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Reliability of Core Needle Biopsy in Diagnosis of Malignant Bone Tumours

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Abstract

Background: Compared to open biopsy core needle biopsy is less invasive technique with fewer complications; however its reliability in reaching accurate diagnosis is still questionable. The aim of this study is to evaluate the accuracy of core needle biopsy in diagnosis of malignant bone tumours.

Materials and method: This is a retrospective analytical study on 152 patients underwent core needle biopsy and followed by definitive surgery during the period of 2016-2017 at Ibrahim Malik Teaching Hospital, Khartoum, Sudan. The needle biopsies were assessed for sensitivity, specificity, predictive positive value, and predictive negative value.

Results: A final diagnosis was not reached in 7/152 patients (4.7%) with an overall sensitivity of 96.2% (104/108), and specificity of 93.1% (41/44), positive predictive value of 97.1% (104/107), negative predictive value of 91.1% (41/45). No complications due to core needle biopsy were noted.

Conclusion: Core needle biopsy is a reliable method for reaching the final diagnosis in malignant bone tumours with fewer complications. It could be adopted confidently in clinical practice instead of the open biopsy method.

Keywords: Core needle biopsy; Malignant bone tumour; Reliability of biopsy diagnosis; Sensitivity of core needles; Specificity of core needle; Complications of biopsy

Introduction

In musculoskeletal oncology biopsy is considered essential for the accurate diagnosis [1]. Management of malignant bone sarcoma requires histologic typing and the degree of tumour differentiation [2]. Biopsy is usually taken after completion of clinical and radiological assessment. Open biopsy was previously considered the gold standard procedure to get enough adequate representative tissue for histopathological assessment [3].

In our local practice, most of orthopaedic surgeons usually take open biopsies with the presumption that open biopsy does not provide adequate tissue for histological diagnosis. In 2013 we established the first specialized musculoskeletal oncology unit in Khartoum Teaching Hospital, Khartoum, Sudan. Adequate training of residents on the technique of needle biopsy was undertaken.

In this study, we assessed the reliability of core needle biopsy method in reaching the accurate diagnosis for malignant bone tumours.

Materials and Methods

This is a retrospective analytical hospital based study on patients' records during the period of 2016- 2017 at Ibrahim Malik Teaching Hospital orthopaedic oncology unit and Histo Centre Lab records. All patients who diagnosed as bone tumours based on needle biopsy result were considered part of this study.

The biopsy technique was well standardized since it was carried out by the same orthopaedic oncology team throughout the study period. The chosen anatomical site of biopsy was dictated by the future plan for the definitive surgery. The procedures were performed under general, spinal, regional or sometimes local anaesthesia. Fluoroscopy used when indicated. Jamshidi needle size (8, 11 gauge) was used and 3-5 cores from different sites of the bone lesion were taken (Figures 1 and 2).

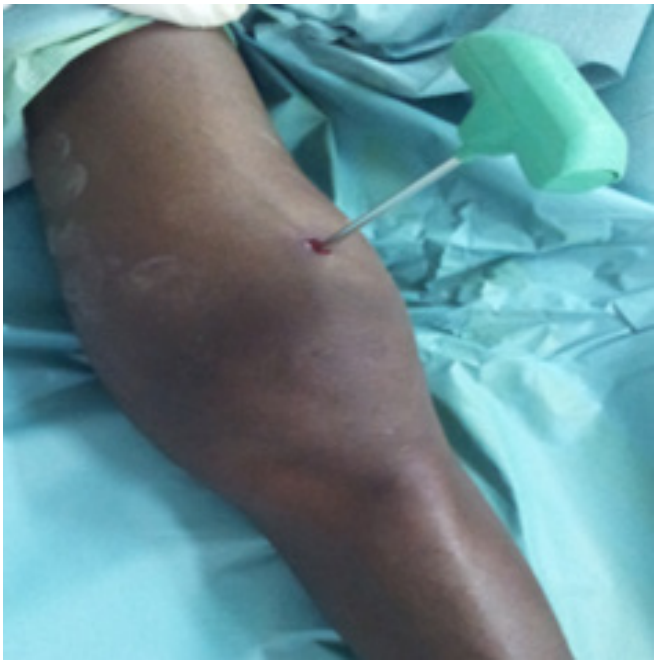

Figure 1: Jamshidi needle.

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Figure 2: Multiple cores gained by core needle.

The proper handling of the sampled tissue was ensured to avoid crush artefacts. The sample fix by 10% buffered formalin to allow further ancillary immunohistochemistry studies. The labelled sample attached to request form which emphasis on important key points in history and examination. The needed images sent to the lab attached with the tissue sample.

Records of 213 patients' biopsy samples from Jan 2016-Dec 2017 at Ibrahim Malik Teaching Hospital and Histo Centre Lab were reviewed. The inclusion criterion was: all core needle samples of malignant and benign tumours which had another available documented biopsy result from the definitive surgery within the same study period. The definitive surgery diagnosis considered the accurate one due to large tissue sample volume. Only 160 samples were met the inclusion criterion. Eight of them were excluded, because the sites of core needle samples were not matching the definitive surgery one.

Sensitivity was defined as the proportion of people who have the malignant bone sarcoma who have positive needle biopsy results, while specificity was defined as the proportion of patients who don't have the malignant bone sarcoma who have negative needle biopsy results. Biopsies results assessed for the sensitivity and specificity in order to answer the study question regarding the reliability of closed method of core needle biopsies. We studied the result of the core needle biopsy using the results obtained during the definitive surgery for the same patient; such as curettage and resection as reference for open biopsy and the final diagnosis. Moreover, the procedure of core needle was tested for predictive positive value (PPV) and the predictive negative value (PNV).

Results

Assessment included 152 patients, 98 were Male and 54 were females. The age ranged between 6 and 64 years (The mean age was 24.6 ± 13.08 Standard deviation).

The most common anatomical location for bone tumour biopsy was distal femur, which accounts (54/152) 35.5%, while scapula was considered the less frequent with (4/152) 2.6% (Table 1).

Site	Frequency	Percentage
Scapula	4	2.60%
Proximal humerus	11	7.30%
Distal humerus	6	3.90%
Distal femur	54	35.50%
Proximal femur	18	11.80%
Proximal tibia	39	25.60%
Distal tibia	11	7.40%
Fibula	9	5.90%
Total	152	100%

Table 1: Anatomical location of biopsied bone.

The biopsy result of final diagnosis showed 108 malignant bone tumours 71%, while there were 44 benign lesions. The most encountered common diagnosis of the malignant bone disease was osteosarcoma 43.5% (47/108), while the most diagnosis among the benign was osteochondroma 18.1% (8/44) (Table 2).

No	Diagnosis	Frequency
1	Osteochondroma	8
2	Chondroblastoma	5
3	Giant Cell Tumour of Bone	4
4	Chronic Osteomyelitis	4
5	Fibromatosis	3
6	Metaphyseal Fibrous Defect	3
7	Fibrous Dysplasia	3
8	Benign Chondroid Lesion	1
9	Desmoplastic Fibroma	2
10	Fibrocartilagenous Dysplasia	3
11	Haemangioma	1
12	Haemangiopericytoma	1
13	Hemorrhage	1
14	Histiocytic Lesion	1
15	Heterotopic calcification	1
16	Fibrous Histiocytoma	1
17	Simple (Unicameral) Cyst	1
18	Aneurysmal bone cyst	1
19	Osteosarcoma (different subtypes)	47
20	Ewing/ PNET	18
21	Synovial Sarcoma	8
22	Diffuse Large B Cell Lymphoma	2
23	Malignant Fibrous Histiocytoma (Pleomorphic sarcoma)	2
24	Metastatic Carcinoma	8
25	Plasmacytoma	7
30	Myxoid Liposarcoma	6
31	Fibrosarcoma	4
32	Myxoid Rhabdomyosarcoma	2
33	Renal Cell Carcinoma	4
	Total	152

Table 2: Final diagnosis according to definitive surgery histopathology.

There were no complications recorded with all core needle biopsy procedures. Infection not only wasn't reported but also the wound incision healed adequately. Hospital stay was 2-6 hours postoperatively.

Closed method of core needle biopsy showed a positive predictive value of 97.1% (104/107), a negative predictive value of 91.1% (41/45), a

sensitivity of 96.2% (104/108), and a specificity of 93.1% (41/44).

In this study, the core needle results were matched the final histological results in 95.3% (145/152) of biopsied tumours, which represent the diagnostic accuracy for benign and malignant cases. Despite of high percentage of matching results, 7 core biopsy results did not match the final histological results; 4 were considered non-malignant (3 benign and one infection) but turned out to be malignant. More 3 cases considered as malignant but turned out to be benign (Table 3).

No	Age	Site of specimen	Core needle biopsy diagnosis	Definitive surgery diagnosis
1	52 years	Lt femur	Telangiectatic Osteosarcoma	Aneurysmal bone cyst
2	36 years	Proximal Right femur	Conventional Osteosarcoma	Heterotopic calcification
3	13 years	Left distal femur	Low grade Osteosarcoma	Benign Chondroid Lesion
4	15 years	Right distal ulna	Hemorrhagic cyst	Telangiectatic Osteosarcoma
5	10 years	Diaphyseal left femur	Chronic osteomyelitis	Ewing's sarcoma
6	17 years	Lt distal Femur	Chondroblastoma	Malignant Fibrous Histiocytoma
				Pleomorphic sarcoma
7	24 years	Right proximal tibia	Gaint Cell Tumour Bone	Conventional Osteosarcoma

Table 3: Mismatch of core needle biopsy and final histological diagnosis.

In fact, the 152 studied core needle biopsies were reported as adequate core samples. The chunk of tissue provided by core needle biopsy were when indicated subjected to immunohistochemistry stains and special tests in order to comment on tumour architecture, interrelation of its cells, nature of neoplasm (benign/malignant), subtype and to reach the accurate diagnosis.

Discussion

Open biopsy carries many complications and risks. It has longer postoperative hospital stay compared to the closed method of biopsy. The possible risk of surgical wound infection in open biopsy may lead to unintended delay for receiving the neo-adjuvant chemotherapy in malignant bone sarcoma. The main purpose of giving the neo adjuvant chemotherapy is to control and kill the blood micro metastasis, thus delay had a significant impact on the overall survival and recurrence rate. Moreover, complication such as seeding of tumour cells in surrounding tissue and hematoma may be encountered in open biopsy technique [4-10]. Complications rate of an open biopsy is reported in literature to be 8%-16% [10].

Many publications have assessed the reliability of use of closed method of core needle biopsy compared to open method based on calculation of sensitivity and specificity, Predictive Positive Value (PPV) and Predictive Negative Value [2,11-15] (Table 4).

Sarcomas of the bone are relatively rare tumors and account for less than 1% of all malignant tumors [16,17]. The protocol for management of malignant bone tumour is completely different from benign one and more different among malignant types and subtypes. Thus, reaching non-skeptical, accurate diagnosis within suitable time frame is a corner stone that directly reflected on better prognosis and high possibility to achieve limb salvage procedure [18,19].

No	Total number of cases	Author et al	year	Journal	sensitivity	specificity	PPV	PNV
1	50	Kaur	2016	J cytology	94.70%	100%	-	-
2	73	T.Taupin	2016	Diagnostic and Interventional imaging	93.10%	100%	100%	99.90%
3	155	J.Walker	2000	Cancer	82%	100%	100%	82%
4	134	Chusheng Seng	2013	J.Orhopedic surgery	95%	97%	-	-
5	143	Mitsuyoshi	2006	J.surgical oncoloy	97%	88%	-	-
6	77	Pohlig	2012	European J.Medical Science	88.80%	100%	100%	83.30%

Table 4: Results of some published literature regarding reliability of core needle biopsy.

In this study the numbers of the malignant diagnosed cases-108, were equivalent of about more than two and half times like benign tumor-40. This is in contrary to the prevalence of bone tumour in literature, in which the benign cases are almost 100 times more common as compared to the malignant tumours [20, 21]. The true frequency of musculoskeletal neoplasms is difficult to be estimate in this 152 case study because most of the benign neoplasms are not treated or dealt with by general orthopaedic surgeon elsewhere. The specialized units most likely received the more advanced cases; hence the frequency of malignant is more than the benign in our study.

The sensitivity and specificity of core needle biopsy in this study are corresponds to what is published in literature. Sensitivity was 96.2% compared to range (82%-97%), while the specificity 93.1% compared to (88%-100%) [2,11-15].

The high percentage of predictive values for positive 97.1% and negative 91.1% in this study is well noted and may be read with high percentage of matched biopsy samples 95.3% and subsequently should be interpreted as an indicator of high diagnostic accuracy of core needle biopsy in reaching the final diagnosis for malignant and benign bone tumours.

The mismatch is accounts small number-7 which is equal to 4.7% of study cases. However, still considered reasonable percentage; but occurred during the early steps of building an oncology unit and under special circumstances such as taking the biopsy sample from fracture side in pathological fracture cases. Obviously, the mismatch biopsy sample decreased lately due to improvement of learning curve.

We encountered no complication with core needle biopsy, and this is supporting the evidence that it has lesser chance of local complications as well as contamination of tumour cells in the surrounding tissue as compared to an open biopsy [22,23].

Conclusion

Core needle biopsy could be adopted as standard method for biopsy, in view of its high sensitivity, specificity, predictive positive value and predictive negative value. Last not least, easy to perform provide enough tissue for further ancillary studies, and of lesser chance for local complications. Core needle biopsy is a reliable method in reaching final diagnosis in malignant bone tumours.

Conflict of Interest

No conflicts of interest were declared by the authors.

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