figure 1). Necrosis, hemorrhage, hemosiderin deposition and reactive bone formation are common secondary features.

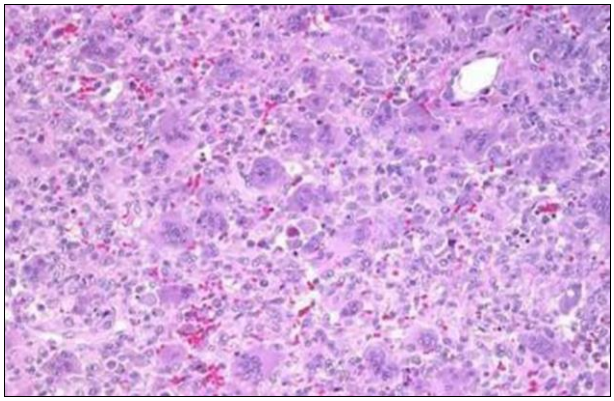

Fig 1: Abundance of multinucleated giant cells with background of mononuclear stromal cells

Grade-I (conventional giant cell tumor), these tumors shows many giant cells with plenty of nuclei located in central with abundant cytoplasm, Grade-II, Grade-III (aggressive morphology) in which number of giant cells were too less, number of nuclei in giant cells were less with a typical nuclear morphology and nuclei were arranged at the periphery of cell. Stromal cells were having aggressive nuclear morphology.

Aneurysmal bone cyst

Multiple hemorrhagic cystic spaces separated by thin tan white septa and surrounded by bland fibrous stroma containing multi-nucleated osteoclast like giant cell and reactive woven bone (Figure 2).

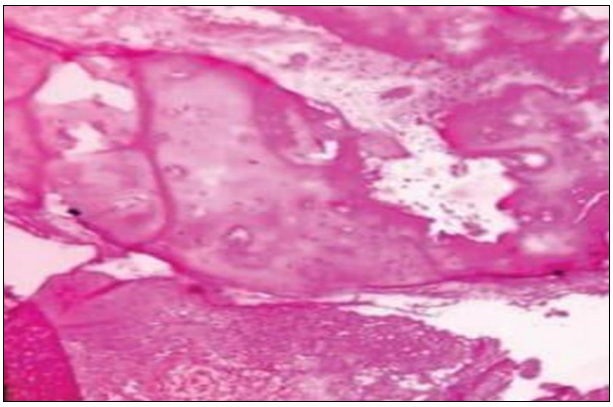

Fig 2: Aneurysmal bone cyst showing uniform fibroblasts with multinucleate giant cells

Osteoma

Admixture of mature lamellar and woven bone patterns with Haversian-like canals, which may have various sizes and shapes (Figure 3). More frequent: Cortical type bone architecture.

Less frequent: Lamellar type bone architecture

Osteoblasts rimming bone are inconspicuous and small but can be prominent in growing lesions Osteocytes in matrix are small and not atypical and randomly distributed

Inter-trabecular marrow spaces are filled with moderately cellular, loose fibrous stroma inflammatory infilterates are typically absent

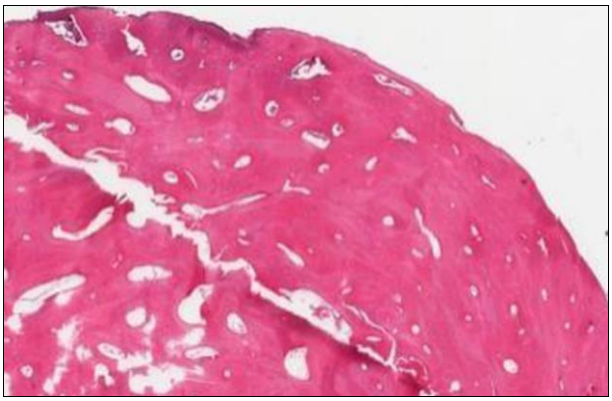

Fig 3: Osteoma, dense compact lamellar bone

Langerhans cell histiocytosis

On microscopic examination, plenty of eosinophils in the background of coffee bean shaped multilobated histiocytes seen.

Malignant lesions

Osteosarcoma

The tumor cells vary in size and shape and frequently have large hyper chromatic nuclei. Bizzare tumor giant cells are common as mitoses. The formation of bone by the tumor cells is characteristic. The neoplastic bone usually has coarse, lace like architecture but also may be deposited in broad sheets or primitive trabeculae. Other matrices, including cartilage or fibrous tissue, may be present in varying amounts. When the malignant cartilage is abundant, the tumor is called chondroblastic osteosarcoma. Vascular

invasion is usually conspicuous, and up to 50 to 60% of an individual tumor may be necrotic (Figure 4).

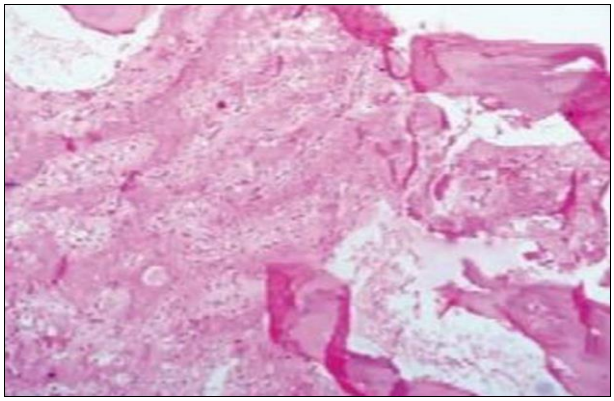

Fig 4: Pleomorphic tumor cells with delicate osteoid

Chondrosarcoma

Conventional chondrosarcoma is composed of malignant hyaline and myxoid cartilage. Low grade or grade 1 lesions demonstrate mild hyper cellularity and the chondrocytes have plump vesicular nuclei with small nucleoli. Binucleate cells are sparse and mitotic figures are difficult to find. Portions of the matrix frequently minerlize and the cartilage may undergo enchondral ossification. By contrast grade 3 are characterized by marked hyper cellularity, extreme pleomorphism with bizzare tumor giant cells and mitoses (Figure 5).

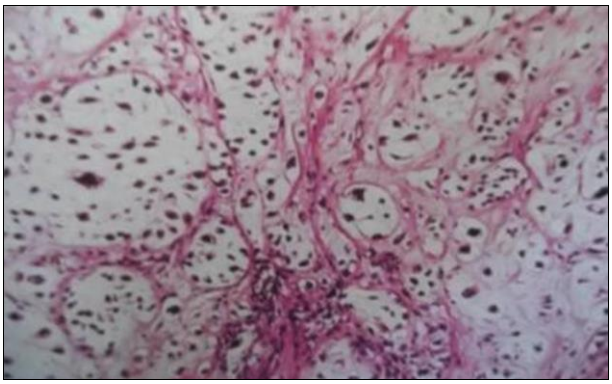

Fig 5: The tumor retains a lobulated appearance with nuclear atypia

Synovial sarcoma

Morphologically, it is monophasic or biphasic. The histological hallmark of biphasic is dual lines of differentiation (Epithelial like and mesenchymal like). Monophasic being composed of only spindle cells or very rarely epithelial cells.

Although, the diagnosis of a bone lesion is dependent on clinical, radiologic and histopathological features, Immunohistochemistry (IHC) is useful ancillary technique to distinguish between entities that share similar morphologic features or are of uncertain histogenesis. It can provide histological identification of antigenic factors in cells not otherwise evident in routinely stained histological sections.

Conclusion

In our study, the bone lesions are predominantly seen in younger age group, and they have predilection for male population. The incidence of non-neoplastic lesions is more than neoplastic lesions. The benign neoplastic lesions are more common than malignant lesions. The histopathological examination remains gold standard to diagnose bone lesions when combined with history and clinical data.

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