CT Guided Biopsies: Radiological and Pathological Correlation

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SUMMARY. Purpose: Overview of our experiences in taking the CT guided biopsies of musculoskeletal lesions during the period of sixteen months, analysis the validity of taken samples and correlation with pathological findings. Material and methods: CT guided biopsies of musculoskeletal lesions were performed in 32 patients during the period of sixteen months. Age range was from 13 to 78 years. Majority of the biopsies were performed with coaxial cutting needle system (14 G and 16 G) with introducer’s size 13 and 15 G. Bone biopsies were performed with Yamsidi needles in purpose of taking the bone cylinder. Majority of the biopsies were performed under local anesthesia except a thirteen years old child to whom CT guided biopsy of corpus Th 6 was performed under general anesthesia. Two samples of tissues were sent in formalin solutions to Institute of Pathology for pathological verification. Results: In one case of musculoskeletal lesions CT guided biopsies didn’t yield a representative tissue sample. We had high level of congruence between radiological and pathological findings; precise presented in the article. Conclusion: CT guided biopsies of musculoskeletal lesions are method of choice for pathologic verification of musculoskeletal lesions proving incomparable less risk compared to «open» biopsy which requires operating theatre and general anesthesia. Coaxial needle systems have shown as suitable for yielding representative tissue samples [two samples for each patient], and samples are also appropriate for imuno-histochemical analysis. Keywords: musculoskeletal lesions, CT guided biopsies, radiological correlation.

1. INTRODUCTION

Percutaneous needle bone biopsy is a safe and accurate method for obtaining a tissue diagnosis (1, 2, 3, 4, 5). In general, superior results are obtained with lesions in the extremities or pelvis compared with those in the spine (6). Percutaneous needle biopsies have a very low complication rate (1.1%), whereas open biopsy has a complication rate of up to 16% (7). A concerning complication of percutaneous biopsy is the risk of seeding malignant cells along the needle track, particularly if the lesion is a sarcoma, which would necessitate resection of the needle track en bloc with the tumor at limb-sparing reconstructive surgery (8). Thus, choosing the appropriate needle path is critical for limb-salvage procedures.

Thorough prebiopsy imaging review is essential, and further imaging may be necessary. Close attention should be paid to evaluating the extent of the lesion and whether skip lesions are present because these factors determine the extent of resection and the feasibility of limb-salvage surgery. In patients with multiple lesions, the lesion that is most amenable to biopsy, allowing the highest yield with the lowest risk of complications, is selected. The presence of multiple lesions is also important because biopsy of a potential metastasis has different considerations compared with biopsy of a primary bone tumor (10). Fine-needle aspiration (FNA) can differentiate a metastasis from a benign lesion; however, core biopsy is superior to FNA in determining cell type and tumor grade, which is necessary for the diagnosis of primary bone tumor. Primary bone tumors necessitate thoughtful percutaneous track planning with limb-sparing resection and rehabilitation in mind, whereas for metastases, the route is less important because seeding is of questionable concern and the shortest and most direct route is usually used. As a general rule, if the lesion is not metastatic—that is, if it is a primary bone tumor or there is uncertainty about metastatic disease, we treat it as if seeding of the biopsy track may occur and an appropriate percutaneous route is used.

Painful lesions, such as neurogenic tumors, or lesions in the hand and foot may require a regional nerve block. Liberal periosteal anesthetic infiltration is often helpful to minimize pain. The enhancing regions of a soft-tissue mass as seen on contrast-enhanced CT or MRI should be sampled, as should the center and periphery of the lesion. In addition, if a mass is calcified or ossified, sampling the least mineralized portion often shows the highest atypia (9). Biopsy samples from two or three different locations in a single lesion, especially a large lesion, may be obtained. An adequate biopsy sample is one that provides enough abnormal tissue for a pathologist to comfortably make a diagnosis. Sometimes, we divide this core into two pieces, one piece each for histology and bacteriology. If the lesion is large, two or three cores obtained with a 14- or 16-gauge needle have proved adequate, but five to eight or more cores may be necessary if the cores are obtained with...
a small-gauge needle; we rarely obtain such small cores of tissue. Two or three partial cores count as a “single” core, and all fluid aspirated is sent routinely for evaluation. With cystic lesions or lesions in which the majority of the lesion is necrotic, we obtain multiple cores through both the superficial and deep margins of the lesion. If blood is aspirated from the lesion, the clotted blood should be sent for pathologic evaluation.

Differentiating infection from tumor is difficult because infection often appears aggressive at imaging and may simulate malignancy. For this reason, we sent the specimens for both pathologic and bacteriologic evaluations. The shortest path between skin and lesion that avoids neurovascular and joint structures, lung, bowel, and other organs is optimal. For primary bone lesions for which limb-sparing surgery is contemplated, every effort must be made not to contaminate a disease-free compartment. If a sarcoma or a primary tumor is suspected, seeding is a concern, and further specific principles are followed: First, the needle path must be close to the incision for the definitive limb-sparing surgery so that the needle path can be resected. Second, the needle should not traverse an uninvolved compartment, joint, or neurovascular Bundle (8-10). This is particularly relevant if these structures are needed for reconstruction. Third, avoiding the physes will allow the option of physis-sparing surgery in the skeletally immature. The biopsy should be considered part of the surgical therapy, and a team approach with the surgical oncology team is critical for a positive outcome. If a sarcoma or a primary tumor is suspected, the decision for working up the patient before biopsy of a suspected primary bone tumor (8, 9, 10, 11).

1.1. The Upper Limb

The deltoid and pectoral muscles are typically used for reconstruction at the shoulder. Because the deltoid muscle is innervated by the axillary nerve from posterior to anterior, en bloc resection of a posterior needle track may denervate and leave functionless the more anterior muscle. A proximal humeral lesion should be approached through the anterior third of the deltoid. The deltopectoral groove is to be avoided because this approach may compromise the use of pectoral muscle for reconstruction and may contaminate the main neurovascular bundle of the upper limb.

1.2. The Forearm

The interosseous membrane between the radius and ulna forms a natural barrier to the spread of tumor. When sampling lesions through the extensor compartment, the flexor compartment should not be traversed and vice versa. It is optimal to biopsy the ulna at its subcutaneous border; if this approach is not possible, contamination of the extensor carpi ulnaris or flexor carpi ulnaris is associated with the least morbidity after resection.

1.3. The Pelvis and Lower Limb

The Pelvis

For primary lesions of bone, if at all possible, avoid traversing the gluteal muscles posteriorly and the rectus femoris muscle anteriorly. Resection of the glutal muscles is associated with a poor outcome after limb-sparing surgery because these muscles provide a significant proportion of functionality after surgery. An anterior or posterior approach through the ilium avoids the glutal musculature. If the lesion is a suspected metastasis, stabilization with hardware rather than resection may be used; therefore, the shortest path may be chosen.

1.4. The Thigh

An anterior approach through the rectus femoris muscle should be avoided.

Resection of these extensor muscles—in particular, the rectus femoris muscle—provides suboptimal results during limb-sparing surgery. If a lesion is closely apposed to the femoral vessels, a medial approach is preferred because a medial incision facilitates vessel exploration. The lateral approach is often more ergonomically feasible and avoids the medial neurovascular structures, especially if the vastus lateralis muscle is involved without vascular involvement.

In the distal thigh, the suprapatellar recess may extend for a varying distance proximally and should be avoided along with the remainder of the knee joint. For a medial approach, we may either elevate the leg to be biopsied or flex and externally rotate the contralateral hip to provide easy access to the medial thigh.

1.5. The Leg

The interosseous membrane between the tibia and fibula is a natural barrier to tumor spread. Because the anterior medial tibia is subcutaneous, both compartments may be avoided.

1.6. Difficult Anatomic Regions

The Hand and Foot

The complex anatomy of the hand and foot necessitates discussion with a surgeon in planning a biopsy route.

Table 1. Detailed review of obtained results: in one case we did not yield representative tissue specimen, procedure failed once; successfull of overall biopsies were confirmed by pathologist in every other cases.
Patients undergoing biopsy of these sensitive areas may benefit from a regional nerve block. We try to avoid traversing the sole of the foot or the palm of the hand, because these areas are more sensitive to pain. Initial needle stabilization in a structure with little subcutaneous tissue at CT-guided biopsy may be challenging and often requires sterile towels around the needle for support.

The Spine
Typically, vertebral body lesions are biopsied using an approach through the pedicles. However, if the epicenter of the lesion is not accessible through the pedicles, a costovertebral approach may be considered. A tangential approach rather than one perpendicular to the pleura is favored to minimize risk of pneumothorax.

The Ribs
The diagnostic yield from a rib biopsy is higher if there is an associated soft-tissue mass. The convex superficial surface, small size, and adjacent lung make these biopsies challenging. A tangential approach rather than one perpendicular to the pleura is favored to minimize risk of pneumothorax.

3. MATERIAL AND METHODS
At the Institute of Radiology, Clinical Centre University of Sarajevo, we used two different needles of a variety that are available for bone biopsy.

A 14-gauge coaxial bone biopsy system with an eccentric drill tip (Bonopty bone biopsy system, C. R. Bard, Inc.) is used to obtain tissue from sclerotic lesions and lesions with an intact cortex. The eccentric bit allows a channel to be drilled just wider than the external diameter of the cannula of the coaxial system, so the cannula can be advanced and can act as a coaxial introducer. Through this introducer, the bone biopsy component of this system may be used, but also a soft-tissue "gun" or a fine-needle aspirate may be obtained. A 14 and 16-gauge biopsy needle (Quick-Core, Cook) is used to sample a soft-tissue mass external to bone, but it also works well through the 14-gauge Bonopty coaxial system to biopsy a soft-tissue mass within bone.

In general, we performed all bone biopsies with the patient under conscious sedation using local anesthesia; however, general anesthesia may be necessary in children or uncooperative patients, in our case we performed only one biopsy under general anesthesia to child

If a soft-tissue mass is associated with a destructive bone lesion, the biopsy was taken from the soft-tissue component and, if possible, a biopsy of an intrasosseous part of the mass is also obtained. At least two samples of tissues were sent for pathological analyses; microbiological analyses; pathological findings indicated Brucella Mellitensis.

This was the case of thirteen years old boy where we performed biopsy of Th6 vertebra under general anesthesia. Differentiating infection from tumor sometimes is very difficult because infection often appears aggressive at imaging and may simulate malignancy. Pathological report has shown infective disease.

This child was underwent to biopsy after his pathological fracture of femur had healed. Radiological report suggested enchondroma, the pathological finding has shown fibrous dysplasia. In this case we decided to use coaxial cutting needle...
4. RESULTS

We had very high level of congruence between radiological and pathological findings (87%). The percentage is even higher among the representatve tissue sample (over 90%).

In one child with suspected fibromuscular dysplasia we did not yield representative tissue sample. Open biopsy was performed and PH findings indicated enchondroma. CT biopsy also failed in patient with suspected osteosarcoma in left shoulder. We had performed CT angiography before the procedure, which has shown very rich vascularisation of the tumor, so it was over risky to yealld representative tissue sample. It was thirteen year old boy, and needed general anestesia. CT guided biopsies are comfortable for the patient, in most case we did it under local anesthesia, and did not have any complicatio. Another very important conclusion of this paper is very high percentage of infective disease, especially specific infective disease like brucellosis and tuberculosis (29%). CT guided biopsies are very suitable method for yealding representative tissue sample, comfortable for the patients, in most cases requires local anestheisa and it is very helpfull for the surgeons. Knowing pathohistologiical diagnosis before the surgery improves surgical results and long-term existing.

5. CONCLUSIONS

CT guided biopsies of musculoskeletal lesions are method of choice for pathological verification of musculoskeletal lesions providing lower risk in comparison to “open” biopsy which requires operating theatre and general anestheisa. Coaxial needle systems were proved as suitable for yielding representative tissue samples for pathological evaluation.

Cooperation between radiologist, pathologist and ortopedic surgeon was a key step which helped us to improve our results

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