Ultrasound Guided Bone Biopsy

Clinical History:

An 86 year old gentleman presented to his primary care physician with one month of sharp, stabbing chest pain centered at the sternum. The pain occurred at rest and with exertion. The patient also reported increasing fatigue and dizziness. His past medical history was notable for benign prostatic hypertrophy, hypertension, diabetes mellitus type II, coronary artery disease, colonic polyps, and several recent falls. He had a remote history of tobacco use and consumed alcohol occasionally. He was retired from the Army, widowed, and lived independently. The family history was non-contributory. A cardiac work-up was negative. The prostate specific antigen was 26 ng/ml (normal < 4), which raised concern for prostate cancer.

A whole body bone scintigraphy was obtained which demonstrated irregular, abnormally increased radiopharmaceutical activity within the inferior aspect of the sternum and the xiphoid. The finding was reported as non-specific in the setting of recent trauma, but remained suspicious for malignancy. Other areas of mildly increased radiopharmaceutical uptake in the right sternoclavicular joint, hands, wrists, right knee, and spine was thought to be degenerative in nature. Cross sectional imaging of the thorax was recommended.

A non-contrast chest CT revealed multiple lytic lesions involving the sternum, left scapula, ribs, and spine, most consistent with metastatic disease. A primary malignancy was not identified in the chest. A follow-up CT of the abdomen and pelvis also did not identify a primary malignancy.

The differential considerations included multiple myeloma, metastatic prostate cancer, or metastatic disease from an unknown primary. The patient’s primary care
provider was most concerned about metastatic prostate cancer, although a definitive diagnosis of prostate cancer had not yet been made. The primary care physician requested an image-guided bone biopsy to guide further management. Ultrasound was chosen as the safest, most comfortable, and most cost-effective imaging modality for guiding the bone biopsy in this setting. The patient received no additional ionizing radiation and did not need sedation. He returned home soon after the procedure without complications.

Figures:

Figure 1: Whole body bone scintigraphy following the intravenous administration of 26.6mCi 99mTc labeled MDP demonstrates increased radiopharmaceutical activity within the inferior aspect of the sternum which is suspicious for malignancy.
Figure 2: Non-contrast axial CT through the sternum demonstrates a lytic lesion in the sternum with cortical disruption.
Figure 3a: Transverse ultrasound through the sternum prior to biopsy depicts the lytic lesion in the sternum and the adjacent cortical disruption.

Figure 3b: Transverse ultrasound through the sternum with color Doppler is used prior to biopsy to identify nearby vasculature.
Figure 3c: Real time sonographic guidance was used during the core needle biopsy of the lytic lesion in the inferior sternum. The 16 gauge needle is identified entering the lesion in the transverse plane.

Diagnosis: Multiple Myeloma

Discussion:
Numerous studies have demonstrated the safety and efficacy of imaging guided percutaneous musculoskeletal biopsies [1, 2, 3, 4]. Ultrasound, computed tomography (CT), fluoroscopy, and magnetic resonance imaging (MRI) have all been used to effectively guide soft tissue and bone biopsies. Technical advances within CT fluoroscopy have increased the prevalence of CT guided bone biopsies, particularly in non-palpable, deep lesions [1]. However, there are many advantages to using ultrasound to guide targeted musculoskeletal biopsies.

Our case demonstrates the efficacy of ultrasound as an imaging modality to guide a technically challenging biopsy. Ultrasound offers the advantages of real-time imaging, multiplanar visualization, no ionizing radiation exposure, flexible positioning for the patient, and use of color doppler imaging to evaluate tumor neovascularity and avoid nearby vascular structures [2, 3, 5, 6]. Sonography is readily available and relatively inexpensive. Necrotic areas can be specifically avoided to improved diagnostic accuracy. Prior studies have documented a high diagnostic accuracy ranging from 83-98% with ultrasound guided percutaneous bone biopsies [2, 3, 4, 5, 6, 7]. Complications are rare [7, 8].
In our case, the lytic bone lesions in the sternum were not palpable, but were easily visualized by both CT and ultrasound. Sonography demonstrated the cortical destruction present in the largest and most inferior of the sternal lesions. This bone lesion was in close proximity to critical vascular structures in the mediastinum and to the lung. Technically, a CT guided biopsy would have been challenging given the superficial nature of the sternal lesion. The shallow tissue tract would have resulted in poor needle stability and awkwardness of needle manipulation [6, 7]. From a safety perspective, ultrasound was advantageous given the ability to observe the needle tip in real-time and to use color Doppler imaging.

In our case the patient did not require any sedation and was given 1% lidocaine locally for anesthesia. A 16 gauge Cook Quick-Core biopsy needle was used. The needle had a 2cm tissue chamber. The inner needle was advanced into the center of the lytic sternal lesion and a core specimen was obtained. Two additional core biopsies were obtained in the same fashion. After withdrawal of the needle from each core a hypoechoic tract was seen where the core had been removed. The core specimens were placed in formalin and submitted for histopathologic evaluation. Manual compression was used for hemostasis. The site was cleansed and a bandaid was applied. The patient tolerated the procedure well and there were no complications.

The patient’s histopathologic diagnosis was multiple myeloma which accounts for 1% of all neoplastic disease and is characterized by proliferation of malignant plasma cells [9]. The median age at diagnosis is 70 years [9]. Bony lesions are present in 80% of patients newly diagnosed with multiple myeloma and 58% of patients reported bone pain, according to one study [9]. Bone marrow biopsy is recommended for the diagnosis of multiple myeloma, although a targeted biopsy is not required. Routine laboratory testing such as complete blood count, chemical analysis, serum and urine protein electrophoresis, and quantification of monoclonal protein are recommended in the diagnostic work-up. Imaging with conventional radiography of the spine, skull, chest, pelvis, humeri, and femora remains the standard of care for detecting bone lesions [9]. Bone scan is not recommended routinely given its high false negative rate. Bone scan was performed in our particular case given the initial clinical concern for metastatic prostate cancer.

In conclusion, when bone lesions are indeterminate by radiographic criteria, percutaneous biopsy is warranted [4, 8, 10]. Often the imaging modality used to guide biopsy is chosen based on the characteristics of the lesion and the radiologists preference. We advocate for the increased use of ultrasound over CT for guiding percutaneous biopsies of selective bone lesions. Superficial bone lesions with near field cortical disruption are particularly amenable to ultrasound guided biopsies. Ultrasound is limited in the evaluation of deep lesions, such as bone lesions in the pelvis or vertebral bodies, in very hard sclerotic lesions, and in some bone lesions with intact cortices which attenuate the ultrasound beam [3, 6, 7]. In these cases CT guidance may be preferable.
References:


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