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Original Research Article

Study of Cytological, Radiological and Histopathological Correlation in Bone Tumours: A Prospective Study from a Tertiary Care Centre

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Abstract

Introduction: Though bone tumors are not very common, an accurate diagnosis is required. Various investigational methods like cytology, histopathology, fine needle aspiration cytology (FNAC), and radiology are employed.

Aim and Objective: To study cytological, histopathological, and radiological correlations in patients with bone tumours.

Material and Methods: This prospective observational study was carried out on 52 patients with bone tumours who were referred to the Pathology Department of the NSCB medical college for diagnosis from 2018 to 2019. All specimens had been examined by plain radiography, FNAC, biopsy, and if required, computed tomography (CT) and magnetic resonance imaging (MRI) with suspected primary bone tumours. The data was collected in a specially designed proforma for the study. It was transformed into a master chart and then subjected to statistical analysis.

Results: The concordance rate of histology and cytology was 82.69% (43 out of 52 cases). The discordance rate of histology and cytology was 17.3% (9 out of 52 cases). The sensitivity and specificity of cytology was 92.3% and 73.1% respectively. False positive rate of radiology in the bone tumour was 29.03%. Diagnostic accuracy of radiology in bone tumours was 75%, and concordance with histopathology was 75%. The discordance with histopathology was 25%.

Conclusion: Findings showed a good correlation between cytological, histopathological, and radiological techniques in patients with bone tumours.

Keywords: bone tumours, cytology, histopathology, radiology, diagnostic methods

Introduction

Bone tumors are the abnormal growth of the tissues resembling bone and ultimately form a tissue mass-like structure. The primary classification of bone tumors encompasses malignant or benign and primary or metastatic. [1] Many of the

bone tumors are asymptomatic and present as incidental findings, making it difficult to estimate the actual incidence of each bone tumor. Mainly if the tumor occurs to be of benign type, even histopathologic workup is not requested for some time, making it even more difficult to deduce the actual incidence of the same. [2, 3] Bone tumors, which are of primary malignant variety, are not very common and comprise 0.2% of total human cancers. [4] However, they contribute to the overall morbidity and mortality in children and adults. [1, 2]

The diagnostic workup of a solitary bone tumor consists of multiple stages like clinical history, tumor localization, radiological investigations of the morphology of the tumor, bone particulates, and histopathological and histocytological examination. [5-8] In recent times, computed tomographic scans, as well as magnetic resonance imaging, equips the doctors with enough resource to study various aspects of the bone tumor-like better determination of bone matrix, mineralisation, various differential diagnosis as well as the spread and the dimensions of the tumor. [5,6,9] Bone scintigraphy has made it easier to investigate the biological reactivity of the tumor. The positron emission tomography (PET) helps detect and analyze the tumor tissue's local metabolic activity, but its widespread availability is limited. [8]

The study of the bone tumor via bone biopsy using image-guided needle aspiration or excisional biopsy is not the primary investigation for the condition. Still, it is invariably performed on almost every patient. However, it is considered to be the gold standard investigation for the diagnosis of bone tumors. [1,5,8,10]

It is always desired to reach the exact and accurate diagnosis in case of a bone lesion to avoid the non-detection of the same or prevent the over-treatment and ultimately provide the best available management for the condition. Though histo and cytological investigations of a tumor and its radiology have played an immense role in the diagnostic workup of any tumor, individually, they carry some flaws in the definitive diagnosis of bone lesions. Therefore, the present study aimed to study cytological, histopathological, and radiological correlations in bone tumours.

Material and methods

This prospective observational study was carried out on 52 patients with bone tumours who were referred to the Pathology Department of the NSCB medical college for diagnosis from 2018 to 2019.

Patients

All patients with clinical and radiological suspicion of primary and secondary tumours and tumour-like lesions of bone that require biopsy or surgical excision were included. Patients with infective, inflammatory, metabolic, and suspected local recurrence of primary or metastatic bone lesions were excluded from the study.

Method of collection

Specimen fixed in 10% formalin are collected from the orthopedic department along with relevant clinical data; the bony specimen were decalcified and proceeded to the pathology department. Sections were cut at 4-5 microns using a microtome and stained with hematoxylin and eosin. Fine needle aspiration of the bone tumour was performed at the bedside in the orthopedics department, and the specimen was fixed in absolute alcohol. All had been examined by plain radiography, Fine needle aspiration, biopsy, and, if required, computed tomography (CT) and magnetic resonance imaging (MRI) with suspected primary bone tumours. The data was collected in a specially designed proforma for the study. It was transformed into a master chart and then subjected to statistical analysis.

Results

The clinical diagnosis was compared with cytological diagnosis, radiological diagnosis, and histopathological diagnosis in all the samples (Table 1)

Table 1: Incidence of Bone Tumours

Bone Tumours type	Biopsy		Clinical		Cytology	
	Females	Males	Females	Males	Females	Males
Benign	16 (51.60)	10 (47.60)	18 (34.60)	12 (23)	13 (25)	8 (15)
Malignant	15 (48.40)	11 (52.40)	12 (23.07)	9 (17.3)	18 (34.60)	13 (25)
Total	31	21	30	21	31	21

Data is presented as the number of patients (percentage)

Table 2: Cytology and histopathology correlation in bone tumours

Histopathology	Cytology		Total
	Malignant	Benign	
Malignant	24	2	26
Benign	7	19	26
Total	31	21	52

Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of cytology with respect to radiological assessment was 92.3% (95% CI=74.9-99.1), 73.1% (95% CI=52.2-88.4), 77.4% (95% CI=59.9-90.4), and 90.5% (95% CI=69.6-98.8) respectively. Area under the curve (AUC) was 0.830 (95% CI=0.73-0.93) (Table 2).

Table 3: Radiological correlation with histopathology radiology

Histopathology	Malignant	Benign	Total
Malignant	22	4	26
Benign	9	17	26
Total	31	21	52

On analysing the correlation of radiological and histopathology assessment (Table 3) sensitivity, specificity, PPV and NPV of radiology with respect to histopathological assessment was 84.6% (95% CI=65.1-95.6), 65.1% (95% CI= 44.3-82.8), 71.0% (95% CI= 52.0-85.8) and 81% (95% CI=58.1-94.6) respectively. AUC was 0.750 (95% CI=0.63-0.87).

Table 4: Clinical and histopathology correlation in bone tumours

Histopathology	Clinical		Total
	Malignant	Benign	
Malignant	19	7	26
Benign	3	23	26
Total	22	30	52

On analysing the correlation of clinical and histopathology (table 4) sensitivity, specificity, PPV and NPV of clinical with respect to histopathological assessment was 73.1% (95% CI=52.2-88.4), 88.5% (95% CI=69.8-97.6), 86.4% (95% CI=65.1-97.1) and 76.7% (95% CI=57.7-90.1) respectively. AUC was 0.080 (95% CI=0.90-0.91).

Table 5: Cytological and radiological correlation in bone tumours

Histopathology	Radiology		Total
	Malignant	Benign	
Malignant	22	9	31
Benign	9	12	21
Total	31	21	52

On analysing the correlation of cytological and radiological assessment (Table 5) sensitivity, specificity, PPV and NPV of cytological with respect to radiological assessment was71.0% (95% CI=52.0-85.8), 57.1% (95% CI= 34.0 -78.2), 71.0% (95% CI=52.0-85.8) and 57.1% (95% CI=34.0-78.2) respectively. AUC was 0.040 (95% CI=0.51-0.71).

Present study suggests that a simple approach based on conventional radiography and fine needle aspiration cytology is reliable in discriminating between benign and malignant bone lesions. In our hospital, all patients with bone lesions undergo both radiological and cytological along with histological assessments. The simplicity of the approach leads to a liberal indication of biopsy, which increases the overall diagnostic accuracy compared to radiology alone.

In present study, the most common benign bone tumour was GCT, and the most common malignant bone tumour was osteosarcoma. The maximum sensitivity of fine needle aspiration cytology was 92.3%, and the highest diagnostic accuracy of fine needle aspiration cytology was 82.69%. The diagnostic accuracy of radiology was 75%.

Discussion

The diagnosis of bone tumour is always made by integrating the histocytological feature with clinio-radiological pictures. Present study result indicates that FNA cytological study guided by clinical and radiological features can be a valuable tool in diagnosing and categorizing primary and metastatic bone tumors.

In a study conducted by Merce Jorda and Luis Ray in 308 cases over a period of 11 years, the sensitivity and specificity for the diagnosis of malignancy were 92% and 99%; the sensitivity of present study was 92.3%, specificity was 73.1%, which is in line with Merce Jorda and Luis Ray. [11]

In the study conducted by Soderlund et al. in 370 cases, the diagnostic accuracy of radiology was 70%, which is similar to the diagnostic accuracy of 75%. [12] Similarly, Sherwani R et al. observed that the diagnostic accuracy of FNAC was 90.7%, and the maximum number of benign cases was GCT, which is similar to present study. [13] Nnodu et al. reported that the accuracy of specific cytological diagnosis was 36/41(87.8%) and was incorrect in 5/41 (12.2%), which is consistent with present study-concordance between cytology and histology was 43/52 cases (82.69%) and discordance was in 9 /52 cases (17.31%). [14]

In a study conducted on 122 cases of the bone tumour by Wahane et al., the diagnostic accuracy of FNAC was 90.5%, similar to present study where diagnostic accuracy was 82.69%. [15] In a study carried out by Kujur et al. (2016), the overall sensitivity was 96.66%, the specificity was 95.23%, the positive predictive value was 97.75%, and present study was consistent with this study with a sensitivity of 92.3%, specificity of 73.1% and PPV 77.4%. [16]

All failures were due to insufficient cytological material. Efforts should be made to improve the technique of obtaining adequate material. The needle can be guided in different directions. Cortical bone has been penetrated, and the

device can easily be inserted at different sites in cortical bone without causing significant discomfort to the patient. This is important since it is well known that a bone tumour can vary considerably histologically, and tissue must be obtained from different areas of the same lesion.

For most bone tumours, however, the distinction between benign and malignant bone tumours, lymphomas, myelomas, and metastatic lesions is sufficient for correct management. As regards treatment, it is very important to establish the correct histogenic tumour type and grade for conditions that require pre-operative chemotherapy, such as osteosarcoma and Ewings sarcoma. As regards primary malignant bone tumours, our results imply that the most significant diagnostic difficulties are found with chondrosarcoma and periosteal osteosarcoma.

In a cytological study of 14 cases of Ewings sarcoma, Akerman and Angervell concluded that the smear has a characteristic appearance and that FNAC can be used for primary diagnosis and chromosomal analysis to reveal the typical 11:22 translocation of Ewings sarcoma. [17] Osteosarcoma seems to be more cytodiagnostic difficulties than Ewings sarcoma but less so than chondrosarcoma.

In the future, efforts should be focused on an improved biopsy technique to obtain a higher rate of conclusive cytological material. This can be done by an improved instrument design to facilitate multiple aspirates through cortical bone and wider application of CT. [18]

Improved diagnostic accuracy can be attained by using complementary methods such as electron microscopy and immunohistochemistry. Objective methods such as DNA cytometry, proliferative rate assessments, karyotyping, and molecular genetics may also be of value. Combined with clinical experience, these methods should reduce the need for open biopsy of bone tumours.

Conclusion

Even though histopathology has the highest accuracy compared to other modalities in the definite diagnosis of bone tumour, fine needle aspiration cytology has its place. It is important as a screening tool in pre-operative cases. It has significantly reduced the requirement of more challenging techniques, such as frozen sections. Fine needle aspiration cytology, though it has less accuracy and a high false positivity rate (82.6%, 17.3%) respectively, is a simple, patients, effective, less costly with less no. of complications is a still very strong modality of screening and guiding towards the diagnosis of bone tumours.

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