Original Article

Tru-cut biopsy as the initial method of tissue diagnosis in bone tumors with soft tissue extension

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Abstract

Background: Tru-cut biopsy in suspected bone tumors can be performed even in less specialized centers. Tru-cut biopsy has been proved as safe with more than 90% accuracy. However, its usefulness was not widely studied in general hospitals where Tru-cut biopsy is performed by orthopedic surgeons. This study was conducted to find out the accuracy and adequacy of Tru-cut biopsy performed by an orthopedic surgeon not trained in musculoskeletal oncology, in a general hospital.

Materials and Methods: A study was conducted through a prospectively collected database using a uniform protocol. All patients who had a malignant appearing bone lesion with a palpable soft tissue mass were included in the current study. Fifty such consecutive cases underwent Tru-Cut biopsy by orthopedic residents or registrars who were aware of the principles of Tru-cut biopsy and the recommendations of Musculoskeletal Tumor Society. When an open biopsy or a resection of the tumor was subsequently performed, the histological diagnosis was compared for accuracy with the diagnosis of needle biopsy. We evaluated adequacy of sample obtained and accuracy of diagnosis in terms of sensitivity, specificity, positive predictive value, and negative predictive value.

Results: Seventy seven cases were initially enrolled. Out of which 18 were excluded and 59 patients were biopsied. Out of which 50 were analysed. Only 4 out of 50 biopsied specimens were inadequate resulting in an adequacy rate of 92%. Among 46 cases, which were analyzed for diagnostic accuracy, 84.78% had true-positive result, 8.69% had true negative, and 6.52% had false-negative report. The sensitivity and specificity of Tru-cut biopsy in our series was 92.85% and 100%, respectively, with positive predictive value of 100% and negative predictive value of 57.14%.

Conclusions: Tru-cut biopsy can be recommended as an initial method of tissue diagnosis in musculoskeletal tumors with soft tissue extension.

Key words: Diagnostic accuracy, musculoskeletal tumors, tru-cut biopsy

Introduction

It is generally recommended to perform biopsy in specialized centers which may not be feasible in countries with less resources. A safe and accurate biopsy technique that can be performed even in less specialized centers by general orthopedic surgeons and yet does not have adverse effect on outcome and prognosis will be ideal in our context.

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Tru-cut biopsy of suspected primary bone neoplasm is a well established procedure, with a good accuracy[1-9] and low complication rate.[4,7] Although most tumors have a palpable mass at the time of presentation, very few studies have been carried out in developing countries to evaluate the accuracy of Tru-cut biopsy performed by general orthopedic surgeon with palpation technique.[7] This study was carried out to evaluate the accuracy and adequacy of Tru-cut biopsy by palpation technique, performed by orthopedic surgeon not trained in musculoskeletal oncology in a general hospital.

Materials and Methods

A prospective study was conducted between November 2005 and November 2011 to evaluate the diagnostic accuracy of Tru-cut biopsy and the adequacy of tissue obtained by Tru-cut. The data was collected using a uniform protocol. The study was approved by our Institutional Review Board and all participants provided informed written consent. Patients who had a bone lesion with a palpable soft tissue mass were included in the current study. Any patient with a bony lesion without palpable mass, or who had undergone

a recent biopsy, or had an inaccessible soft tissue mass, or a soft tissue mass of benign appearance with characteristics of lipoma on MRI were excluded from the study. After performing all the radiological investigations, Tru-cut needle (Baxter healthcare Co., 16G Chicago, USA) biopsy was done on an outpatient basis, unless they had been admitted for other reason. All the biopsies were performed by orthopedic residents or registrars who were aware of the principles of Tru-cut biopsy and the recommendations of Musculoskeletal Tumor Society.[2]

Operative procedure

The skin was prepared with a sterile technique. Local anesthetic (2% xylocaine with adrenaline 1:200000) was injected subcutaneously, and a stab wound was made with a number-11 surgical blade. The stab incision was placed such that it could be incorporated in subsequent definitive surgery. Mass was located by palpation and two to four passes were made through the mass in different directions depending on the quality of specimen obtained through the same stab incision. The specimens were immediately fixed in formalin. Pathologists were provided with all clinical details, radiological findings, and clinical provisional diagnosis along with the biopsy specimen. They were requested to fill a form which required their opinion regarding the adequacy of specimen and the Tru-cut biopsy diagnosis. When an open biopsy or a resection of the tumor was subsequently performed, the histological diagnosis was compared for accuracy with the diagnosis of needle biopsy.

To determine the accuracy of diagnosis, we used the following definitions: (1) a true-positive result in which the needle biopsy provided lesional tissue and a correct diagnosis; (2) a true-negative result in which the needle biopsy produced no lesional tissue and no tumor was present; (3) a false-positive result when the needle biopsy provided lesional tissue which was diagnosed as tumor when no tumor was present; and (4) a false-negative result in which the needle biopsy produced no lesional tissue, but tumor was present, or there was a mismatch in the diagnosis between the needle biopsy and open biopsy.[10] The sensitivity, specificity, positive predictive value, and negative predictive value were calculated using Microsoft Office Excel 2007. Diagnostic yield was calculated by the formula: [number of diagnostic cases/total number of cases] × 100%, with the numerator equaling the number of interpretable samples and the denominator equaling the number of samples submitted for interpretation. The complications after the Tru-cut needle biopsies were also documented.

Results

Seventy seven cases of suspected (radiologically and clinically) malignant tumors of musculoskeletal system were initially enrolled. Eighteen cases were excluded from the study, 6 had no soft tissue extension in MRI so they underwent biopsy with Jamshidi needle under C-arm guidance, 10 tumors were not accessible to palpation, these required ultrasound or CT guided tru-cut biopsy, and 2 patients decided to go elsewhere for management, so biopsy was not performed. A total of 59 patients were biopsied during the study period with a mean age of 26.72 years (range 15-76 years). 4 patients were lost to followup, 3 died before the final treatment was instituted, and 2 refused to undergo further treatment as the tumor was advanced and they had distant metastasis. So, for final analysis of diagnostic accuracy we had only 50 cases. The most frequent location of the tumor was around the knee ($n = 27$, 54%) [Table 1].

Only 4 out of 50 biopsied specimens were reported as inadequate with the adequacy rate (diagnostic yield) of 92%. Among the 46 Tru-cut biopsy results available, the most common diagnosis was osteosarcoma in 24 (52.17%), followed by chondrosarcoma in 7 (15.12%), and giant cell tumor in 4 (8.69%) cases [Table 2].

Among 46 cases which were analyzed for diagnostic accuracy, 39 (84.78%) had true-positive result, 4 (8.69%) had true–negative, and 3 (6.52%) had false-negative report [Table 3]. The sensitivity and specificity of Tru-cut biopsy in our series was 92.85% and 100%, respectively, with positive

Table 1: Site distribution of tumors

Site of tumors	Number of cases (%)
Proximal tibia	16 (32)
Distal femur	11 (22)
Humerus	6 (12)
Pelvis	5 (10)
Distal tibia	4 (8)
Shaft of tibia	2 (4)
Proximal femur	2 (4)
Calcaneum	2 (4)
Clavicle	1 (2)
Distal radius	1 (2)

Table 2: Types of tumors as diagnosed by Tru-cut biopsy

Type of tumor	No of cases (%)
Osteosarcoma	24 (52.17)
Chondrosarcoma	7 (15.12)
Giant cell tumor	4 (8.69)
Ewing sarcoma	2 (4.34)
Chondromyxoid sarcoma	2 (4.34)
Plasmacytoma	2 (4.34)
Langerhan's cell histiocytosis	1 (2.17)
Pigmented villonodular synovitis	2 (4.34)
Tunercular synovitis	1 (2.17)
Intraosseouslipoma	1 (2.17)

predictive value (PPV) of 100% and negative predictive value (NPV) of 57.14%.

No major complications were recorded. Two of our patients complained of significantly increased pain after the biopsy, requiring analgesics for pain control.

Discussion

There is general agreement to have a histological diagnosis before starting definitive management of bone tumors, the optimum method of biopsy is still subject to debate.[11-13] Open biopsy is considered the gold standard, but is feared due to significant contamination of surrounding tissue with tumor cells.[14] The contamination, however, had minimal significance because most of the malignant tumors of the extremities were treated with amputations in the past.[1] At present, as a result of advances in chemotherapy, surgical techniques, and availability of custom made prostheses, amputations have largely been replaced by limb salvage surgeries,[15] but improperly performed open biopsy remained one of the most common causes of amputation in a salvageable limb.[2]

In 1982, Musculoskeletal Tumor Society reported that in about 18% of patients the treatment plan had to be altered due to inappropriate open biopsy. Four percent had an amputation and in 8.5%, the biopsy had an adverse effect on prognosis or outcome. These findings were three to five times more frequent when the biopsy had been performed in a referring institution rather than in a treatment center.[16] Despite the extensive recommendations, the authors found a nearly identical complication rate with open musculoskeletal biopsies in their followup study 14 years later. The society had restated the previous recommendations and emphasized the importance of venue of biopsy.[2]

Referring all the patients with suspected tumors may not be feasible in many parts of the world, where there are no referral systems, limited specialized institutions and paucity of musculoskeletal oncologists. Hence, there was a need for a safer biopsy technique that can be carried out by any surgeon which is user friendly, has fewer complications and yet does not have adverse effects on outcome and prognosis. Tru-cut biopsy of suspected primary bone neoplasm is a well-established procedure, with a reported accuracy in diagnosis ranging from 69% to 99%[1-9] and low complication rate of 0% to 6%.[4,7,16] Authors have used ultrasound,[10] CT scan,[17] fluoroscopy,[18] and even MRI[19] to guide the needle to the correct location to improve the accuracy of needle biopsy but there is no clear evidence of their advantage.[20] Although we lack enough published data, but most of the malignant musculoskeletal tumors when they present to clinician in developing countries already have a palpable mass. In our series of 77 cases only 6 (7.8%) had tumor without soft tissue extension and 10 (12.9%) were inaccessible to palpation. So, we believed that palpation technique will be appropriate in most of the cases who have palpable mass.

Table 3: Diagnostic accuracy of Tru-cut biopsy

Diagnostic accuracy	No. of cases	%
True-positive	39	84.78
True-negative	4	8.69
False-positive	0	0
False-negative	3	6.52

Although Mankin[16] reported 40% diagnostic errors, rates of altered treatment and altered outcome as a result of needle biopsy were significantly lower than those for open biopsy. Over the years, the technique and proper selection of patients improved the accuracy of needle biopsy and now it is been even considered as substitute to open biopsy.[4] Forty-six (92%) samples out of 50 in our series were adequate. Adequacy (diagnostic yield) was defined as the sample which can be interpreted and have pathological tissue on the basis of which a diagnosis can be achieved. Higher adequacy indicates the effectiveness of the method itself, whereas accuracy depends upon other factors also like experience of the pathologist. The adequacy of palpation technique in our series was similar to those with fluoroscopy, ultrasound, CT, or MRI guided techniques.[10,19,21,22] The palpation technique seems to be equally effective, and is more feasible as it can be performed without the need of any equipments and it is cost effective as well.

The sensitivity (92.85%), specificity (100%), PPV (100%), and NPV (57.14%) of our series is similar to that of the similar published articles and with the ones done under ultrasound, fluoroscopy, CT, and MRI guidance.[5,10,11,13,19,20,23-25] These localizing technique will have a definitive advantage if the tumor is not palpable or if they are deep and near a neurovascular structure. Using these devices, the neurovascular structure can be bypassed, but for tumor which is palpable and location of neurovascular structure are known from radiological investigations, simple palpation technique will guide the needle to correct location. In 10 tumors which were not amenable to palpation and were excluded from the study, we used ultrasound in six cases, fluoroscopy in one case, and CT in three cases.

All the 50 Tru-cut biopsies in our series were performed by an orthopedic surgeon not specialized in musculoskeletal oncology and though our center is a referral center, it is not a specialized center for musculoskeletal oncology. Although Mankin[2,16] emphasized the venue and the specialist doing biopsy, there are few articles stating that needle biopsies performed by all physicians had equal rates of diagnostic

accuracy whether or not they were at a specialized center. They found that the accuracy is not significantly different when the biopsy was performed by radiologists, pathologists, general surgeons, general orthopedic surgeons, or sarcoma specialists.[20,26] We also believe that any physician who is aware of basic principles of musculoskeletal tumor biopsy and have the basic skills of performing the Tru-cut biopsy, can perform the procedure even in less specialized centers. These facts have emphasized the value of Tru-cut biopsy as an initial method of tissue diagnosis. It can be repeated at any given time, and if the results are inconclusive open biopsy can be performed in a more specialized center. Considering the fact that all the Tru-cut biopsies in our series were performed by general orthopedic surgeon without using localization devices and the specimen were analyzed by general pathologist (not specialized in musculoskeletal pathology), this method seems to be a reliable technique in an area where the facilities are limited and specialist are not readily available.

Three of our patients had diagnostic mismatch (false negative report), a case of Langerhan's cell histiocytosis, and one case of plasmacytoma was reported as osteosarcoma. Both of these two cases were associated with pathological fracture. Four cases had true negative results, two of them were pigmented villonodular synovitis of knee, one was tubercular synovitis of knee, and one was intraosseous lipoma of calcaneum. Two patients had significantly increased pain after Tru-cut biopsy, which were successfully treated with analgesics. We performed ultrasound examination of both the cases on emergency, which revealed intralesional hematoma. Only Olscamp[27] in his series reported psoas hematoma after Tru-cut biopsy. The final treatment did not have to be altered in any of our cases because of biopsy related problems. Out of these 46 available reports, 11 patients were taken up for open biopsy as the needle biopsy reports were not matching with the radiological features or clinical presentation. Only three of these had diagnostic mismatch.

In conclusion tru-cut biopsy is a reliable method to obtain representative tissue for histopathological examination of bone tumors with soft tissue extension. It is accurate, simple to perform, less expensive, almost free from complications.

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