CT guided percutaneous vertebral body biopsy: Our experience in spine mining


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Abstract

Background: CT guided biopsy of the spine is considered a safe, accurate and relatively inexpensive technique. The authors present data of a retrospective study of 52 CT guided biopsies of the spine observed over a period of one year in a tertiary care hospital of southern India. Objectives: To discuss the methodology of percutaneous CT-guided biopsy of spine and determine its diagnostic accuracy and clinical usefulness in the hands of a novice. Methods: Spine biopsy was performed using Ackermann Bone Biopsy Needle Set with 16 slice GE Optima CT. Most cases were under local anaesthesia and in prone position. Bone and soft tissue specimens obtained were sent for histopathological analysis. Results: Out of 52 patients, 40 were males and 12 females with ages ranging from 3 to 74 years. There were 20 dorsal, 28 lumbar, and 4 sacral lesions used as biopsy sites. Histopathologically confirmed reports were 38 in number and biopsy inconclusive were 14 in number with a diagnostic accuracy of 73%. Pathological specimens revealed 6 metastasis, 1 lymphoma, 2 plasmacytoma, 1 Ewing’s sarcoma, 2 hemangiomas, 2 GCT/ABC and 24 infections [16 tubercular and 8 others]. Minor complication was noted in one patient who experienced radicular symptoms (1.2%). Conclusion: CT guided biopsy is safe and has good accuracy in the evaluation of spinal lesions even in the hands of a novice. Higher diagnostic accuracy rates can be obtained with the experienced hands, use of both 1 and 2 cm biopsy needles, obtaining two or more bone specimens, and adjunctive use of soft tissue wherever necessary.

Introduction

A wide variety of lesions involve spine, spectrum including vascular lesions, metabolic diseases, infections, and tumours. Magnetic Resonance (MR) imaging with its multiplanar capabilities, high soft tissue, and contrast resolution plays a pivotal role in characterization, diagnosis, and differentiation of these lesions. However, a definitive diagnosis based solely on radiological and laboratory investigations is not always possible, particularly in differentiating primary and metastatic tumours, specific and nonspecific infections, and metabolic diseases. Accurate diagnosis of spine lesions is important for its successful management. Therefore, a biopsy is generally necessary for accurate diagnosis.1

Open biopsy is a major surgical procedure associated with problems, such as those related to general...
anaesthesia, local spread of malignant tumours, longer hospitalization period, high costs, and resultant morbidity and usually precludes a second surgical intervention using the same approach. Image guided percutaneous biopsy, an alternative technique is a relatively safe and effective technique and can avoid most of these problems. Percutaneous needle biopsy was first described by Robertson and Ball in 1935. CT is currently the modality of choice for guiding biopsy of lesions of the spine.

Aim
To discuss in brief the methodology that we followed to perform CT guided biopsy and determine its diagnostic accuracy and safety at the hands of novice interventional radiologists under training involved in the study.

Methods
The study group consisted of 52 patients (40 men, 12 women) aged 3 to 74 years who underwent CT-guided lumbar (n=28), thoracic (n=20) and sacral (n=4) bone biopsy in our center from September 2014 to September 2015. Lesions involving cervical vertebrae were not biopsied. Procedure was done on a day-care basis. Coagulation profiles of all the patients were normal and informed consent was obtained before the procedure. The radiologist performing the procedure reviewed all priorly done imaging [CT/MRI] to ensure that biopsy was indicated and to determine the most appropriate biopsy site. Operating radiologists had 0 to 2 years of experience in performing these procedures. Spine biopsy was performed using Ackermann Bone Biopsy Needle Set (Cook Medical, Bloomington, IN) under CT guidance (16 slice GE Optima CT). Almost all cases were done under local anaesthesia and in prone position with a support under the abdomen to ensure patient comfort. GA was required for a three-year-old child and one patient was placed in lateral decubitus position due to restricted mobility. Back area was shaved if required.

Following preliminary axial CT scanning with a grid of radiopaque skin markers, the most appropriate slice and entry point was selected. Under aseptic precautions, skin entry point was first infiltrated with 5 ml of lignocaine, then using a 20G LP needle additional 5 ml of lignocaine was injected at the periosteum. Before removing the needle, a thin slice CT acquisition (1.25 mm) was taken covering just area of interest. This gives a better idea of trajectory to be further used while inserting bone biopsy needle. A small nick was given at the skin surface using an 11 no. scalpel blade and compressed for a minute. A 12 guage Ackermann Bone Biopsy Needle guide and stylet were then inserted, maintaining trajectory, into the superficial part of bone for support. Three approaches were used: posterolateral, transcostovertebral and transpedicular (Figures 1, 2, and 3).
CT cuts were taken to confirm the required position and trajectory. Once the correct position was established, the needle guide and stylet were drilled further using rotating movements until it reached the lesion. Then, the stylet was removed and both short (1 cm) and/or long (2 cm) needles were introduced into lesion with rotating movements. It was then pulled back giving a small initial anticlockwise rotational movement. Stylet was inserted back into the needle guide to prevent bleeding, if any from the tract. Bone specimen was collected in a specimen bottle containing formalin. Procedure was repeated if required.

One to two bone and/or soft tissue specimens obtained were sent for histopathological analysis and reports were collected. Lateral decubitus procedural complications, if any, were noted. Once the required specimens were obtained, both trocar and cannula were removed and the site was compressed for about two to three minutes to achieve hemostasis. Bandage was applied and analgesic was given, if required. The patient was kept lying in prone position for 30 minutes; and was further observed for an hour for any bleeding from the site of entry and then discharged.

Observations and Results

Histopathologically conclusive diagnosis was possible for 38 patients and was inconclusive for 14 with a diagnostic accuracy of 73%. Pathological specimens revealed metastasis (n=6), lymphoma (n=1), plasmacytoma (n=2), Ewing’s sarcoma (n=1), haemangiomas (n=2), GCT/ABC (n=2) and infections (n=24, 16 tubercular and 8 others).

The procedure was well tolerated by all patients. Only 1 patient (1.9%) complained of radicular symptoms during the procedure which, however, subsided on adjusting the track of needle. No immediate/delayed post-procedural complications were noted. The Figures 4, 5, 6, 7, and 8 display CT scan of giant cell tumour with aneurysmal bone cyst conversion, aggressive haemangioma, Ewing’s sarcoma, adenocarcinoma metastasis with brain, vertebral and lung metastatic lesions and tubercular osteomyelitis showing targeting of subchondral bone respectively.

Discussion

Percutaneous biopsy has been successfully performed for the last 70 years and CT has been the imaging investigation of choice that allows faster imaging and more precise localization of lesion, minimizing the risk and discomfort to the patient. Three approaches were used in our study. Selection of approach was mainly based on level and part of vertebra involved and width of the pedicle.

Transpedicular approach requires introduction of the needle through pedicle with adequate width. In our experience, this approach is best for lesions in lower thoracic and lumbar levels where the pedicle width is greatest. Inside diameter or cancellous pedicle width ranges from slightly more than 1 mm at T4 to slightly less than 6 mm at L5 and outside pedicular diameters varies between 4.5 mm at T5
Ullas UA et al: CT guided percutaneous vertebral body biopsy: Our experience in spine mining

Figure 5: Case of aggressive hemangioma

Figure 6: Case of Ewing’s sarcoma

Figure 7: Case of adenocarcinoma metastasis with brain, vertebral and lung metastatic lesions.

Figure 8: Case of tubercular osteomyelitis showing targeting of subchondral bone.
at T5 and 18 mm at L5.\textsuperscript{4,5} Where inside pedicular diameters measure less than the outside diameter of the biopsy needle, the outside diameter of the pedicle still allows transpedicular biopsy. Stringham et al in their study concluded that vertebral pedicle provides a safe conduit for biopsy of most vertebral body lesions and percutaneous transpedicular biopsy can be performed with minimal morbidity and high diagnostic yield.\textsuperscript{6} Transcostovertebral approach is best suited for upper and mid thoracic lesions in which pedicle width is much smaller and provides a stable (anchored between bones on either side) and a safe trajectory avoiding pleura laterally and spinal canal medially. Edward Bailey et al in their study had suggested this approach for upper thoracic lesions.\textsuperscript{9} Another approach used was posterolateral vertebral approach at lumbar level, which provided better accessibility to lesions involving mid and deeper parts of vertebral body.\textsuperscript{10}

Various commercially available core bone biopsy needle sets include Trap system, Craig-Kogerler set, Bonopty set, and Ackermann’s set.\textsuperscript{11} In this study, we used the Ackerman Needle which has the advantage of a coaxial system rendering safer biopsy retrieval with decreased need to repuncture as several samples may be obtained via a single tract; however it can cause crush artifact in a few cases and can make histologic diagnosis difficult.\textsuperscript{7} The 12 G size needle was well suited for lesions in lumbar, sacral as well as thoracic vertebrae.

Diagnostic accuracy of 73% in our study correlates well with those found in the previous studies (67% to 97%).\textsuperscript{5,12,13,14,15} One of the largest series of 430 biopsies, published by Rimondi et al reported a diagnostic accuracy of 93.3%.\textsuperscript{11} Our study reestablishes accuracy of CT guided vertebral biopsy, which obviates the requirement of an open biopsy and helps in correct management even in less experienced hands.

The reported complications in the literature include bleeding, needle breakage, radicular pain, infection, neurological injury, including paresis or paralysis, pneumothorax, and tumour seeding along the needle track.\textsuperscript{1} Complication rate in the literature ranges from 0–26%.\textsuperscript{2} In our study only one patient (1.9%) complained of radicular symptoms during the procedure which, however, subsided on adjusting the track of needle. No other significant complications were noted. Rimondi et al, also in their study reported complications in 9 out of 430 biopsies which resolved spontaneously.\textsuperscript{11} Such low complication rates even in the hands of less experienced operating radiologists uphold the safety profile of percutaneous CT guided biopsy. Diagnostic accuracy of CT guided vertebral biopsy can further be improved by the following steps.

**Steps recommended to improve diagnostic accuracy include**

Comfortable positioning of patient wherever possible.

Use of coaxial technique and both short (1cm) and long (2cm) biopsy Ackerman needles which enables one to retrieve two or three biopsies through a single tract at varying depths for better diagnosis.

To obtain at least two to three bone specimens ideally from different parts of the lesion ensuring representative sampling and adjunctive use of soft tissue biopsies wherever necessary.

Presence of a cytotechnologist, if possible, during the procedure to confirm adequacy of the biopsy specimen.

**Conclusion**

CT guided biopsy is an accurate and safe tool in the evaluation of spinal lesions, even in the hands of less experienced operating radiologists, which may preclude the need for open surgical intervention.

**COI:** The authors state that they have no conflict of interest

**References**
