Original Article

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Utility of FNAC in the Diagnosis of Bone Tumors

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Abstract

Background and Objectives: Fine needle aspiration cytology (FNAC) is an accurate, cost effective and safe technique for diagnosing neoplastic lesions of the bone. Objective of the study is to know the utility of fine needle aspiration cytology in the diagnosis of bone tumors and assess the diagnostic accuracy of this technique. *Materials and Methods*: FNA of bone was performed in 30cases. Smears prepared were fixed in 95% ethyl alcohol and stained by Hematoxylin and Eosin. 9 smears were considered unsatisifactory as they contained acellular hemorrhagic aspirates. The remaining 21 smears were classified as malignant lesion(12) and benign lesions (9). 15 out of the 21 cases were subjected to histopathological examination. *Results*:The malignant tumors were giant cell tumor (6), osteogenic sarcoma (1), chondrosarcoma (2) and adamantinoma(1), fibrosarcoma (1) and metastasis (1). The benign tumors were osteochondroma (6), osteoblastoma (2) and enchondroma (1). Histological correlation was obtained in 14 cases of the 15 cases operated and the diagnostic accuracy was 93.3% in this study. A case of chondroblasticosteogenic sarcoma that was reported as chondrosarcoma was the only diagnostic error in the study. *Conclusion*: Fine needle aspiration of bone is a simple reliable and accurate diagnostic technique that can facilitate patient management and preoperative decision making patient decision making and avoid unnecessary invasive procedures for patients with primary or metastatic bone lesions.

Keywords: Fine Needle Aspiration; Bone Tumors; Osteosarcoma; Adamantinoma.

Introduction

Fine needle aspiration cytology(FNAC) is an increasingly accepted important procedure in the diagnosis of bone tumors. Bone tumors are those conditions of the skeletal system that are neoplastic or could be mistaken for a neoplastic condition on the basis of radiological or pathological evidence [1]. The technique of needle aspiration biopsy was first applied to bone tumors by Coley, Sharp and Ellis in 1931 [2]. Later Martin and Ellis made a more exhaustive study of the use of aspiration biopsy when 1400 tumors of all types including 140 bone lesions were aspirated [3]. Since then several published series have yielded overall accuracy values ranging from 51% to 100% [2]. High percentages of unsatisifactory smears have been reported. The high diagnostic yield of FNAC of bone for the diagnosis of bone tumors has been stressed in several of these reports [4]. In recent years development of new orthopedic surgical techniques such as salvage limb procedures and neoadjuvant chemotherapy to treat bone neoplasm has enhanced the role of FNAC in the management of these lesions [4]. The aim of the study is to determine the role of FNAC in the diagnosis of bonetumors , its utility in the preoperative management and its important therapeutic decisions.

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Material and Methods

A group of 30 cases of bone tumors were studied by FNAC preoperatively for a period of 2 years from

January 2015 to December 2016. The study included 18 male patients and 12 female patients whose ages were from 15 to 75years. Most of the patients were in the second and third decade of life. The cases were selected on the basis of theclinical (Bone swelling, pain, pathological fracture) or radiological recognition as bone tumor. The exact site of aspiration and the depth of swelling were first determined by carefull studying anteroposterior and lateral views of radiographs. Aspiration were carried out with 20ml syringe to which a 22-24 guage disposable needle was attached. FNAC was carried out according to standard procedure described in textbooks. Radiological guidance was used whenever required. After preparing smears from the material obtained they were immediately wet fixed in 95% ethanol for Hematoxylin and Eosin staining. Material for histologic study was obtained wherever possible for cytohistologic correlation.

Results

FNAC of bone from 30 patients were performed. Smears from 9 cases were acellular or consisted of blood or rare fibroblasts and therefore were considered unsatisifactory for diagnosis. Adequate material were obtained in 21 cases(70%) of cases. In this study the bones around the knee joint were most frequently affected (42.8%), the lower end of the femur was affected in 20% and upper end of the tibia in 22.8%. Detailed diagnosis

Serial number	Cytodiagnosis	Number of cases	Age range	Sex Male: Female ratio	Sites involved
A	Malignant bone tumors	12			
1	Giant cell tumor	6	16-64yrs	2:1	Radius, head of fibula, femur, clavicle, tibia, tibia
2	Chondrosarcoma	2	26yrs, 70yrs	1:1	Scapula, rib
3	Osteosarcoma	1	18yrs	Male	Femur
4	Adamantinoma	1	36yrs	Male	Tibia
5	Fibrosarcoma	1	50yrs	Female	Tibia
6	Secondaries	1	75yrs	Male	Clavicle
B	Benign bone tumors	9			
1	Osteochondroma	6	20-25yrs	2:1	Humerus, Scapula, Tibialcondyl, tibia, humerus, femur
2	Enchondroma	1	18yrs	F	Thumb
3	Osteoblastoma	2	23yrs	M	Iliac crest, femur
C	Inadequate aspirate	9			
Total		30			

was given only after completely study and correlation of the clinical, radiological and cytological features.

Malignant Bone Tumors

In the present study 12 cases (57.1%) of malignant bone tumors were reported cytologically.

Giant cell tumor was the most common tumor accounting for 50% of the cases. The smears were cellular showing a dual cell pattern of mononuclear stromal cells and multinucleated osteoclastic giant cells (Figure 1). The stromal cells were seen in cohesive clusters and as dispersed cells. They were oval to spindle showing dense amphophilic cytoplasm and ovoid centric or eccentric nuclei. Osteoclastic giant cells were scattered through out the smears but were more often found to be attached to the periphery of stromal cell clusters. They were 50-100micrometer in diameter, irregular in shape and contained 20-50 nuclei having small nucleoli, strands of collagen, endothelial cells were also observed.

Chondrosarcoma comprised 2 cases amounting for 16.6%. One case occurred in a 26 yr old male patient with multiple exostosis. Chondrosarcoma yielded gelatinous material on aspiration, smears showed a background rich in chondromyxoid matrix, chondroid tissue fragments and disscociated round to polygonal cells were observed. These cells were either in loose aggregates and small sheets or were seen as dissociated single cells. The cells had a variable amount of dense often vacuolated cytoplasm, binucleate and multinucleate cells were frequent. The nuclei showed hyperchromasia, granular chromatin and pleomorphism. Mitotic figures were observed (Figure 3).

Osteosarcomawas reported in one case accounting for 8.3%. The smears show low cellularity, cells were dispersed singly as well as in small groups. Markedly anaplastic round cells had moderate cytoplasm, large pleomorphic hyperchromatic nuclei with coarsely stippled chromatin network. Mononucleate bizarre tumor giant cells were seen. Osteoid was noted in

the background in between the cells and in clusters (Figure 2) .

Fibrosarcomawas reported in one case accounting for 8.3%. Smears were cellular showed small tissue fragments and single cells consisting of pleomorphic spindle cells in a myxoid background. These cells had indistinct cytoplasm, variable cytoplasmic projections, large irregular elongated nuclei with coarse granular chromatin. Bizarre cells, infrequent mitotic figures were observed (Figure 4). Adamantinoma was reported in one case accounting for 8.3% . Smears were paucicellular showing tiny nests of basaloid cells with peripheral palisading (Figure 5). Metastatic malignancy was seen in one case and clavicle was the site. It is reported in 75yr old male. Smears showed cell clusters, acinar or glandular structures suggestive of adenocarcinoma (Figure 9).

Benign Bone Tumors

Six cases(of osteochondroma were reported. The cytology showed admixed mature osteoid and chondroid fragments with one case shows hematopoietic marrow elements (Figure 6, Figure 10).

Two cases of osteoblastoma were reported in the present study. The smears showed osteoblast like cells singly or in groups. The osteoblast like cells had eccentric nuclei and a perinuclear cytoplasmic Hoff. Occasional multinucleated cells were seen (Figure 7). Enchondroma was seen in one case (8.3%) and the site is proximal phalanx of right thumb (Figure 8). The smears showed cartilaginous tissue fragments composed of abundant chondromyxoid ground substance and benign chondrocytes in lacunae.

Table 2: Cytohistological correlation

Bone Tumors	Number of cases	Confirmed on Histology	Not confirmed on Histology	Diagnostic accuracy
Giant cell tumor	5	5	0	100%
Chondrosarcoma	2	1	1	50%
Osteosarcoma	1	1	0	100%
Adamantinoma	1	1	0	100%
Fibrosarcoma	1	1	0	100%
Osteochondroma	4	4	0	100%
Enchondroma	1	1	0	100%

Diagnostic Accuracy

In 15 cases (71.4%) correlation was available by way of histology(Table 2), cytological diagnosis was confirmed in 14cases giving a diagnostic accuracy of 93.3%. The only diagnostic error in the study was chondrosarcoma that was reported as chondroblastic osteosarcoma.

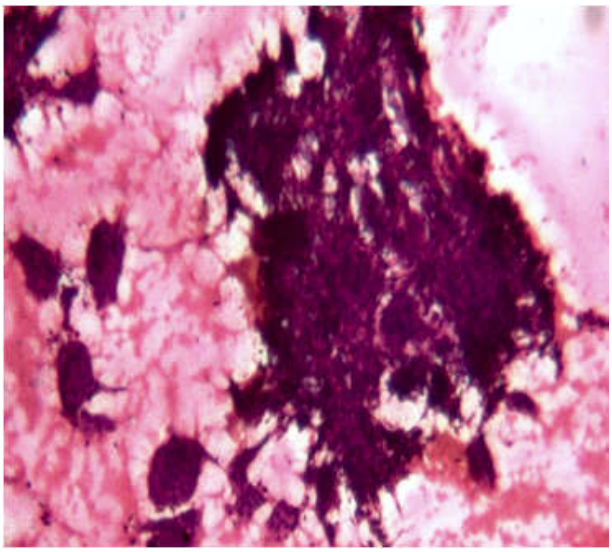

Fig. 1: Giant cell tumor showing stromal cell fragment with peripheral numerous giant cells

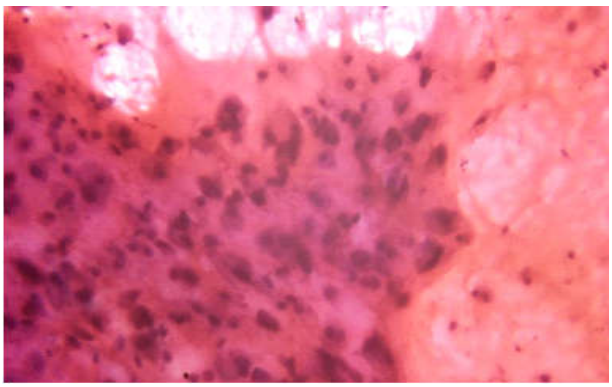

Fig. 2: Osteosarcoma showing pleomorphic spindle cells in the background of osteoid material

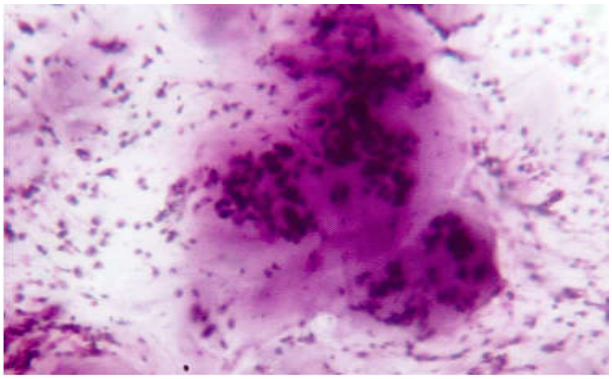

Fig. 3: Chondrosarcoma showing hpercellularity, cells show hyperchromatic nuclei in the background of chondroid material

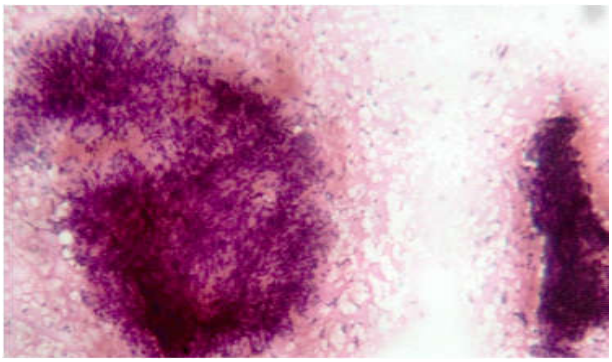

Fig. 4: Fibrosarcoma showing spindle cell tissue fragment in the backround of fibromyxoidstroma. Spindle cells show pleomorphic, hyperchromatic nuclei

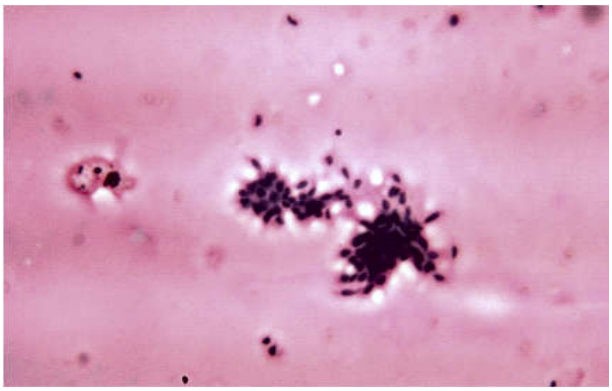

Fig. 5: Adamantinoma showing basaloid cells arranged in stellate pattern

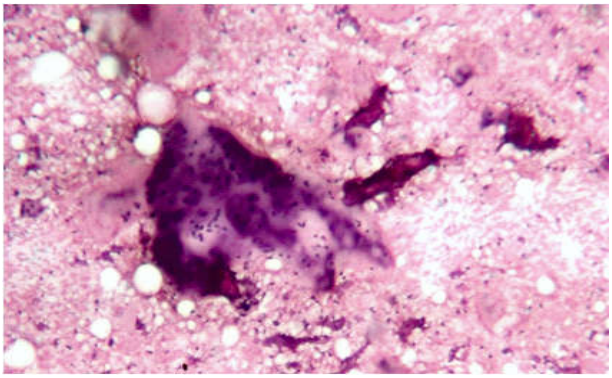

Fig. 6: Osteochondroma showing mature hyaline cartilage with osteoid

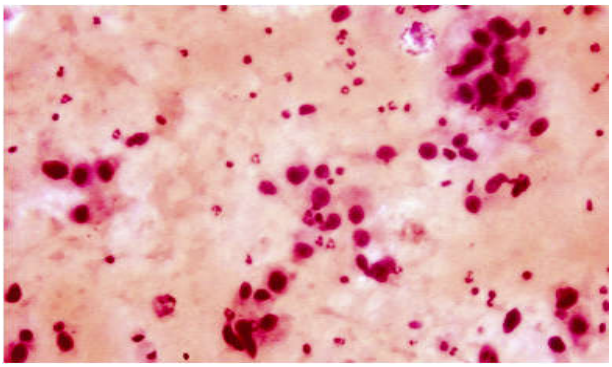

Fig. 7: Osteoblastoma showing osteoblasts with eccentric placed nucleus and perinuclear Hoff

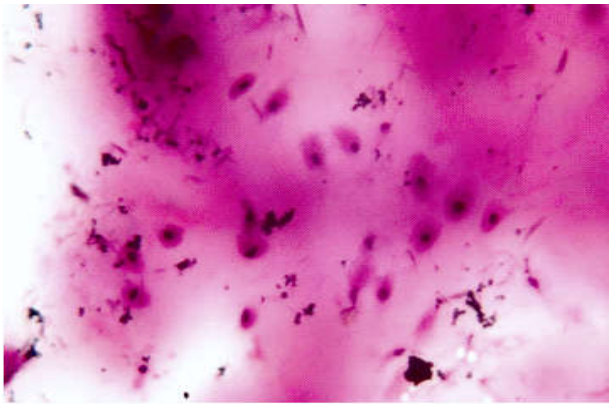

Fig. 8: Enchondroma showing benign chondrocytes in the background of chondroid material

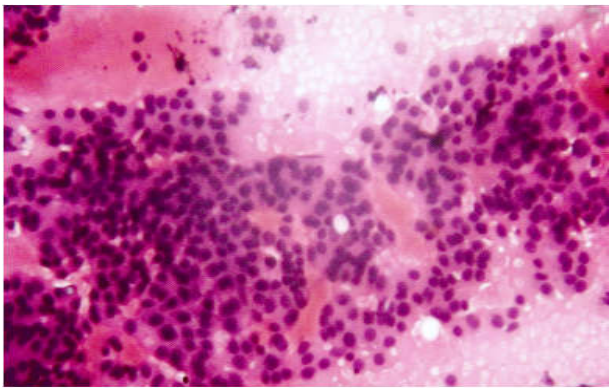

Fig. 9: Metastatic adenocarcinoma of clavicle showing malignant cells with follicular arrangement and in sheets

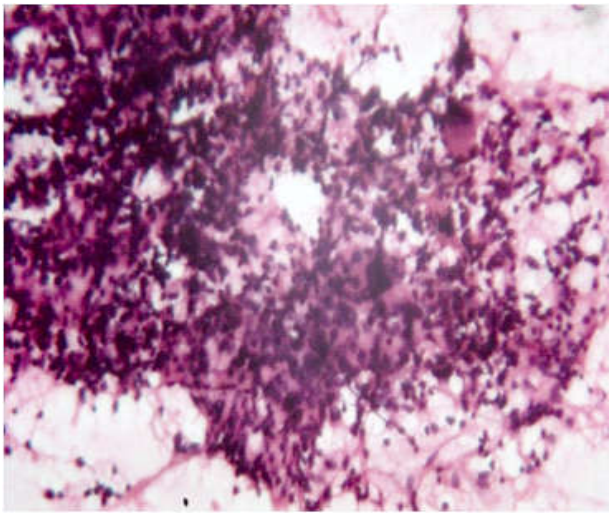

Fig. 10: Normal bone marrow cells with megakaryocyte in case of osteochondroma

Discussion

FNAC plays an important role in the diagnosis of bone tumors because of its high accuracy. An accuracy rate 93.3% was achieved in this series but rates as high as 95% have been described [5,6,7]. FNAC is a

simple and economical technique that can be performed as an outpatient procedure, reducing patient hospitalization and lowering the over all cost of patient care [8]. Complications are few and multiple specimens can be obtained without increasing morbidity [8]. Treatment with radiation and chemotherapy can be initiated without any delay. In addition using FNAC as the diagnostic method the possibilities for salvage of a limb improve because there is less disruption of soft tissue and less distortion of the affected bone [8].

The most frequent malignant lesion was giant cell tumor correctly diagnosed in 83% of our. The most helpful cytologic feature was the attachment of osteoclasts to a cohesive group of mononuclear tumor cells [9,10]. It should be emphasized that the presence of rare giant cells in a bone aspirate should not imply a diagnosis of giant cell tumor. Aneurysmal bone cyst, giant cell reparative granuloma, chondroblastoma and metaphyseal fibrous defect may also demonstrate giant cells in the aspirate. They have however distinct clinical and radiological features. On the other hand Brown tumor of hyperthyroidism is cytologically and histologically indistinguishable from other bone lesions displaying osteoclasts. Clinical and laboratory evidence of hyperthyroidism is required in order to establish this diagnosis.

Cytologicatypia seen in a chondroidlesiom along with clinical and radiological information allowed the diagnosis of a malignant chondroid neoplasm 50% of cases. Differential diagnosis between low grade chondrosarcoma, an enchondroma is not possible on the basis of cytology alone particularly in certain peripheral bone lesions in which benign chondroma tends to show nuclear atypia and pleomorphism [11]. Chondroma in general could be distinguished from low grade chondrosarcoma, low grade chondrosarcoma showed cellular chondroid fragments having pale opaque stroma frequently observed binucleation and multiple cells per lacunae and bland nuclear chromatin. High grade chondrosarcoma could be distinguished from low grade by its charctersticcytomorphology as described in the literature [11].

Snyder et al [4] reported that osteosarcoma was the most frequently primary malignant tumor aspirated. In our study a definitive diagnosis was made in 50% of the cases. In other studies a diagnostic accuracy of less than 50% was observed [4]. On review inadequate and hypocellular samples were considered to be the cause of lower sensitivity in the diagnosis.

For osteogenic sarcoma demonstration of osteoid material was crucial for diagnosis White et al [12] in their series of 56 osteosarcomas established that osteoid like material can be seen in cytologic preparations. Other authors however have questioned the possibility of identifying osteoid in cytologic smears [10]. Ayala et al [13] stated that osteoid is not necessary for the diagnosis of osteosarcoma in cytology material. In the absence of osteoid a diagnosis of pleomorphic sarcoma suspicious for osteogenic sarcoma was given provided and radiology supported the diagnosis [10]. Variants of osteosarcoma such as pleomorphic, epithelioid, small cell, chondroblastic, sclerotic were described [12].

It was difficult to distinguish chondroblastic variant of osteosarcoma from high grade chondrosarcoma in this study, because of the unusual site uncommon (rib) presentation (10years) and cytomorphologic feature resembling chondrosarcoma were probably the factors that led to wrong diagnoses as chondrosarcoma.

Such distinctions between the two may be possible if one searches for malignant osteoblasts apart from pleomorphic chondrocytes which are easily distinguished from the latter by lack of cytoplasmic granules. Abundant mitotic figures are found.

One case of metastatic deposits in the clavicle was reported in the present study. The primary origin of the tumor could not be categorized. Other studies have mentioned the cytologic categorization of these lesions to correctly point out the primary with variable accuracy [14,15]. An appropriate diagnosis of a metastatic lesion by FNAC facilates either nonoperative management or contempory surgical techniques.

One case of fibrosarcoma of tibia in 50yr old female was encountered in the present study. Microscopically this tumor is similar to its soft tissue counterpart. By definition it should not contain any area of tumor osteoid. Extremely well differentiated fibrosarcoma may be misdiagnosed as benign lesions of fibrous tissue but the radiolographic appearance usually suggests their malignant nature. Microscopiccaly the presence of cellular areas, mitotic figures and hyperchromasias are all features that favor a diagnosis of fibrosarcoma [16]. One case of adamantinoma of the tibia was reported in the present study. Cytologically the tumor consists of solid nests of basaloid cells with palisading at periphery and a stellate configuration in the canter.

Two cases of osteoblastoma were reported in the present study. The differential diagnosis between osteoblastoma and osteosarcoma is difficult because the later may be well differentiated and the former is accompanied by the presence of scattered bizarre

tumor cells of a degenerative nature [17].

Osteochondroma is the most frequent benign tumor. Cytologicallyit composed of a mixture of cells resembling hyaline cartilage, mature osteoid and hematopoietic bone marrow. The tumor sometimes regress spontaneously but the importance of studying this tumor lies in the fact that a very small proportion of solitary tumor evolve into chondrosarcomas but the incidence reaches 10% in cases with multiple lesion. One case of chondrosarcoma was reported in a 26 year old male with multiple exostosis in the present study. Utility of FNAC as a diagnostic tool can be measured. By the fact that therapeutic decision is a major fraction of patients in study by Wahane et al were made solely on the basis of FNAC without any need for confirmation by histopatholgy [18].

Conclusion

FNAC is reliable, accurate and useful method in the diagnosis of bone tumors. When correlated with the clinical and radiological data because of its ease of use, rapidity, accuracy and helpful in making therapeutic decisions.

Ethical Clearance

Obtained from ethical committee VIMS Ballari.

Source of Funding

Self

Conflict of Interest

NIL

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