International Journal of Biomedical and Advance Research
ISSN: 2229-3809 (Online); 2455-0558 (Print)
Journal DOI: https://doi.org/10.7439/ijbar
CODEN: IJBABN **Original Research Article**

Fine Needle Aspiration Cytology as a diagnostic technique in bone tumors and tumor-like lesions

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Abstract

Background: Fine needle aspiration is routinely used as a highly effective technique in various lesions. The present study was carried out to evaluate the role of FNAC in diagnosing primary bone tumors and tumor-like lesions so as to overcome the disadvantage associated with surgical biopsy, though surgical biopsy being the procedure of choice.
Method: This study was conducted in 57 cases of bone tumor and tumor-like lesions over a period of 18 months by various methods like Conventional FNAC; Radiology (CT, 'C' arm, USG) guided FNAC, Double Bore FNAC in medullary bone lesions with intact cortex as and when required, followed by staining of obtained smear with PAP and MGG stain. The cytological diagnosis of cases was then correlated with available histopathological diagnosis.
Results: Among 57 cases, the histopathology samples were available in 45 cases and in only those cases cyto-histopathological correlation was made possible. The overall sensitivity and specificity of FNAC in diagnosing primary bone tumors and tumor-like lesions were found out to be 89.7% and 83.3% respectively with the diagnostic accuracy (effectiveness) of 88.8%.
Conclusion: FNAC plays a vital role in diagnosing bone tumors and tumor-like lesions and also helps the surgeons to plan the extent and type of surgery based on the cytological diagnosis. With the use of C-arm guided FNAC and double bore FNAC technique in intramedullary bone lesions with the intact cortex, the rate of the inadequacy of cytology smear can be reduced, as in the present study.
Keywords: FNAC, Lesions, Tumor, Biopsy, Radiology, Smear Cytology, Histopathology, Sensitivity, Specificity.

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***Article History:**
Received: 08/05/2019
Revised: 10/06/2019
Accepted: 12/06/2019
DOI: https://doi.org/10.7439/ijbar.v10i6.5204

QR Code

How to cite: Dhamal S.R, Soni R.R, Deshmukh A.T, Ganesh N. Pundkar G.N. Fine Needle Aspiration Cytology as a diagnostic technique in bone tumors and tumor-like lesions. *International Journal of Biomedical and Advance Research* 2019; 10(6): e5204. Doi: 10.7439/ijbar.v10i6.5204 Available from: https://ssjournals.com/index.php/ijbar/article/view/5204

1. Introduction

Primary bone tumors, both benign and malignant, are uncommon. Among which primary malignant bone tumors are even more uncommon, constituting only 0.2% of all neoplasms and the incidence of 0.8 in 100,000 people per year [1-2]. Tumor-like lesions of bone are the lesions having the appearance of a neoplasm and clinical behaviour of non-neoplastic lesions. Their significance lies in the fact that they are very common, and their radiological appearance mimics true bone tumors including malignant lesions [3].

Open surgical biopsy is considered as the procedure of choice for obtaining diagnostic tissue sampling of bone tumors [4]. However, considering not only an inpatient procedure and cost, other disadvantages of this

procedure include disruption of compartments, contamination of surrounding tissues, risk of infection, hematoma and pathological fracture [5].

Aspiration cytology has proven in recent years to be a very convenient and reliable method for the rapid diagnosis of bone lesions [6]. In developing countries like India, where high-resolution bone scanning and CT-guided biopsy facilities are a minimal and large proportion of patients belong to rural areas, aspiration cytology provides a simple, quick and easy method of diagnosis [7]. However, for the definitive diagnosis, tissue study i.e. histopathological evaluation of biopsy specimen is important [8].

2. Materials and Methods

The present observational study was conducted in 57 patients (29 male, 28 female) of bone tumor and tumor-like lesions from OPD and admitted to the Orthopedic ward of Dr. Panjabrao Deshmukh Memorial Medical College and research centre in Amravati over the period of 18 months. They were studied initially by fine needle aspiration cytology, followed by histopathology.

All the patients were clinically examined for symptoms, duration, onset, past illness, personal and occupational history and course of treatment. Radiologically, anteroposterior and lateral view of the affected part was obtained and the skiagram was examined for the site of the lesion, effect of the tumor on cortex and medulla, and neo-osteogenesis or periosteal lifting, infiltration to soft tissue, articular surface involvement, osteoblastic or osteolytic response, and sclerosis or osteoporosis. Ultrasonography, computerized tomography scans, or magnetic resonance imaging scan were performed whenever necessary for localizing the lesion.

After locating the ideal site for aspiration, the patient was asked to settle down to the most advantageous position to obtain the shortest and possible path of the needle and to prevent damage to the underlying structures. 18-22 gauze sized needle was selected based on the radiographic appearance of the bones involved by bone lesion [8]. The tumor was localized by careful palpation, and the puncture site was selected. The skin over the site was cleaned with surgical spirit. The study has included the following types of FNAC procedures as when needed-

1) Conventional FNAC with 18-22 G needle: The tumor mass was fixed in a favorable position with one hand, and the needle was introduced perpendicular to the cortex of the bone to be aspirated [9]. Smears obtained by FNAC was fixed in 95% ethyl alcohol for Papanicolaou staining and air-dried smears were stained by May-Grunwald-Giemsa staining.
2) Radiology (CT, 'C' arm, USG) guided FNAC.
3) Double Bore FNAC in medullary bone lesions with intact cortex: The cortex of bone was pierced by Bone Marrow Aspiration needle, then the stylet was removed and the lumbar puncture needle was inserted through the cannula; with to and fro movement the cells were loosened and then the aspiration was done through the medullary lesion for getting adequate aspirate.

All the patients in the present study tolerated the aspiration procedure very well without any complications. Re-aspiration was done whenever aspirate obtained was inadequate.

3. Observations and Results

Total 57 cases were included in the study, among them 29(50.9%) were males and 28 (49.1%) were females. A maximum number of cases were in the age group of 11-20 years (17 cases; 29.8%) followed by 31-40 years (13 cases; 22.8%). The histopathology samples were available in 45 cases among the 57 and thus in only those cases, the cyto-histopathological correlation was made possible. The inadequate smears were found in 4 cases which constitute 7% of total cases leading to inconclusive diagnosis on cytology. The rate of inadequacy was reduced with the use of C- arm guided FNAC and use of double bore FNAC technique in intramedullary bone lesions with intact cortex in 12 cases constituting 21.1% of total cases.

Most of the cases (17 cases; 29.8%) had a tumour and tumor-like lesions (12 cases; 21.1%) located in tibia followed by the femur. Among total 57 cases, primary benign bone tumors and tumor-like lesions contributed 42 cases (73.7%) followed by primary malignant bone tumors contributing 9 cases (15.8%) and at last followed by bone metastatic cases that were total 6 cases (10.5%).

Among the 35 cases of primary benign tumors and tumor-like lesions in which histopathology samples were available, in 30 cases (85.7%) cytological diagnosis showed concordance with histopathological diagnosis. The 5 disconcordant cases included 4 cases in the inconclusive/ non-diagnostic/ inadequate category, in which all the cases showed disconcordance of cytological diagnosis with histopathological diagnosis (i.e. False negative cases) and 1 case of giant cell tumor on cytology which turned out to be deep fungal infection on histopathology (i.e. False positive case). Out of 5 cases from each group of primary malignant tumors and metastasis in which histopathology samples were available, the cytological diagnosis showed concordance with histopathological diagnosis in all cases i.e. 100% (Table 1).

The overall sensitivity and specificity of FNAC in diagnosing primary bone tumors and tumor-like lesions were found out to be 89.7% and 83.3% respectively with the diagnostic accuracy (effectiveness) of 88.8%.

Table 1: Correlation of cytological diagnosis with histopathological diagnosis

Cytological diagnosis	Total cases	Histopathology		Histological diagnosis	
		Not available	Available	Concordance	Disconcordance
Total Primary Benign bone tumor and tumor-like lesions	38	7	31	30	1
Osteomyelitis	9	1	8	8	0
Villonodularsynovitis	2	1	1	1	0
Aneurysmal bone cyst	4	0	4	4	0
Fibrous dysplasia	1	0	1	1	0
Giant cell tumor	7	1	6	5	1
Osteochondroma	10	3	7	7	0
Enchondroma/ chondroma	4	1	3	3	0
Osteoblastoma	1	0	1	1	0
Non-diagnostic/ Inconclusive/ Inadequate	4	0	4	0	4
Total Primary Malignant Bone tumor	9	4	5	5	0
Solitary Plasmacytoma	2	2	0	-	-
Ewings sarcoma/ PNET	4	1	3	3	0
Chondrosarcoma	1	0	1	1	0
Osteogenic sarcoma	1	0	1	1	0
Malignant Mesenchymaltumor	1	1	0	-	-
Bone Metastasis	6	1	5	5	0

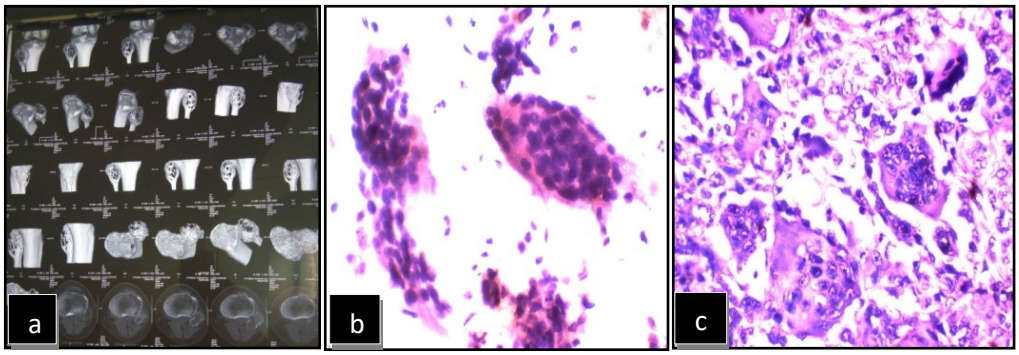

Figure 1: Giant cell tumor (a) C T image of left knee joint showing large expansile lesion at fibular head (b) cytological smear showing mixture of mononuclear cells with multinucleated giant cells (MGG stain, 40X), (c) follow-up histopathology revealing same (H&E, 40X).

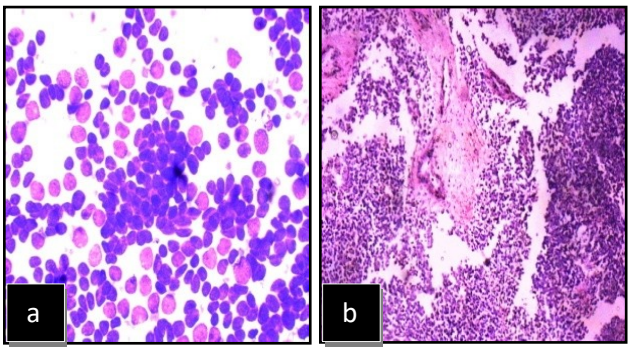

Figure 2: Ewings Sarcoma/ PNET (a) cytological smear showing plenty of small round cells with scanty cytoplasm (MGG stain, 40X), (b) follow-up histopathology revealing same (H&E, 10X).

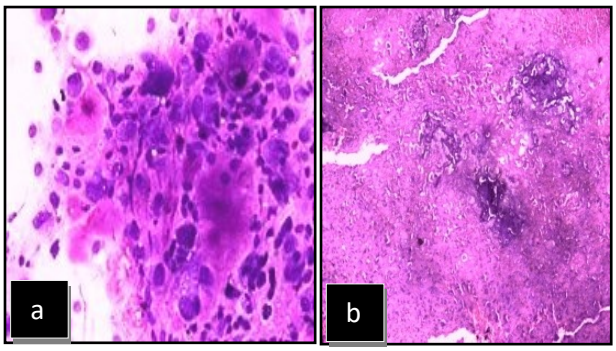

Figure 3: Osteosarcoma (a) cytological smear showing osteoid surrounded by pleomorphic tumor cells (MGG stain, 40X), (b) follow-up histopathology revealing same (H&E, 10X).

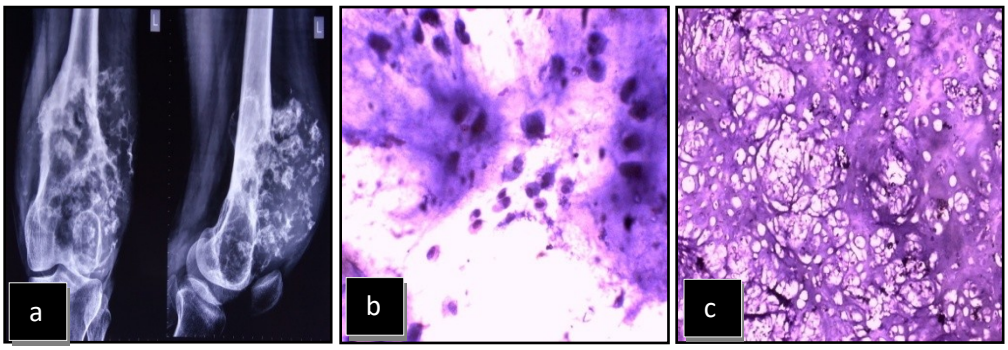

Figure 4: (a) X-ray of the left knee joint (AP/lateral view) showing the variegated appearance of mass at the lower end of the femur, (b) cytological smear showing marked cellular pleomorphism and tumor cells producing cartilaginous matrix, (c) follow-up histopathology revealing same (H&E, 40X).

4. Discussion

The present study was conducted over a period of 2 years in 57 patients of Bone tumors and tumor-like lesions. The mean age of patients was 31.47 years with ranged from 7-65 years which is similar to the study done by Nnodu *et al* [10] and Jain *et al* [11] in which they observed the age range of cases from 4 to 76 years and 5 to 75 years respectively. The maximum number of our cases were found in the age group of 11-20 years (17 cases; 29.8%) followed by 31-40 years (13 cases; 22.8%) and minimum cases were found in the age group of 61-70 years which is comparable to the study of Rajani *et al* [12]. Male to female ratio found out to be 1.04:1, with 29 males and 28 females, which is nearly similar to study by Goyal S *et al* [13]and Jorda *et al* [14].

In the current study, the most common site for Bone tumor and tumor-like lesions was tibia with 17 cases constituting 29.8% of total cases followed by femur with 12 cases constituting 21.1% of total cases. Likewise, Kujur *et al* [3], Hasan *et al* [15] and Agarwal *et al* [16] also found the tibia as the most common site followed by femur, with tibia as a commonest site in 58%, 24.52% and 30% of total cases and femur as second common site in 20%, 16.98% and 21% of total cases respectively.

The inadequate smears were found in 4 cases which constitute 7% of total cases leading to inconclusive diagnosis on cytology. This inadequacy rate was lower than in previous studies [9, 17-19]. The rate of inadequacy was reduced with the use of C- arm guided FNAC and use of double bore FNAC technique in intramedullary bone lesions with intact cortex in 12 cases constituting 21.1% of total cases. Of these 12 cases, 5 cases were of giant cell tumor, 2 cases were of Ewing's sarcoma/PNET, 3 cases were of the aneurysmal bone cyst, 1 case was of plasmacytoma and 1 case was of enchondroma.

Histopathological samples were available in 45 cases (78.9%) which is nearly equal to study done by Mahajan *et al* [17] showed 80.5% of cytological diagnosis were compared to histopathological diagnosis. In the rest 12 (21%) cases cyto-histopathological correlation could not be done in the present study due to loss of follow-up or non-availability of histopathology samples in the form of biopsy or excised specimen.

Similar to Mahajan *et al* [17] and Ramdass *et al* [18], the benign bone tumors and tumor-like lesions (including the 4 cases of inconclusive category on cytology) exceeds the primary malignant bone lesions in the present study. In the current study, the metastatic bone tumors from occult primary constitute 10.5% of total cases. On the contrary, in Jain *et al* [11] and Kujur *et al* [3] study, the primary malignant tumors outnumbered the benign tumors with the metastasis in 9.26% and 9.9% of cases respectively.

Hasan *et al* [15] studied 106 cases in which 50 were benign lesions constituting 47.16% of cases, 29 were primary malignant tumor constituting 27.35% of cases and 27 were metastatic bone tumor constituting 25.47% of cases which are higher than the metastatic lesions in the current study. In the present study, metastatic lesions from known primary malignant lesions were kept in the exclusion criteria. All the cases of metastatic lesions in this study were from an unknown primary. Clinically and radiologically, they appeared to be primary bone lesions but on cyto-histopathology evaluation, they were found out to be a bone metastatic lesion of unknown primary and were placed in the bone metastasis category. Among 6 (10.5%) bone metastasis cases, histopathological samples were available in 5 (8.8%) cases due to the presentation of cases as a pathological fracture of bone or narrowing of joint space on x-ray, hence, in those cases the bone curettage procedure was done, thereby, making histopathological samples available.

Among 35 cases of primary benign tumors and tumor-like lesions (including the cases of inconclusive category) in which histopathology samples were available, in 30 cases i.e. 85.7% cytological diagnosis showed concordance with histopathological diagnosis.

Out of 5 cases from each group of primary malignant tumors and metastasis in which histopathology samples were available, the cytological diagnosis showed concordance with histopathological diagnosis in all cases i.e. 100% cyto-histopathological concordance. These findings are correlated with prior studies [3,11,12].

The sensitivity and specificity of FNAC in diagnosing primary bone tumor and tumor-like lesions were found out to be 89.7% and 83.3% respectively with the positive predictive value of 97.2% which is comparable with the study by Meena *et al* [19] in which the sensitivity, specificity and positive predictive value were found out to be 93.7%, 87.5% and 91.6% respectively. The sensitivity, specificity and positive predictive value, quoted by Nirmala *et al* [20] were 91.6%, 90.9% and 91.65% respectively and by Mahajan *et al* [17] were 92.85%, 94.4% and 93.7% respectively. The specificity of FNAC was found out to be low in the present study due to greater number of true negative cases as compared to other studies [17,19,20]. The diagnostic accuracy of FNAC in diagnosing bone tumors and tumor-like lesions was found out to be 88.8% and which is comparable with previous studies [10, 19, 21, 22].

5. Conclusion

FNAC being rapid, easy, cheap, and minimum invasive outpatient department procedure, plays a vital role in diagnosing bone tumors and tumor-like lesions. It also helps the surgeons to plan the extent and type of surgery based on cytological diagnosis. With the use of C-arm guided FNAC and double bore FNAC technique in intramedullary bone lesions with intact cortex, the rate of inadequacy of cytology smear can be reduced, as in present study.

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