

Original Research Article

A retrospective analysis of computed tomography guided biopsy in the diagnosis of primary bone tumors

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Received: 18 February 2017

Accepted: 30 March 2017

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ABSTRACT

Background: Primary bone tumors account for a small yet significant number in the total incidence of tumors. Computed tomography (CT) guided percutaneous core biopsy is a novel yet significant step in the approach towards the diagnosis of bone tumors and is increasingly performed by orthopaedic oncologists around the world. This study is aimed to evaluate the diagnostic accuracy of CT guided biopsy in the diagnosis of primary bone tumors.

Methods: Patients who underwent CT guided biopsy and subsequent excision for primary bone tumors from January 2008 to July 2015 were analysed. CT guided biopsy results were compared with post-operative histopathological reports to evaluate its sensitivity and specificity.

Results: A total of 161 patients were included in the retrospective study. Among them, 147 were true positives, 7 were false negatives, 6 were true negatives and one was false positive. The sensitivity of CT guided biopsy in the diagnosis of primary bone tumor was 95.4 % with specificity of 85.7% with a diagnostic efficiency of 90.5%. The complication rate was 4.3%.

Conclusions: CT guided biopsy is a safe, simple and effective procedure to rule out and rule in the diagnosis of primary bone tumors.

Keywords: CT guided biopsy, Sensitivity, Specificity, Histopathology report, Primary bone tumors

INTRODUCTION

Proper diagnosis is imperative for the appropriate management of primary bone tumors and biopsy remains a critical step in the diagnosis of bone tumors. The goal of performing a biopsy is to obtain a diagnostic tissue while minimizing morbidity, limiting the potential tumor spread and avoiding interference with the future treatment. Techniques for the diagnosis of primary bone neoplasm include incisional biopsy, excisional biopsy, frozen section and fine needle aspiration cytology (FNAC). Open biopsy is traditionally considered to be the gold standard, but requires a theatre setup.¹ CT guided biopsy, being a less invasive procedure, and is increasingly performed by orthopaedic oncologists

around the world. Furthermore, CT guided biopsy has all the advantages of an open biopsy and it lacks the disadvantages of an open biopsy.

CT guided biopsy is developed as an alternative to open biopsy. There is an appreciable shift from open biopsy to CT guided biopsy since the latter requires less sedation, low cost and has a low rate of complications.² However, the literature contains a number of controversies regarding sensitivity and specificity of this technique. The overall diagnostic accuracy of open biopsies range from 91-96%.^{3,4} Complications like hematoma, infection, fracture, tumour fungation etc occur more often in case of open biopsies in the range of 4% - 19%.^{4,6} The purpose of this study was to find out the sensitivity and specificity of

CT guided biopsy in the diagnosis of primary bone lesions and to determine the clinical utility of CT guided biopsy in primary bone tumors.

METHODS

The study included all the patients who underwent CT guided percutaneous core needle biopsies during the period from January 2008 to July 2015 at the Department of Orthopaedics in Amala Institute of Medical Sciences. Cases of metastases and myeloma were excluded from the study. After the approval from institutional review board, data was retrospectively acquired from medical records department. All the cases were statistically analyzed for the sensitivity and specificity. Result of the post-operative histopathological report was considered as the gold standard.

All CT guided biopsies were performed by the first author or under his guidance, after obtaining the consent from the patient or guardian. All procedures were done as outpatient procedures. Local anaesthesia was used in all cases. Two to three cores were obtained using a Trucut core needle biopsy system after visualizing the lesion under CT scan. The core of tissue was first transferred on to a glass slide. It was rolled from one edge to the other. Cells shed on to/stick to glass will be a good source for cytology. The remaining specimens were then transferred to bottle with buffered formalin and saline solution for histological analysis. All the patients were monitored for 1 hour. Pathologic specimens were examined by a musculoskeletal pathologist.

Subsequently patient underwent surgical excision of the tumour and specimen was sent for histopathological examination. Surgery is carried out by the same surgeon who did the CT guided biopsy. Histopathology report of gross specimen is the gold standard against which CT guided biopsy findings were compared. All the patients were followed up at 1 month, 6 months and 12 months. True positives, false positives, false negatives and true negative values were found to get the sensitivity and specificity. True positive is one in which CT guided biopsy report and histopathology report diagnosed the same tumor type. False positive is one in which CT guided biopsy diagnosed a bone tumor and histopathology report came as negative. False negative is one in which CT guided biopsy fails to diagnose a bone tumor but histopathology report showed the presence of a bone tumor. True negative means both CT guided biopsy and histopathology failed to show a bone tumor. From the above values sensitivity and specificity were calculated by

$$\text{Sensitivity} = \frac{\text{True positive}}{\text{True positive} + \text{False negative}} \times 100$$

$$\text{Specificity} = \frac{\text{True negative}}{\text{True negative} + \text{False positive}} \times 100$$

RESULTS

A total of 704 patients underwent CT guided biopsy from January 2008 to July 2015. Relative distribution of cases is represented in Table 1. Obviously metastasis/myeloma cases outnumber the other cases. About 541 cases myeloma and metastasis were excluded from the study. Among the 161 cases included in the study, the major portion was from giant cell tumor (n=72). The incidence of primary bone tumors and the diagnostic accuracy of CT guided biopsy in each of them as obtained from our study are given in the Table 1.

Table 1: The incidence of primary bone tumors and the diagnostic accuracy of computed tomography guided biopsy.

Tumour	Incidence	Diagnostic accuracy
1) Giant cell tumour	44.7% (n=72)	95.83%
2) Chondrosarcoma	14.2% (n=23)	91.3%
3) Osteosarcoma	16.1% (n=26)	100%
4) Aneurysmal bone cyst	9.9% (n=16)	81.25%
5) Ewings sarcoma	6.8% (n=11)	100%
6) Simple bone cyst	3.7% (n=6)	16.6%
7) Chondroblastoma	2.5% (n=4)	75%
8) Osteoblastoma	1.8% (n=3)	100%

Table 2: True positive and negative results of computed tomography when compared to histopathological reports (HPR).

	Positive HPR report	Negative HPR report
Positive CT guided biopsy	True positive 147	False positive 1
Negative CT guided biopsy	False negative 7	True negative 6

True positive cases were 147, false positive case was 1, false negative cases were 7 and true negative cases were 6. From this sensitivity and specificity was calculated using the above formula and was found to be 95.4% and 85.7%, respectively (Table 2). The complication rate noted in our study was 4.3%. There was a single case of infection and 6 cases had excessive bleeding from the puncture site which required admission. CT guided biopsy has a sensitivity of 94.3% i.e. 153 cases out of 161 were diagnostic biopsies. 8 non diagnostic biopsies were

- Three cases of simple bone cyst
- One case of bone defect from harvesting bone graft
- One case which was diagnosed as chondroblastoma in CT guided biopsy was found to be low grade chondrosarcoma after curettage.
- One case of aneurysmal bone cyst diagnosed as giant cell tumour in CT guided biopsy

- Two cases in which insufficient samples were obtained for diagnosis in CT guided biopsy which were 2 cases of aneurysmal bone cyst.

The least diagnostic accuracy was noted in cystic lesions, as it was difficult to obtain diagnostic cells from such lesions by a less invasive method. Another drawback that authors found was in the diagnosis of cartilaginous tumours. As these tumours are highly heterogeneous, biopsy site may have a low grade malignancy and HPR may come as a high grade malignancy which will be interspersed within these low malignant areas. So to avoid controversy, pathologists now report these lesions simply as cartilage lesions without mentioning their grade. In our opinion, if the biopsy report came as cartilage lesion, it is better to treat such a case as high grade lesion, unless otherwise proved.

DISCUSSION

Percutaneous CT guided core needle biopsy is an important diagnostic tool in primary bone tumours. It is cost effective, accurate and safe. CT guided biopsy is ideally taken in close collaboration with a multi-disciplinary team consisting of radiologist, orthopaedic oncologist, musculoskeletal pathologist and in some cases a medical oncologist. The diagnostic yield of image guided biopsy in case of musculoskeletal lesions was said to be in the range of 80%-95%.⁷⁻¹⁰ In addition to core needle biopsy, FNAC of bone tumours was another option, added to the biopsy armamentarium by Martin and Ellis in 1930.¹¹ Limitation of FNAC is that we get cells only; but the diagnosis of many primary bone tumors is by substance produced by the cells i.e. extracellular matrix. So by seeing the cells alone a Pathologist cannot distinguish malignant lesion like osteosarcoma and chondrosarcoma. Sarcomas are usually heterogeneous unlike carcinoma. So the utility of FNAC in bone tumours is restricted to skeletal secondaries than in primary bone tumours.¹²⁻¹⁴

A poorly performed biopsy could become an obstacle to proper diagnosis and may have negative impact on future treatment. Wu et al reported increased biopsy success with greater number of specimen obtained and suggested at least three cores of bone lesions to be sent for histopathological examination.¹⁵

High sensitivity in this study can be attributed to the fact that in our hospital we usually do a MRI scan before proceeding with CT guided biopsy. So the chances of false negative results are very much reduced, since MRI scan provides a high contrast between primary bone tumours and soft tissues.¹⁶ One of the true negative cases in this study was a case of lytic lesion presented in the upper tibia which radiologically appeared as giant cell tumour. CT guided biopsy taken from the lesion was negative. Per operatively there was no tumor tissue. It appeared like epiphyseal defect produced by harvesting graft from upper

tibia for the treatment of delayed union of open fracture of femur before epiphyseal closure.

In a study by Seil et al, CT guided biopsy in general oncology patients has a sensitivity of 94%, specificity of 92% and effective accuracy of 92%. This is in par with the findings in our study.¹⁷ Patients undergoing percutaneous needle biopsy had lower rate of major diagnostic errors and complications than previously described for open biopsy.¹⁸ But one has to keep in mind the low diagnostic accuracy posed by these percutaneous biopsy techniques in cases of spinal lesions, myxoid tumours, infective pathology and round cell histologies.¹⁹ An optimal biopsy technique in case of musculoskeletal tumours is debatable. Low complication rates, minimally invasive nature and cost effectiveness of image guided core needle biopsies offer an advantage over traditional incisional biopsies.

CONCLUSION

CT guided core needle biopsy is a safe, simple and effective procedure for diagnosis of lesions of axial and appendicular skeleton without any associated complications. Low complication rate, minimally invasive technique, cost effectiveness of doing as an outpatient procedure, high sensitivity and specificity of this procedure can make it an attracting alternative to open biopsies. But this needs to be evaluated further.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the valuable help of Dr. Ajith TA, Professor of Biochemistry, Department of Biochemistry, Amala Institute of Medical Sciences during the preparation of the manuscript.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Dominic KP, Dijoe D, Toms J. A retrospective analysis of computed tomography guided biopsy in the diagnosis of primary bone tumors. *Int J Res Orthop* 2017;3:569-72.