ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 16, Issue 2, 2023

Online - 2455-3891
Print - 0974-2441

Research Article

ROLE OF FNAC IN BONE LESIONS, A CYTOLOGICAL AND HISTOLOGICAL CORRELATION IN A TERTIARY CARE CENTER IN CENTRAL INDIA

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Received: 04 December 2022, Revised and Accepted: 18 January 2023

ABSTRACT

Objectives: FNAC plays a pivotal role in any lesion for the ease of diagnosing and treatment of an ailment. The role of FNAC in bone lesions has not been studied in great vastness but it can definitely ease the time taken for diagnosing on histopathology. The aim of the study was to study the sensitivity, specificity, positive predictive value, and negative predictive value of FNAC in bone lesions, comparison of cytological findings to histopathological findings and to identify the accuracy of FNAC in bone lesions.

Methods: The study was retrospective and observational study. All the FNAC samples were studied and correlated with the histopathology findings where available.

Results: A total of 92 cases were studied. The accuracy of the study stands at 81.3% along with the sensitivity of 87.5% and specificity of 75% with a positive predictive value of 77.8%. Non-neoplastic lesions were 18, followed by primary benign bone tumors 29, Primary malignant bone tumors 28, secondary tumors of bone 6, and unsatisfactory smears 11 cases were identified.

Conclusion: FNAC plays a very crucial role in diagnosing and early intervention and treating any ailment. Bone FNAC also is beneficial for identifying the treatment modality. It should be used on regular basis for bone lesions.

Keywords: Bone lesions, Cytology, FNAC, Histopathology.

 DOI: http://dx.doi.org/10.22159/ajpcr.2023v16i2.47273. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

Improvement in healthcare today comes with the drawback of increased time and cost due to greater complexity of the evolved procedures and/or the need for highly trained personnel to maintain and run high priced equipments [1].

It comes as a pleasant surprise that fine needle aspiration is the antithesis to this trend and because of its ease of operation, it is a do anywhere procedure.

An aspiration can be performed during a routine doctor's office or clinic visit or at the patient's bedside [2]. It utilizes inexpensive equipment and can be typically be performed, interpreted and reported in a matter of minutes thereby accelerating a patient's entry into treatment. An intraoperative/pre-operative aspiration can negate the respective need for a frozen section/histological examination of tissue, the first steps in traditional two step surgical procedure and eliminate the time, cost, and morbidity associated with the additional surgical exploration [1]. The first individuals credited for laying the foundation for the development of today's fine needle aspiration cytology were the surgeon Hayes Martin, Edward Ellis and the pathologist Fred Stewart at The Memorial Centre for Cancer and Allied Diseases in New York. In the late 1920's and 1930's, they demonstrated the utility of needle aspiration in the diagnosis of large number of cases and detailed the procedure [3,4].

In deep seated lesions, such as bone, the open biopsy is almost a major surgical procedure. The surgical exploration has its own drawbacks, such as violation of tissue compartments, placing of a biopsy incision in an area which may interfere with planning of subsequent surgery, risk of general or spinal anesthesia, the necessary of hospitalization, and off course the cost involved [5].

Aims and objectives

The objectives of the study are as follows:

To fine the accuracy of localized bone FNAC in relation to the final diagnosis made by histopathology.

To study diagnostic cytological criteria of different bone lesions.

To study immediate and long term complication of FNAC procedure in patients of bone lesions.

METHODS

The retrospective and observational study was pre-approved by the Institutional Ethics Committee (IEC) for the final permission (vide letter no. 271-304/Ethical/MC/2008). After obtaining the permission of IEC, the study was conducted in the pathology department of medical college hospital of Western India. A total of 92 cases were subjected to FNAC during this period. Preliminary information about age, sex, clinical features, and site of lesion were collected. Cytodiagnosis on light microscopy was embarked on; all the smears were meticulously interpreted by two experienced cytopathologists. After ascertaining, the clinical examination included the age, sex, location of tumor, careful assessment of general condition of the patient, local examination of the swelling, and evidence of any other concomitant lesion elsewhere.

RESULTS

The study includes retrospective evaluation of localized bone lesion FNAC and its correlation with histopathological findings. During the study period (2001–2007), all the cases of localized bone lesions were retrieved from cytology files. In all the cases (n=92), patients with

skeletal lesions were referred from the department of orthopedics. FNAC was done after clinical evaluation.

Out of these, the needle or open biopsy for histopathological examination was done in a total of 20 patients. Patients were followed up for post FNAC complications. No complications were reported in any of the cases and surgical decisions were not altered due to FNAC procedure in any of these cases.

Based on total diagnostic assessment, the final diagnosis was: Non-neoplastic bone lesions [NNBL] (18 cases), primary benign bone tumors [PPBT] (29 cases), primary malignant bone tumors [PMBT] (28 cases), secondary tumors of bone [STS] (six cases), and unsatisfactory smears [US] (11 cases) (Chart 1).

Table 1 shows the distribution of bone lesions in various bones. Lower extremity was the most common site for localized bone lesions. About 45.2% of cases from long bones were in femur, followed by tibia 21% of cases, respectively.

Table 2 shows various lesions diagnosed on cytological examination under the 5 major categories of Non neoplastic bone lesion [NNBL], primary benign bone tumours [PBBT], primary malignant bone tumours [PMBT], secondary tumours of bone [SBT] and unsatisfactory smears.

In all categories of lesions except non-neoplastic bone lesions, femur was the most common bone involved.

In non-neoplastic bone lesions, there were 9/18 cases of chronic osteomyelitis, four of aneurysmal bone cyst, three of tuberccular osteomyelitis followed by 2/18 of simple bone cyst.

In primary bone tumors cases of Ewing's sarcoma were highest 41.37% followed closely by osteogenic sarcoma (34.48%).

In the category of secondary tumors of bone, three cases were diagnosed on cytology including, one case of alveolar rhabdomyosarcoma, and two cases of adenocarcinoma. If we look at the overall picture, primary bone tumors (benign and malignant, number = 57) outnumbered all other type of cases.

There were 14 unsatisfactory aspirations because of hemorrhagic aspirate, no cell element was seen in all these cases. Three of these were later diagnosed on biopsy reducing final number of unsatisfactory cases to 11.

Table 3 shows the cytological diagnosis and its histopathological correlation of the various bone entities.

There were four discrepant cases out of 16 biopsied cases where the material was considered adequate for cytodiagnosis. In this group of Ewing's sarcoma, only one case was discordant and showed squamous cell carcinoma on histopathology.

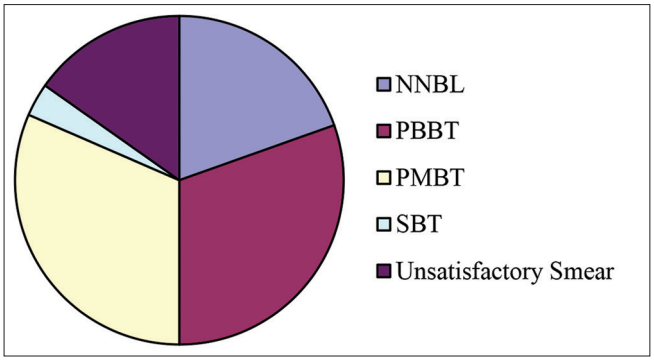

Chart 1: Classification of bone lesions according to cytodiagnosis

Ameloblastoma diagnosed on cytology was reported as the solid variant of alveolar rhabdomyosarcoma. Giant cell tumor was falsely diagnosed as fibroblastic variant of osteogenic sarcoma.

If we correlate the cytological and histological findings in these 16 cases, the accuracy of cytological diagnosis in bone lesions for diagnosing malignancy is as follows-:

- True Positive: Histologically and cytologically malignant cases
- True Negative: Histologically and cytologically benign
- False Positive: cytologically malignant, histologically benign
- False Negative: cytologically benign, histologically malignant
- Sensitivity: 87.5%
- Specificity: 75%
- Positive Predictive value: 77.8%
- Negative Predictive value: 85.7%
- Accuracy: 81.3%.

Microscopy

The various stains used in FNAC were Geimsa and PAP and ZN staining in cases of granuloma formation to identify the tuberculli bacilli. The histopathological examination involved routine hand E stain. Figure 1 shows the presence of osteoclast in the inflammatory and necrotic background in an osteomyelitic lesion. Figure 2 shows the presence of tubercule granuloma of epitheloid cells in the caseous necrotic background.

Discrepant case

Case of squamous cell carcinoma misdiagnosed as Ewing's carcinoma on cytology.

DISCUSSION

This study entitled "Role of fine needle aspiration cytology in bone lesions – a retrospective study" was carried out in department

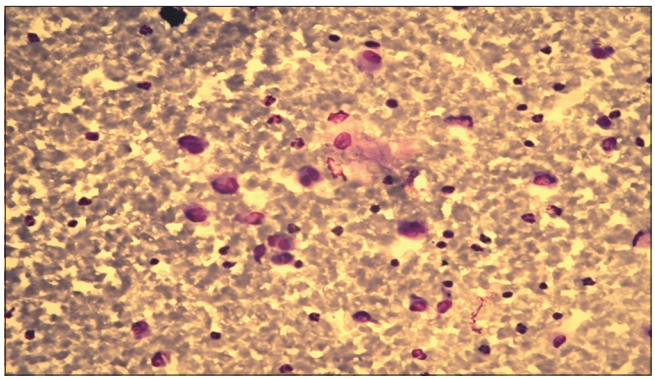

Fig. 1: Geimsa stained (×400) chronic osteomyelitis shows mixed inflammatory infiltrate with occasional osteoblast

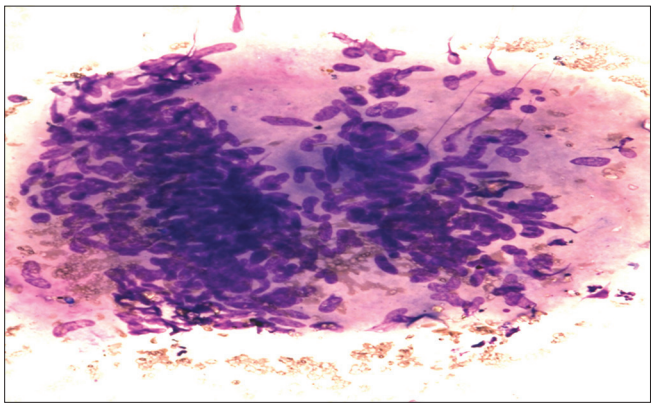

Fig. 2: Geimsa stain (×400) tuberculous osteomyelitis shows granuloma formation by epitheloid cells

Table 1: The location of skeletal lesions

Type of bone	Type of bone lesion					Total (%)
	NNBL (18)	PBBT (29)	PMBT (28)	STB (6)	US (11)	
Long bone (62)						
Femur (28)	4	10	9	2	3	62 (67.4)
Tibia (14)	2	4	4	2	2	
Humerus (13)	6	2	4	1	-	
Radius (6)	2	1	2	-	1	
Fibula (1)	-	-	1	-	-	
Flat bone (17)						
Ileum (9)	-	3	4	-	2	17 (18.5)
Spine (4)	2	-	1	-	1	
Mandible (2)	-	1	-	1	-	
Ribs (1)	-	-	1	-	-	
Clavicle (1)	-	1	-	-	-	
Short bone (13)						
Metacarpal (9)	2	5	1	-	1	13 (14.1)
Metatarsal (4)	-	2	1	-	1	

Table 2: Various lesions diagnosed as on cytological examination under the five major categories of NNBL, PBBT, PMBT, SBT, and unsatisfactory smears

NNBL (18)	PBBT (28)	Malignant (29)	Secondary (3)	Unsatisfactory (14)
Chronic inflammatory infiltrate (Chronic osteomyelitis) (9) (50.0%)	GCT (13) (46.4%)	Ewing's Sarcoma (12) (41.4%)	Adenocarcinoma, Primary GIT/Ovary (1) (33.3%)	Unsatisfactory (14)
Aneurysmal Bone Cyst (4) (22.2%)	Benign cartilagenous tumour (4) (14.3%)	Osteogenic sarcoma (10) (34.5%)	Solid variant alveolar rhabdomyosarcoma (1) (33.3%)	
Tubercular Osteomylitis (3) (16.7%)	Chondromyxoid fibroma (2) (7.1%)	Chondrosarcoma (4) (13.8%)	Metastais of epithelial malignancy (1) (33.3%)	
Simple Bone Cyst (2) (11.1%)	Ameloblastoma (2) (7.1%)	Malignant Fibrous Histiocytoma (2) (6.9%)		
	Osteochondroma (2) (7.1%)	Plasmacytoma (1) (3.4%)		
	Benign Chondromyxoid tumour (1) (7.1%)			
	Enchondroma (1) (7.1%)			
	Chondroblastoma (1) (7.1%)			
	Benign Spindle cell neoplasm (1) (7.1%)			
	Osteoma (1) (7.1%)			

NNBL: Non-neoplastic bone lesion, PBBT: Primary benign bone tumors, PMBT: Primary malignant bone tumors, SBT: Secondary tumors of bone

Table 3: Cases with histopathological examination performed

Cytological diagnosis	Histological diagnosis
Ewing's sarcoma (6)	Ewing's sarcoma (5)
	SCC (1)
Osteogenic Sarcoma (2)	Osteogenic sarcoma (1)
	GCT (1)
GCT (2)	GCT (2)
Ameloblastoma (2)	Ameloblastoma (1)
	Alveolar rahbdomyosarcoma (1)
Osteochondroma (1)	Osteochondroma (1)
Chondroblastoma (1)	Chondroblastoma (1)
Aneurysmal bone cyst (1)	Aneurysmal bone cyst (1)
Metastasis of epithelial malignancy (1)	Papillary Digital Adenocarcinoma (1)
Unsatisfactory Smear (4)	Osteogenic Sarcoma (1)
	Metastasis of renal cell carcinoma (1)
	GCT (1)
	Unsatisfactory Smear (1)

of pathology. A total of 92 FNAC's of localized bone lesions were performed. Of these 20 cases were biopsy proven.

In the present study, bone lesions FNAC's have accounted for an average of 13 FNAC's per year. In the initial period of the study, the total number of bone lesion FNAC's performed were 5–7 per year. However, over the years, a number of localized bone lesion FNAC's have been increasing and currently account for 10–15 FNAC's per year. In many other studies also, bone lesion FNAC's have accounted for average of 7.25 [4], 13.2 [6,7], 8.25 [6], and 23 [2], FNAC's per year, thus correlating well with the present study.

In the present study, we found bone lesions in all age groups, ranging from 6 year to 70 years (most common between 11 and 40 years), which is similar to the findings of most other workers.

However, the age most commonly affected by localized bone lesions in the present series was 11–40 years with a mean age of 15 years which is not in agreement with most of the studies which observed mean age at much older age [8-11]. This discrepancy is mainly because the number of primary tumors (57 cases) of bone is more in this series in comparison to less number of secondary metastasis to bone (6) which is common in older age group.

Less number of secondary tumors can be explained by the fact that being a rural hospital once a primary is diagnosed in adult person, the bone lesions are usually considered as secondary and no diagnostic workup is done for them because of the cost constraints.

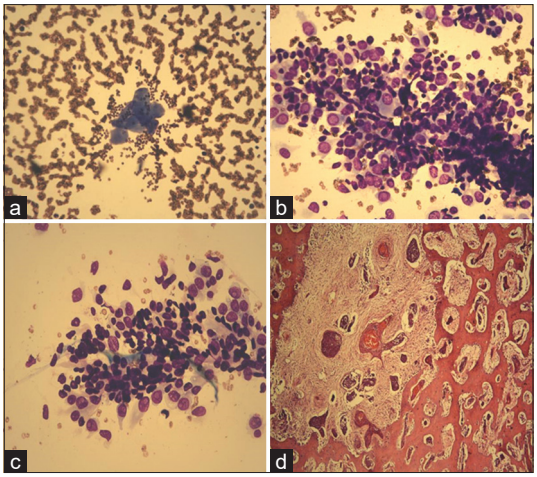

Fig. 3: (a) Pap stain ×400 showed a group of mature squamous cells. (b) Geimsa stain ×400 malignant cells resembling round cell. (c) Geimsa stain ×400 shows squamous cells interspersed between malignant round cells. (d) H and E stain ×400 biopsy proves it to be metastasis of squamous cell carcinoma in bone

In the present study, localized bone lesions were distributed among 54 males and 38 females, that is, they were more common in males as compared to females with male to female ratio of 1.4:1. In the study by Nnodu *et al.* [12], there were 57 males and 39 females with male to female ratio of 1.5:1. The male preponderance has been observed by other workers also such as Boomer *et al.* [13] (1.25:1). Kabukcuoglu *et al.* [14] who recorded 22 males and 16 females with a male to female ratio of (1.1:1). In this way, the male preponderance is well correlated with the other studies.

In the present study, maximum lesions were found in the long bones (67.4%) followed by flat bones (18.5%) and then short bones (14.1%). In other studies, also majority of FNAC were from long bones. El Khoury *et al.* [9] (64.7% cases in long bones and 35.3% cases in short bones), Kabukcuoglu *et al.* [14] (64.9 % in long bones and 35.1% cases in flat bones). Yu GH *et al.* [15] (85.7% cases in long bones and 14.3% cases in flat and short bones together). Handa *et al.* [7] (65.1% in long bones and 34.9% in flat bones), Nnodu *et al.* 13 (94.2 % cases in long bones and only 4.3% cases in flat bones). In the present study, femur was the most common site 2862 (45.2%) followed by tibia 14/62 (22.6%) and humerus 13/62(21%) in close succession. White *et al.* [8] too got the same findings (femur 40.2% cases and in tibia 23.7% cases). Kumar *et al.* [16] got 44.8% cases in femur and 21.3% cases in tibia, once again the similar findings were observed by Jorda *et al.* [17].

In the present study, FNAC of localized bone lesions revealed non-neoplastic bone lesions (NNBL) in 19.6% of cases, primary benign bone tumors (PBBT) in 30.4% of the cases, primary malignant bone tumors (PMBT) in 31.5% of the cases, and secondary tumors of bone (STB) in 3.3% of the cases.

This finding is in agreement with Hutagalung *et al* [15] who studied malignant lesions containing both primary and secondary metastatic bone tumors (74%) and benign lesions (26%) and Handa *et al.* [7] who reported 50% cases of non-neoplastic and neoplastic lesions (including both benign, primary malignant, and secondary bone tumors).

Non diagnostic cases accounted for 11/92 (11.9%) cases after clinical, cytological, and histological correlation, where as it was seen in 14/92 (15.2%) cases when only aspiration cytology was taken into account. This finding is similar to the failure rates of Handa *et al.* [7] (18.18%) cases, Stromby and Ackerman [8] (17.4%), and Mehrotra *et al.* [19] (10.9%). However, non-diagnostic aspirates accounted for higher number of cases (22.7%) in the study conducted by I kaur [19] and 34.9% of cases in the study conducted by Stromby and Akerman [8] as most of the FNACs were performed by the cytopathologists themselves. Many authors have the opinion that FNAC has a limited role in diagnosing these types of sclerotic lesions. However, it proves that an experienced aspirator (preferably the cytopathologist as in our series) with correct aspiration technique may minimize the chances of inadequate material being aspirated.

Limitations of the study

The FNAC can sometimes be not of much help in the following scenarios:

1. The lesion is very deep seated and its approachable with routine needle.
2. The lesion is having varied morphology then it becomes difficult to make a certain diagnosis on cytology.

CONCLUSION

FNAC plays a crucial role in diagnosing the entity faster than any other mode of evaluation though it any require other correlations to give a more accurate diagnosis.

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