IJCRR
Vol 06 issue 14
Section: Healthcare
Category: Research
Received on: 15/05/14
Revised on: 11/06/14
Accepted on: 08/07/14

TECHNICAL CHALLENGES AND SPECTRUM OF LESIONS IN FINE NEEDLE ASPIRATION CYTOLOGY OF BONE LESIONS

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ABSTRACT

Bone lesions can be approached on the basis of history, radiological examination, fine needle aspiration cytology (FNAC) and excision biopsy of the specimen.

Objective: To analyze the technical challenges encountered with the procedure of fine needle aspiration cytology of bone lesions.

Methods: A prospective study of fine needle aspiration cytology (FNAC) of bone lesions was done as an outpatient procedure in our institution except for small lesions which were done under radiological guidance. A core needle biopsy was done along with aspiration in all the cases. Aspirates were smeared, few were alcohol fixed and rest air dried and stained with H & E and MGG stains accordingly. The corresponding biopsies obtained were fixed in 10% formalin.

Results: The current study is comprised of 25 index cases. The incidence of bone lesions was higher in the age group between 5 to 30 years with a male preponderance. Tibia emerged to be the most common bone to be involved.

Sample adequacy was observed in 20 cases. Histopathological correlation was available for 23 cases. Of these, 11 cases were benign and 12 cases were malignant.

Conclusions: FNAC is a very useful initial diagnostic modality in bone lesions.

The main limitation noted in our study was obtaining an adequate material for cases with intact cortex and small lytic lesions. This study signifies the importance of advent of instruments which will aid in piercing the intact cortex and avoid open biopsy and its complication.

Keywords: Bone FNAC, lytic lesions, cortical erosion

INTRODUCTION

Primary bone tumors are rare. Conditions mimicking primary bone tumors (e.g. Metastasis and non-neoplastic conditions) are far more common than the cases of true bone tumors[1].

Bone lesions are diagnosed on the basis of history and radiological examination[2.] The other modalities include fine needle aspiration cytology (FNAC) and excision biopsy of the specimen.

FNAC of bone lesions is a challenging procedure as bone is not as easily accessible as other tissue.

FNAC of bone tumor was first attempted by Coley, Sharp and Ellis in 1931.[3]

The reluctance to perform FNAC at many centers is due to the difficulty in accessing hard tissue, inadequacy of material, lack of experienced cytopathologists in this field, lack of radiological guidance at all centers, calcified components, loss of architecture, etc. Many centers practice open biopsies, which is an invasive procedure, time consuming and requires hospitalization. Open

biopsy is associated with complications like hematoma formation and pathological fractures.

At centers with good radiological guidance, FNAC of bone lesions is emerging as a popular diagnostic modality. FNAC gives accurate results in a shorter duration and thus aids in rapid management. It is an out-patient procedure with minimal complications and also aids multiple site aspirations whereas open biopsy yields single site biopsy.

FNAC serves as a very useful diagnostic aid in rural regions and other areas where facilities for surgical biopsies are insufficient.[4]

There have been varying results in the literature regarding the inadequacy rates ranging from 0–5%[5, 6] to 31–33%.[7, 8]

The other merits of using FNAC for diagnosing bone lesions include the advantage of utilizing the same material for special investigations like immunohistochemistry (IHC), cytogenetic, electron microscopy, culture etc.[9]

Together with an experienced cytopathologist, clinical and radiological findings, the accuracy of FNAC of bone approaches almost of that of the histopathology of the same lesion.[10]

The present study was conducted to assess the technical difficulties encountered with FNAC of bone lesions and also to evaluate the accuracy of FNAC as an initial diagnostic modality for bone lesions.

MATERIALS AND METHODS

A prospective study of FNAC of bone lesions was done as an outpatient procedure in our institution except for small lesions which were done under radiological guidance. The approach to patients with lytic bone lesions and intact cortex and biopsy was followed as depicted in flow chart 1, 2 & 3 respectively. For large lytic lesions with complete cortical erosion, a 10ml disposable syringe and 22guage needle were used. For deep seated lesions, disposable lumbar puncture needle was used. FNAC of small lytic lesions was done under Computed Tomography (CT) guidance. Few studies mention the use of co-axial drill[11] to approach the shaft of long bones; we couldn't use it due to non-availability of the instrument.A core needle biopsy was done along with aspiration in all the cases. 18 G (Trucut) biopsy needle was used for cortical lesions with erosions and Jamshedi needle was used for bone lesions with intact cortex. Aspirates were smeared, few were alcohol fixed and rest air dried and stained with H & E and MGG stains accordingly. The corresponding biopsies obtained were fixed in 10% formalin. Decalcification was done only in cases containing hard bony tissue followed by routine histopathological processing.

The slides were examined and criteria forassessing and grading the cellularity of the smear, pattern, cell type, cellular atypia and backgroundwere followed as mentioned by Ambreen Moatasim and Anwar UI Haque[12]in a study on bone lesions.The corresponding core biopsy slides were examined and a Cyto-histopathological correlation was done.

Statistical methods: The diagnostic accuracy, sensitivity, specificity of FNAC diagnosis of benign and malignant lesions, positive and negative predictive value of the test was calculated.

A positive Cyto-histopathologic correlation was taken as true positive (TP), Cyto-histopathologic disagreement was considered false positive (FP) i.e. cytology reported as malignant and histopathology diagnosed as benign, it was considered false negative (FN) when the cytology was reported as benign lesion and histopathology diagnosed as malignant lesion. Those cases which were diagnosed as benign by both FNAC and histopathology were considered as true negative (TN)[13].

RESULTS

Our study comprised of 25 index cases. The incidence of bone lesions was higher in the age group between 5 to 30 years with a male preponderance. Tibia emerged to be the most common bone to be involved. The most common

clinical symptom was pain followed by swelling, fracture and mixed symptoms.

Sample adequacy was observed in 20 cases.

Inadequate aspirates were obtained in 5 cases. 2 cases showed lesions located in the femur and its cortex could not be penetrated hence no material was obtained.The 3rd case was a pathological fracture in the shaft of the tibia, showed only hemorrhages on cytology smears, which on histopathology corresponded to metastatic deposits.

2 cases were lytic lesions of the spine and image guided FNAC could not be done.

Histopathological correlation was available for 23 cases. 11 cases were confirmed as benign and 12 as malignant on histopathology. The benign lesions were tuberculous osteomyelitis (2), chronic osteomyelitis (2), simple bone cyst (1), aneurysmal bone cyst (2), benign spindle cell lesion (2) and ossifying fibroma (2). The malignant lesions were metastatic deposits (3), osteosarcoma (3), small round cell tumor (3), eosinophilic granuloma (1) and solitary myeloma (2). Among the 23 cases which had histopathological correlation, cytohistological concordance was noted in 19 cases (82.6%) and discordance in 4 cases (17.3%). The sensitivity was 91.6%, specificity 90.9%, diagnostic accuracy 91.3%, positive predictive value 91.65 and negative predictive value 90.9%

DISCUSSION

The present study highlights the cytological features in 25 cases of bone lesions.

The location of the lesion, type of lesion, type of needle used, the experience of the aspirator and the presence of cortical erosion are factors affecting cellular yield. Lesions located in superficial palpable regions, deep seated lesions as in head and neck of femur, body of the spine are difficult to access and always require radiological guidance. Cellular yield also differs by type of lesion.

Obtaining adequate material fromthe bone is a technical challenge to the performing pathologist due to the hard nature of the tissue. For large lytic lesions with cortical erosion, with or without soft tissue extension, FNAC can be performed with ease due to the soft nature of the tissue. Those lesions which are small, located in the medulla of the bone without cortical erosion pose difficulty in obtaining material for cytological study.

Benign and fibroblastic lesions yield poor cellularity as compared to malignant ones.

Inflammatory lesions yield moderate cellularity.

Shaft of long bones is impossible to be penetrated with the available needles and use of drilling machines has been used in a few studies. In our study drilling machine was not used due to non-availability of the instrument.

Presence of cortical erosion- a lesion already eroding the cortex, gives an easy access to obtain cells for study as compared to the dense non eroded cortex.

Aspirateswere scanty and hemorrhagic in most of the benign cases. Cystic lesions, such as aneurysmal bone cysts and simple cysts, frequently yield insufficient material.[14]

In a case of lytic lesion of tibia, 20ml of altered blood (brownish fluid) was aspirated, which did not clot evenafter 15 minutes. The smears showed hemosiderin laden macrophages and a diagnosis of aneurysmal bone cyst was considered and confirmed on open biopsy. In another case of lytic lesion in the shaft of the fibula, 5ml of straw colored fluid was aspirated. Smears were cellular; biopsy confirmed a diagnosis of a solitary bone cyst. Aspirates from malignant primary and metastatic bone lesions were hemorrhagic in most of the cases.

Diagnostic yield was higher in lyticlesions than in sclerotic bone lesions similar to the observation done by Wu[15] who in their study mention thatthe significantly lower diagnostic yield for sclerotic versus lytic bone lesions may be due to a “masking” of the underlying lesion by reactive sclerosis. Most often sclerotic lesions require a

cutting needle or drill to breach the cortex and / or reactive bone and these samples can be degraded by crush artifacts, hindering histological evaluation and lowering diagnostic yield accuracy. Needles of shorter lengths yielded poor material, which composed of reactive zone only and were inadequate for opinion as notedsimilarly byNnodu *et. al.*[1 6]*in* their study. Patients who presented in the later course of the disease showed abreached cortex on x-ray. In these cases approach was easy. Intra cortical lesions posed a technical difficulty, in them bone aspiration and biopsy needles were used.

Adequate material was obtained in 20/25 cases. 11 cases showed benign lesions and 12 malignant lesions. There were 3 metastatic cases. In a similar study by Nnodu *et. al.*[16], adequate material was obtained in90/96 cases, 40 were benign lesions and 47 malignant lesions. Metastasis was noted in 27 cases.

One of the cases we reported was an eosinophilic granuloma in an 8 year old girl who presented with acute pain in lower limbs inthe right mid-thigh region. Clinically it was diagnosed as acute osteomyelitis. This case was a diagnostic challenge to us as initial aspirates were hemorrhagic and had scanty material and inconclusive. Repeat aspirates done under ultrasound guidance yielded cellular material which showed histiocytes along with eosinophils, neutrophils with few osteoclasts in the background. Few of the histiocytes showed characteristic nuclear grooving and finely granular chromatin pattern with inconspicuous nucleoli. With these features, a diagnosis of eosinophilic granuloma was made.

Tarik Elsheikh *et. al.*[17] reported 3 cases of eosinophilic granuloma on FNAC, of which two were seen in male and one in female. All 3 cases were noted in below 15 years of age. One of the cases presented with mid-thigh pain, similar to the case we reported. They performed S-100 protein stain on the aspirated material to demonstrate intra cytoplasmic as well as intranuclear staining of the Langerhan's cells in all three cases. The accurate diagnosis of metastatic lesions and myeloma on FNAC and cell block avoided unnecessary surgeries in these patients. They were managed with radiotherapy and chemotherapy.

The risks of open biopsy include infection, bleeding (especially in metastases from renal carcinoma), weakening of the bone leading to pathological fracture, contamination of surrounding soft tissues, and discomfort associated with surgery[18]. These can be avoided if FNAC isused as the initial diagnostic modality for bone lesions.

The sensitivity of our study was 91.6%, specificity 90.9%, diagnostic accuracy 91.3%, positive predictive value 91.65 and negative predictive value 90.9% as compared to the observations by Ravi *et. al.*[19] who reported FNAB findings in 91 cases of bone tumors. In their study, the overall sensitivity and specificity was 93.3%, and 94.5% respectively. The positive predictive value was 87.5%, while the negative predictive value was 97.2%. The diagnostic accuracy was 94.23%.

Merits:

FNAC provides a reliable and rapid diagnosis of bone lesions.

Application of FNAC in bone lesions as a diagnostic tool proved to be useful as in most of the cases, treatmentdecisionswere made on the basis of FNAC diagnosis.

FNAC as a diagnostic modality proved to be conclusive in metastatic bone lesions.

Needle biopsies give accessibility to deep seated lesions and multiple specimens can be obtained without an increase in morbidity.

Limitations:

The major drawback of the current study is obtaining an adequate material for cases with intact cortex and small lytic lesions.

Bone FNAC has not gained wide application because of difficulties in obtaining material for study due to the hard nature of the bone.The regular FNAC procedure can be followed in osteolytic lesions and in lesions with cortical

erosions. Those lesions with intact hard cortex require specialized techniques to obtain material for cytological studies.

Radiological guidance [x-ray, CT scan] is required in smaller and in deep seated non palpable lesions.

CONCLUSION

FNAC is a very useful initial diagnostic modality in bone lesions. The main limitation noted in our study was obtaining an adequate material for cases with intact cortex and small lytic lesions. This study signifies the importance of advent of instruments which will aid in piercing the intact cortex and avoid open biopsy and its complication.

ACKNOWLEDGEMENT

The authors are thankful to Bangalore Medical College & Research Institute for providing continuous academic support. Authors are thankful to the Head of the Department of Pathology, Bangalore Medical College& Research Institute, Bangalore for the encouragement and support.

The authors acknowledge the help received from the authors whose article are cited and included in the references of this manuscript. The authors are also grateful to authors / editors / publishers of all these articles, journals and books from where the literature to this article has been reviewed and discussed. We also acknowledge the generous help of Dr. Pooja Suresh, Assistant Professor, Pathology, Kasturba Medical College, Mangalore for reviewing the manuscript and recommending the required corrections.

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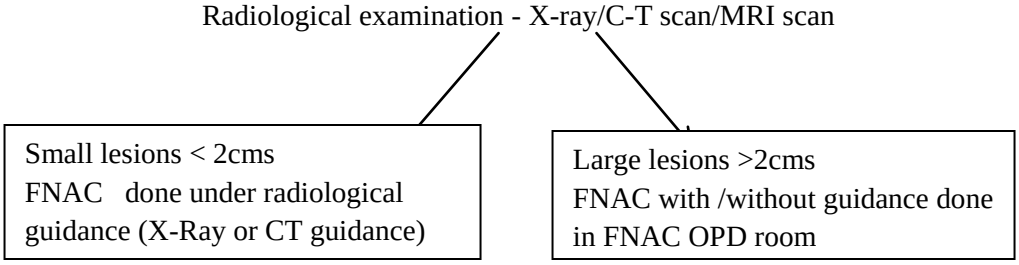
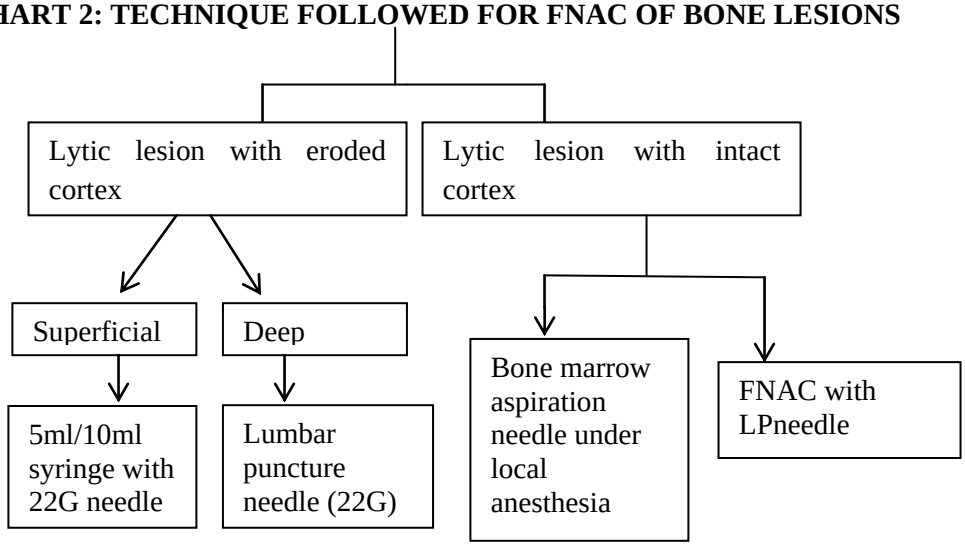
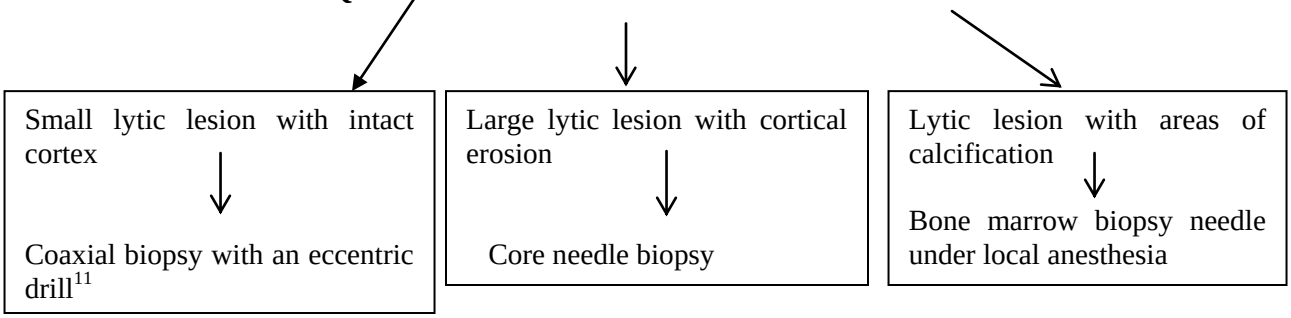
FLOWCHART 1: APPROACH TO A PATIENT WITH LYTIC LESION OF THE BONE



FLOWCHART 2: TECHNIQUE FOLLOWED FOR FNAC OF BONE LESIONS



FLOWCHART 3: TECHNIQUE FOLLOWED FOR CORE NEEDLE BIOPSY OF BONE



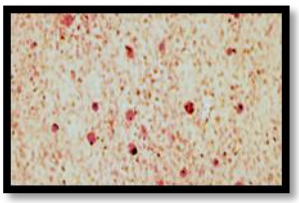


Fig 1: FNAC, 40X, Simple/Aneurysmal Cyst

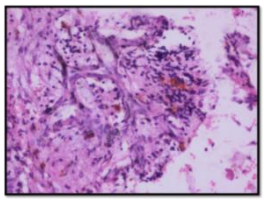


Fig 2: HPE, 10X, Simple Bone Cyst

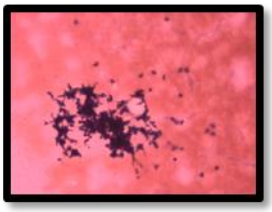


Fig 3: FNAC, 40X, Ossifying Fibroma

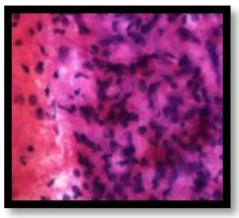


Fig 4: FNAC, 40X, TB Osteomyelitis

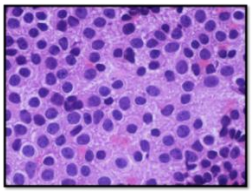


Fig 5: FNAC, 40X, Small Round

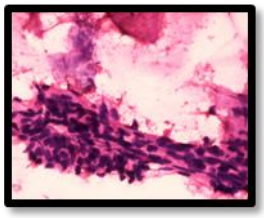


Fig 6: FNAC, 40X, Osteosarcoma Cell Tumour

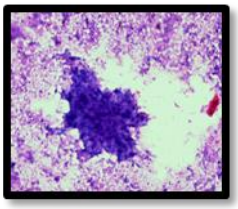


Fig 7: FNAC, 10X, SCC Metastasis to Bone

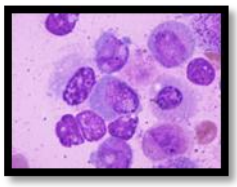


Fig 8: FNAC, 100X, Myeloma Bone