

ORIGINAL RESEARCH

RADIOLOGICAL SIGNIFICANCE IN DIFFERENTIAL DIAGNOSIS OF OSTEOSARCOMA: A RETROSPECTIVE STUDY

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ABSTRACT

Introduction: Osteosarcoma (OS) is the relatively most prevalent bone malignancy accounting for 20% of primary bone tumors. Differential diagnosis of OS is a daunting problem as they can masquerade with different kinds of bone tumors. None of the studies correlate the radiological findings of suspected cases of osteosarcoma with biopsy.

Purpose: The purpose of this retrospective study is to correlate the radiological findings with biopsy of suspected osteosarcoma.

Materials and Methods: The current retrospective study was carried out in the Department of Orthopaedics in collaboration of Department of Pathology at a tertiary care center in north India from 2015 to 2021. A total of 162 patients of suspected OS included in this study after carefully examination of clinical and radiological features analyzed by two Orthopaedic surgeons. The differential diagnosis of OS was observed in all patients through analyzing the clinical and radiological features followed by biopsy. The accuracy of radiology was calculated against biopsy procedure.

Results: Out of 162 patients, 102 patients were male and 60 were female with a mean age of 29.65 ± 10.55 years. The accuracy of clinical and radiological findings as compared to biopsy diagnostic procedures was 44.44%. A discrepancy between radiology and biopsy was 55.56%.

Conclusion: Radiological finding reveals that OS mimics different kinds of tumors reflected with low diagnostic accuracy of radiology. Hence, biopsy must consider confirming the diagnosis of bone tumors.

Keywords: Osteosarcoma, Tumors, Diagnosis, Radiography and Biopsy Image**INTRODUCTION**

Primary bone tumors are a relatively uncommon type of cancer accounting for 0.5% of global cancer^{1,2} and it is the 6th most prevalent tumor among children.³ Primary bone tumors frequently occur in male with respect to females especially during the second or third decade of life.⁴ Occurrence of osteosarcoma and Ewing sarcoma is very rare in the general population while it frequently occurs in children.⁵ Diagnosis of osteosarcoma and Ewing sarcoma is a demanding issue for orthopaedic surgeons, radiologists and pathologists which are based on a combination of prototypical pathological and radiographic features. Basically, Ewing sarcoma and osteosarcoma have very dissimilar radiological features and clinical symptoms. Radiographic images play a crucial role in early work up and diagnosing the primary bone tumors owing to its sensitivity to recognize the bone matrix density.⁶ The classical features of bone malignancy on radiographic images are Codman triangle, onion skin periosteal reaction, permeative pattern and sunburst periosteal reaction.^{7,8} Hence, orthopaedic surgeons must focus on initial signs and symptoms for diagnosing osteosarcoma and Ewing sarcoma to differentiate it from other kinds of orthopedic conditions like tendonitis and osteomyelitis followed by cross sectional imaging for initial evaluation of primary bone tumors.⁹ Laboratory and clinical findings can often narrow the differential diagnosis of primary bone tumors, however definite distinguishing between osteosarcoma and other kinds of bone tumors is very difficult as radiological sign Periosteal reaction - onion and sunburst appearance and permeative pattern and clinical sign like pain and swelling features of both sarcoma mimics with one another.¹⁰ The features of Ewing sarcoma, osteomyelitis and other bone tumors and osteosarcoma are mimicked with one another on imaging.¹¹ Several lines of evidence proved that diagnosis of Ewing sarcoma is misdiagnosed as osteosarcoma on imaging reports.^{11,12,13} Even sometimes findings of biopsies are inconclusive in differential diagnosis of osteosarcoma with Ewing sarcoma, osteomyelitis and other kinds of tumors that leads to mistreatment of bone tumors.^{14,15} Abundance of literature defines the imaging features of osteosarcoma and osteomyelitis while few studies compare the imaging characteristics of a large cohort of these patients.^{7,16} Some of the reports focused on crucial dissimilarity between osteosarcoma and Ewing sarcoma based by using MRI and FTIR spectroscopy.^{17,18} Only few studies compare the radiological findings with biopsy findings of suspected cases of primary bone tumors^{19,20,21} while none of the studies correlate the radiological findings of suspected cases of osteosarcoma with biopsy. Hence, the purpose of the current retrospective study is to examine the correlation of radiological images with biopsy finding of suspected osteosarcoma.

MATERIALS AND METHODS

The current retrospective analysis was carried out in the Department of orthopaedics in collaboration with Department of Pathology at tertiary care centre in north India from 2015 to 2021. All patients were seen in the Outpatient Department (OPD). A total of 162 patients included in this study after carefully examination of clinical and radiological features analyzed by two orthopaedic surgeons. Exclusion criteria were non-neoplastic patients and infection related patients. All the patients with suspected osteosarcoma were enrolled with

inclusion criteria of pain, swelling and radiological sign of osteosarcoma like Codman triangle, sunburst appearance and permissive pattern of destruction of bone analyzed through radiographic films. Biopsy including incisional and trocar biopsy of the lesions were carried out to ensure the histological diagnosis of the bone tumor and correlate with this radiological finding.

STATISTICAL ANALYSIS

All statistical analyses were carried out by employing the 21.0 version of SPSS software (SPSS Inc., Chicago, IL, USA). Descriptive statistics were expressed as mean, frequency and percentage.

Table-1: Frequency of suspected cases of osteosarcoma according to age interval

Age Intervals	Frequency	%
18 to 20 years	81	50.0
21 to 30	41	25.30
31 to 40	24	14.81
41 to 50	16	9.87
Total	162	100.0

Table-2: Biopsy of patients of suspected cases of osteosarcoma

Diagnosis	Frequency
Osteosarcoma	Subjects (44.44%)
GCT	39 Subjects (24.07%)
Bone cyst	3 Subjects (1.85%)
Leiomyosarcoma	3 Subjects (1.85%)
Ewing Sarcoma	24 Subjects (14.81%)
Round Cell tumor	21 Subjects (12.96%)
Total	162 Subjects

Figure-1: Primary site affected by osteosarcoma

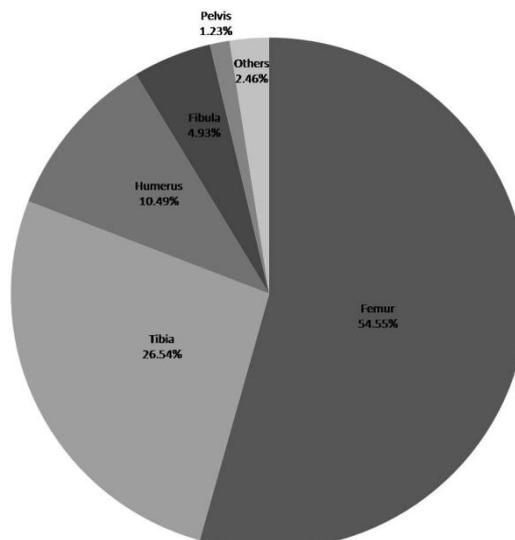


Figure 2: (a) Radiograph of arm with shoulder showing permeative lesion of metaphyseal and diaphyseal region with periosteal reactions (Left Side). (b) HE-Section shows tumour Cells disposed in solid sheets .Tumour cells occasionally form rosettes. Tumour cells have high nucleo-cytoplasmic ratio, coarse chromatin& moderate cytoplasmic. Tumour cells are round to oval in shape. Frequent mitotic figure noted suggestive of Ewing sarcoma/PNET (Right Side).

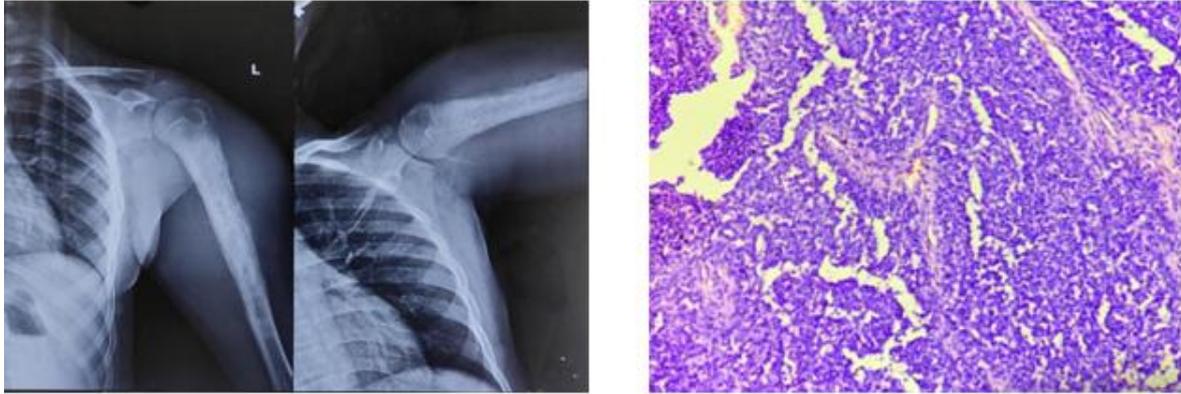
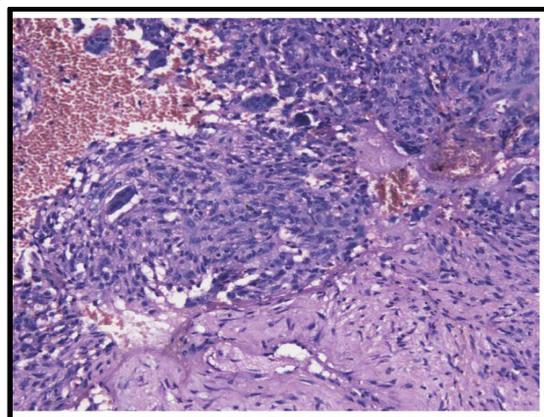


Figure 3: (a) Radiograph of hip thigh (AP/lateral view) exhibiting medial cortical breach with loculated new bone formation suggestive of osteosarcoma



Figure 3: (b) Hemotoxylin and eosin stained section shows fibroblastic proliferation intermixed with osteoclast type giant cells along with hemorrhage (H&Ex200). 32 female, Lesion site : Right Femur.



RESULTS

Out of 162 patients, 102 patients were male and 60 were female with a mean age of 29.65 ± 10.55 years, and the median was 31.50 years. The majority of the patients were between 18 and 30 years of age (**Table-1**). The suspected cases of osteosarcoma were observed in all patients after carefully analysis of clinical findings like pain and swelling and radiological findings like sunburst appearance, onion like periosteal reaction, permeative bone destruction and Codman triangle) associated with osteosarcoma. (**Figure-1**). Majority of the osteosarcoma cases occur at the femur site (54%) followed by tibia (27%), humerus (11%), fibula (5%), pelvis (1%) and others (2%) (**Figure-2**). All the suspected cases of osteosarcoma were subjected to biopsy (trocar and incisional) after the clinical and radiological findings. 44.44% (n=72) and 24.07% (n=39) cases were found to be osteosarcoma and GCT respectively while 14.81% (n=24) and 12.96% (n=21) cases were found to be Ewing sarcoma and round cell tumor respectively after histological analysis (**Table-2**). Bone cyst (**Figure-3**) and Leiomyosarcoma were observed only in 1.85% of suspected cases of osteosarcoma (**Table-2**). The accuracy of radiological findings as compared to biopsy diagnostic procedures was 44.44% (**Table-2**). A discrepancy between radiology and biopsy was 55.56% (**Table-2**).

DISCUSSION

Osteosarcoma is the relatively most prevalent bone malignancy accounting for 20% of primary bone tumors.²² Osteosarcoma predominantly occurs in individuals with age less than 20 years and primarily affects the long bones of the extremities.²³ Differential diagnosis of osteosarcoma is a daunting problems as they can masquerade with osteomyelitis Ewing sarcoma and other kinds of bone tumors with presenting radiological (periosteal reaction - onion and sunburst appearance and permeative pattern) and clinical (pain and swelling) features that are common to bone malignancy. Aggressive behavior of tumors is also a big hurdle for radiologists because they can recognize by the following manifestation: rapid growth, a soft tissue mass, irregular osteolysis and periosteal reaction.²⁴ Clinical information like personal history of malignancy, age and gender is also very essential in determining the primary bone tumors.^{25,26} Age is one of the important clinical factors. Different kinds of primary bone tumors occur in different age intervals.^{27,28} In the current reports, the majority of the cases of osteosarcoma occur in the second and third decade (18-20 years of age) of life which is concurring with several previous findings.^{4,23,29} Abundance of reports showed that the primary affected site of osteosarcoma is femur.^{11,30,31} In the current study, the majority of cases of osteosarcoma occur at the femur . It is well reported that diagnosis accuracy of radiology is 70% for primary bone tumors which ranges from 44% to 86%.³² Vijayaraghavan et al.²¹ correlated the radiological findings with histological findings based on Lodwick's classification³³ and observed 80% correlation. Another study found the correlation between radiological findings and biopsy was 84% which might be due to combining the clinical, radiological and MRI images. Gerber et al.,²⁰ reported the 41% diagnostic accuracy of radiology for aggressive bone tumors. In the current study, diagnostic accuracy of radiology was 44.44%. Nagesh et al.,³⁴ reported that osteosarcoma is the most prevalent type of bone tumors through biopsy diagnostic procedure following the radiological diagnosis of bone tumors. In the current study, the most prevalent type of bone tumors was osteosarcoma

followed by giant cell tumor post biopsy which is consistent with previous studies.^{20,35} Several lines of evidence observed the discrepancy between imaging methods to diagnose the primary bone tumors^{7,14} and between radiological and biopsy findings.²⁰ In the current study, the discrepancy between radiology and biopsy was 55.56%. This study had limitations like retrospective nature and inters observation radiographic bias.

CONCLUSION

Clinico-radiographic finding in diagnosing suspected osteosarcoma having low accuracy specially in between OS and Ewing sarcoma. Hence, biopsy is necessary to confirm the differential diagnosis of OS. Further, a multi-model approach must be employed for the accuracy of radiology in differential diagnosis of osteosarcoma. Additionally, large multi-centric prospective studies are required to validate these findings.

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