ORIGINAL ARTICLE

Histological and Radiological Correlation in the Diagnosis of Bone Tumors

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ABSTRACT

Objective: To Determine the sensitivity, specificity, positive predictive value and negative predictive value of radiological results of bone tumors, taking histological findings as the gold standard.
Study design: Descriptive case series
Subjects & methodology: Thirty cases of clinically suspected and with radiological evidence of bone tumors were included in this study. The specimens were sent to the Histopathology Department, fixed in 10% formaline.
Results: The peak age incidence of bone tumors was between 10 to 20 years age groups, with mean age 22.87±12.13, while minimum number of patients were above 40 years age. The study revealed more males 20 cases (66.7%) with bone tumors than females 10 (33.3%). Histopathologically, 12 tumors were malignant and radiology suggested 10 tumors as malignant, Sensitivity, specificity, diagnostic accuracy, positive predictive value (PPV) and negative predictive value (NPV) of radiological findings were found as 83.3%, 100.0%, 93.3%, 100.0% and 90.0%, respectively.
Conclusion: The histopathology appears slightly more accurate compared to radiology in typing, grading and staging of the bone tumors and remains the gold standard.

Key words: Bone tumors, Plain radiographs, MRI, CT scan, Malignant tumors

INTRODUCTION

Histology and Radiology have played a crucial role in the diagnosis of many benign and malignant bony lesions but individually they carry many pit falls in the definitive diagnosis of bone disease. Bone tumors are relatively rare tumors. The incidence of malignant bone tumors is 8.7 per million. The most frequent and the most lethal are osteosarcomas and Ewing's sarcoma.[1] Primary bone tumors and tumor-like lesions of the spine and sacrum are rare. A wide variety of benign and malignant lesions can arise in the spine and sacrum. Specific diagnosis is based on the location, matrix appearance and patient's age at time of presentation. In this location computed tomography (CT) is often necessary for matrix characterization, particularly, detection of mineralization. Magnetic resonance imaging (MRI) can be helpful for further characterization and radiological differential diagnosis. An overview of age distribution and imaging features including pattern for differential diagnosis is presented for the most frequent primary spinal bone tumors and tumor-like lesions.[2] The need for validation is required more than ever for early and successful diagnosis, management and treatment. Five basic parameters of importance in this regard are the age of the patient, bone involved, specific area within the bone, radiographic appearance and microscopic appearance. The pathologist should have full information about the first four before trying to evaluate the fifth one.[3]

Histological examination of bone tumors is one of the most difficult subjects in pathology. Correct diagnosis of childhood bone tumors requires review by a multidisciplinary team of experts. Specifically in non-bone tumor centers, the accuracy of the initial diagnosis can be questioned.[4]

It is also important to note that radiographic imaging plays a very important, often critical, role in allowing the pathologist the opportunity to reach the best final diagnosis. This is especially true when a malignant interpretation is contemplated and in subtyping lesions. A close collaboration between musculoskeletal radiologists, clinicians, and pathologists is recomended when dealing with complicated neoplasms of bone.[5,6]

Patient's age is also an important clinical factor in the diagnosis of bone tumors, because various lesions have predilections for specific age groups. The biopsy can be an image-guided needle biopsy or an open incisional biopsy. Knowledge of specific tumor characteristics and treatment options for osteosarcoma, Ewing's sarcoma,

chondrosarcoma, malignant fibrous histiocytoma, chordoma, and adamantinoma is important.[7]

This study was carried out to compare the histological and radiological correlation in the diagnosis of bone tumours.

MATERIAL AND METHODS

The study was carried out in Histopathology Department of Shaikh Zayed Hospital Lahore in collaboration with Radiology Department of Sheikh Zayed Hospital. Thirty cases of clinically suspected and with radiological evidence of bone tumors were included in this study. All cases were admitted in Orthopedic Department, an informed consent was taken, confidentiality ensured and the patients were explained about the purpose, procedure, risks and the benefits of the study. The basic demographic profiles were recorded and important clinical findings like fever, weight loss, pain, swelling, tenderness etc, radiological findings (bone involved & size of the tumor) and radiological diagnosis with lab investigations like Hb%, TLC, ESR, serum alkaline phosphatase etc. were noted. The Confounding Variables (like sampling error and inadequate biopsies) were controlled by repeat biopsies. All informations were collected through a specially designed Proforma (attached). Biopsies were done after confirming the normal bleeding time, clotting time and platelet counts for each patient. Surgery was done in the Orthopedic Department by an expert surgeon. The specimens were sent to the Histopathology Department fixed in 10% formaline and were examined macroscopically and processed. Three to five micron thick paraffin embedded sections, stained with hematoxyline and eosin were examined microscopically, a final diagnosis was made and report was sent to Orthopedic Department and also entered in the proforma.

RESULTS

A total of thirty patients were studied between the age of 10 months to 55 years. The peak age incidence was between 10 to 20 years age groups, with mean age 22.87±12.13, while minimum number of patients were in 40 age group. The study revealed more males 20 cases (66.7%) with bone tumors than females 10 (33.3%). Histopathologically, 12 tumors were malignant (11 primary bone tumors including 5 osteosarcomas, 4 Ewing's sarcomas, 2 chondrosarcomas, and 1 metastatic ductal carcinoma from breast) and 18 were benign (6 Giant cell tumor, 4 Osteochondromas, 3 aneurysmal bone cyst, 2 Chondroblastomas, 1 Enchondroma, 1 fibrous dysplasia and 1 Osteoid osteoma).on radiology 10 tumors were diagnosed as malignant,(9 primary bone tumors, 1 metastatic carcinoma) and 18 cases were reported as benign, correctly,whereas, 2 cases of malignancy were misinterpreted as benign radiologically. Sensitivity, specificity, diagnostic accuracy, positive predictive value (PPV) and negative predictive value of radiological findings were found as 83.3%, 100.0%, 93.3%, 100.0% and 90.0%, respectively.

Table-1: Age distribution (n=30)

Age (Year)	No. of cases	Percentage
< 20	15	50.0
20-30	09	30.0
31-40	03	10.0
> 40	03	10.0
Total	**30**	**100.0**
Mean±SD	**30.9±4.8**	

Table-2: Gender distribution (n=30)

Gender	No. of cases	Percentage
Male	20	66.7
Female	10	33.3
Total	**30**	**100.0**

Table-3: Comparison of histological versus radiological diagnosis of bone tumors.

Radiological findings	Histological findings (Gold Standard)		Total
	Malignant	Benign	
Malignant	10 (TP)	0 (FP)	10
Benign	02 (FN)	18 (TN)	20
Total	**12**	**18**	**30**

Key: TP=true positive, FP=false positive, FN=false negative, TN=true negative

Table-4: Sensitivity, specificity, diagnostic accuracy, PPV, NPV of radiological diagnosis.

Sensitivity	83.3%
Specificity	100.0%
Diagnostic accuracy	93.3%
Positive predictive value	100.0%
Negative predictive value	90.0

DISCUSSION

Bone tumors include primary tumors and metastatic tumors. The primary tumors can be further divided as benign and malignant tumors. The imaging evaluation of bone tumors is critical because it helps to distinguish malignant from benign lesions and guides the follow up, subsequent evaluation and therapy of the patient. In the past two decades, survival and quality of life of the patients with bone tumors has dramatically improved as a result of multimodality treatment approach.

In our setup all the patients with bone pains/swelling are first evaluated with plain film examination, for diagnosis, short listing of differential diagnosis or indicating the degree of aggressiveness of the lesion. More detailed information about the lesion is obtained using MRI, CT scan where needed. Our study is focused on the role of radiology using plain radiographs in diagnosing the bone tumors. Our study was compared with similar studies conducted in Pakistan and abroad. The peak age incidence in our study is between 10 and 20 years i.e; adolescence and young adults which is comparable with the study of van den Berg et al.[8] which showed peak incidence of bone tumors at the age of 13 to 15 years in 142 case in 100,00,00 population.

The common tumors which were found in our study in the age group of adolescence and young adults were osteosarcoma and Ewings sarcoma which are comparable with the study of Bielack et al.[9], which showed osteosarcoma and members of Ewings sarcomas family of tumors as typical malignancies of adolescence and young adults.Weber et al.[7] also showed that most common primary malignant tumors occurring in childhood are osteosarcoma and Ewings sarcoma.

Regarding gender our study revealed more male 66.7% patients with bone tumors than females 33.3%, this study is comparable with the study of van den Berg et al.[9] which also showed higher incidence of tumors in males than in females in the children.

As far as symptoms and signs are concerned 40% of the patients presented with fever and weight loss. Progressive bone/joint swelling and bone tenderness remained the most common clinical signs seen in 99% of the patients, these are comparable with the Weber et al.[7] which also showed pain and bone swelling as primary complaints.

Regarding the spectrum of bone tumors the most common benign tumor was benign Giant cell tumor n=6 , followed by osteochondroma n=4, and chondroblastoma n=3, comparable with the study of Settakorn et al.[10] where most common benign tumors were Giant cell tumor, osteochondroma and chondromas. Among the malignant tumors osteosarcoma and Ewing's sarcoma remained the common malignancies in young adults comparable with study by Settakorn et al.[10] (Spectrum of bone tumors in Chiang Mai University Hospital, Thailand according to WHO classification 2002) which showed the frequent non-hemolytic malignancy in the Thailand population being osteosarcoma 68%, chondrosarcoma 12% and Ewings sarcoma 4%.

In our study serum alkaline phosphatase was normal in 16 and was raised in 14 patients i.e; 8 out of 12 malignant and 5 out of 18 benign tumors reveal raised serum alkaline phosphatase levels.This is comparable with the study carried out by Wang et al.[11] and Study of Liu et al.[12] which showed that the alkaline phosphatase levels in the patients with osteosarcoma were significantly higher both in teenage and adult groups and also concluded that higher alkaline phosphatase levels are valuable for the diagnosis of osteosarcoma.

When radiological diagnosis were compared with the histological findings, radiology, diagnosed 10 tumors as malignant including (9 primary bone tumors and 1 metastatic carcinoma) and 18 cases as benign, correctly,whereas,2 cases of malignancy were misdiagnosed as benign radiologically.

Regarding radiological diagnosis of bone tumors by plain x-rays in current study, the sensitivity, specificity, positive predictive value and negative predictive value in diagnosing bone tumors in our sturdy were 83.3%, 100%, 100% and 93.3% respectively, comparable with the study of Baweja et al.[13], where, the sensitivity, specificity, positive predictive value and negative predictive value of plain x-rays in detecting cortical break were 61.5%, 100%, 100% and 50% respectively.

The data of our study is also comparable with Lee et al.[14] where quantitative analysis of the plain radiographic appearance in the diagnosis of bone tumors reveal the sensitivity of 80% and specificity of 93%.

CONCLUSION

Histopathology appears slightly more accurate compared to radiology in typing, grading and staging of the bone tumors and remains the gold

standard in the proper diagnosis of bone tumors.

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