

Diagnostic Success, Safety and Effectiveness of (CT)-guided Percutaneous Biopsy of Bone Lesions

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Abstract

Objective: To evaluate the diagnostic success and rates of complications of computed tomography (CT)-guided percutaneous biopsy of bone lesions suspected for malignancy. **Materials and methods:** The one-year prospective study considered 20 cases undergoing CT-guided percutaneous biopsies of bone lesions. All the specimens were obtained with either 11 gauge or 18-gauge needles for bone biopsy and soft tissue biopsy, respectively. The data related to demographics, lesions and histopathological results were collected and analyzed. The biopsy findings were corroborated with the final diagnosis of the clinicians to verify the accuracy of the procedure. The percentage of diagnostic positive yield with CT-guided percutaneous biopsy was analyzed for all the selected cases. **Results:** The mean age of the study participants was 45.0 ± 28 years and 55% of them were men. Based on the biopsy findings, 12 subjects were diagnosed with primary tumors (60%) and 3 with metastasis (15%). The result was inconclusive for 5 (25%) subjects. Long bones (35%) were found to be the most common site for bone metastasis followed by spine (30%) and hip (25%). Complications were not encountered in any of the cases. Corroboration of the biopsy findings demonstrated that CT-guided percutaneous biopsy was 95% accurate in diagnosing the bone lesions. **Conclusion:** CT-guided percutaneous biopsy is a safe and effective procedure for the diagnosis of suspicious bone lesions.

Keywords: CT; Percutaneous; Biopsy; bone lesions; Malignancy; Cancer

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Introduction

Primary bone tumor and metastasis are not uncommon entities, and the former is most common in adolescents and young adults. Bone has been identified as the most preferential target for cancer metastasis. Cancers such as breast, kidney, lung and prostate account for nearly 70–80% bone metastasis. Bone sclerosis, characterized by abnormal bone hardening and increase in density, and bone metastasis have a negative and devastating impact on life activity and quality.¹ All the bone lesions discovered may not be

due to primary malignancies and proper diagnosis is paramount for the characterization. Though the occurrence of primary bone tumors are relatively rare, they degenerate into malignant metastatic neoplasms.²

As a part of systemic diagnostic approach, a biopsy is mainly performed to obtain diagnostic tissue without any obstructions to future treatments and to evaluate infection or neoplasm. It is generally considered as the most accurate diagnostic tool, as the histological evidence assists in definite diagnosis. It is used to identify the primary malignancies, and to differentiate neoplastic and inflammatory

conditions for proper treatment. Biopsy should be performed under strict oncological principles and a poorly performed one can impair the accurate diagnosis, complicate patient care and may have a negative impact on future treatments.^{3,4} Typical benign bone lesions do not require biopsy, whereas primary malignant bone tumors require biopsy and histological analysis to differentiate and grade the lesions.

Biopsy should be mainly designed based on the site and location of the lesion. The two main types of biopsy include open and percutaneous biopsies. Open biopsy is more practiced and advantageous for definitive diagnosis of malignancy and further treatment. The open biopsy can be performed in large samples and are 98% accurate, but may lead to wound complications and increased risk of local contamination. Percutaneous biopsy is mainly used in musculoskeletal lesions; it is generally safe, accurate and with minimal complications levels. However, numerous controversies prevail with regard to the diagnostic yield of these techniques, tumor seeding and rate of infection, even though percutaneous biopsy is minimally invasive nature with little morbidity.⁵

They are mostly done under the guidance of computed tomography (CT). CT-guided biopsy is considered as a safe, painless and precise method for tissue diagnosis.⁶ CT-guided biopsy is more accurate if the lesions are deep such as pelvis or spine. Moreover, it has several advantages such as cost effective, reduced morbidity, avoidance of overnight hospital stay, and early initiation of radiation therapy.⁷

The success of a biopsy mainly depends on the procedure and the adequate material it can provide for the histopathological analysis. The present study is intended to determine the rates of complications and diagnostic success of CT-guided percutaneous biopsy of bone lesions suspected for malignancy.

Materials and methods

The prospective study was carried out for a period of 1 year at a cancer specialty hospital based in south India. The study considered 20 cases undergoing CT-guided percutaneous biopsies of bone lesions for suspected malignancy. All the specimens were obtained with either 11 gauge or 18-gauge needles for bone biopsy and soft tissue biopsy, respectively. The findings of CT-guided percutaneous biopsy were corroborated with the final diagnosis concluded by the clinician based

on the extensive clinical investigations carried out. For each case, demographic details and the data pertaining to the lesion, procedure and histopathological results were collected. The lesions were characterized as lytic sclerotic, lytic, and lytic lesion with ground glass opacity. Soft tissue components were categorized as mild, moderate and nil. Other lesion-related parameters considered for the analyses were cortical break, complications, biopsy type, and primary and metastasis stages.

Diagnostic yield was interpreted from the final clinical diagnosis of all twenty patients. The percentage yield was calculated by dividing the number of subjects with positive or similar final clinical findings by CT guided biopsy divided by total number patients (20) with biopsy procedure performed.

Results

The study considered 20 patients (11 men and 9 female) with a mean age of 45.0 ± 28 years. Following CT-guided bone biopsy, 12 subjects (60%) were diagnosed with primary tumors and 3 with metastasis (15%). The diagnosis was inconclusive in 5 (25%) cases. Re-biopsy was done in two patients for better clinical diagnosis. Long bones (35%) have been identified as the most common site of bone metastasis, followed by spine (30%) and hip (25%).

Based on the evaluation of lesion-related parameters and the final clinical diagnosis, 95% (19/20) of the diagnosis was identified as positive and correct.

The diagnosis was negative only in a minor percentage of the patients (5%, 1/20). The characterization of the pathological diagnosis and final clinical diagnosis was similar in most of the cases. No complications were reported during the biopsy and after the final diagnosis.

The cortical break was observed in almost 80% of the subjects. The number of samples collected for biopsy varied from one to five within subject and the respective percentage of samples collected were sample 35%, 20%, 40% and 5%. Eleven (55%) patients exhibited primary malignancies, 1 with infection/primary tumor (5%) and 7 (35%) had metastatic malignancies. The percentage of organs affected and the percentage positive results are represented in the table 1. Histopathological evaluation by bone parts demonstrated that the metastasis was higher for vertebra (25%) and 100% diagnostic yield was noted for all lesions except femur and pubic.

Table 1: The percentage of organs affected and the percentage positive yield

| Parts affected | Histopathological malignancies by bone parts | Percentage positive yield |
|----------------|--|---------------------------|
| Vertebra | 25% | 100% |
| Femur | 15% | 67% |
| Tibia | 10% | 100% |
| Humerus | 10% | 100% |
| Rib | 10% | 100% |
| Sacrum | 10% | 100% |
| Pubic | 10% | 50% |
| Ilium | 5% | 100% |
| acetabulum | 5% | 100% |

Discussion

Image-guided percutaneous biopsy is gaining wider recognition in the field of diagnostics, as it assists in conducting investigation for an infection, determining the characteristics of a solitary bone lesion, concluding metastasis in patients with known primary tumors and ruling out malignancy in vertebral body compression. The success of CT-guided percutaneous biopsy of bone may vary from 61 to 100%. The present study has concluded CT-guided biopsy as a distinct diagnostic method with 95% accuracy in diagnosing bone metastasis.

A 2006 review by Peh *et al.* has reported CT as the modality of choice for conducting biopsy of spinal lesions. The study has also noted that the success of the procedure may depend on meticulous planning, knowledge of spine anatomy and possible complications, and indications and contraindications.⁷ A 9-year study by Garg *et al.* has found 89% sensitivity of core image-guided percutaneous needle biopsy for vertebral neoplasms. The study has noted that coaxial advancing of the 14-gauge spring-loaded cutting biopsy needle into lytic lesion has provided the highest diagnostic yield.⁸

A 2013 study by Raphel *et al.* has recommended bone biopsy for the management of patients with one known primary malignancy, and the occurrence of second malignancy, which would alter the clinical management, is suspected. The researchers evaluated the data of 482 consecutive patients and has found that in 3% of the subjects with one unknown malignancy, the presence of suspicious lesion was due to previously unknown second malignancy.⁹

An India-based study, which has evaluated 265 procedures, has validated the safety and improved diagnostic yield of CT-guided aspiration and biopsy procedures for intrathoracic lesions. The corresponding diagnostic yields noted for lung,

mediastinal, and pleural lesions were 80.7%, 74.2%, and 75%.¹⁰ A retrospective review by Toomayan *et al.* has reported that conducting CT-guided biopsy of skeletal lesions is justifiable. The retrospective review has found that the biopsy was successful in diagnosing skeletal involvement in 88% of the time in patients with known malignancy. Excluding the lesion as benign or as a new malignancy in 12% of the subjects has major prognostic and treatment implications.¹¹ Though there is sufficient literature evidence to validate the safety and effectiveness of the procedure, safe access to deep locations poses a major challenge to interventional radiologists. Hence understanding the anatomy of deep-seated lesions plays a paramount role in planning the safer access route.¹²

Long bones (35%) have been identified as the most common site of bone metastasis in the present study, followed by spine (30%) and hip (25%). Whereas a review by Maccauro *et al.* has reported spine as the most common site of bone metastasis and the spinal metastasis is estimated to occur in 10% of cancer patients.¹ A retrospective evaluation of 48 breast cancer patients has found ribs as the most affected bones (45.8%), followed by spinal column (41.6%) and the femur (37.5%).¹⁴

The present study has not reported any complications during the CT-guided biopsy and after the final diagnosis, thereby corroborating the safety of the technique. In agreement with this finding, a retrospective study by Gul *et al.* has reported acceptable complication rate of the technique in experienced hands. The researchers evaluated 170 CT-guided biopsies and has noted that the success rate (80%) is comparable to that of previous literature evidence.¹⁵

In line with the current findings, a retrospective study involving 186 cases has concluded on the safety and effectiveness of CT-guided percutaneous biopsy for diagnosing suspicious bone lesions. However, the study has reported spine (36.0%)

as the most commonly involved, followed by hip (32.8%) and long bones (18.3%). Complications were reported in 3 cases and they include paresthesia with functional impairment, bone fracture, and needle breakage requiring surgical removal. The researchers highlighted the need of establishing the objective criteria by the interventional biologists at the time biopsy site selection for achieving better success rate. Basic strategies that can be adopted to improve the success rate include avoiding necrosis areas and selecting more aggressive part of the lesion as the primary target.

The present study has several limitations and the major drawback was smaller sample size. The study did not consider cancer history, and age- and sex-related factors for the analysis, and the association of these factors with the diagnostic outcome of biopsy. The presence of primary and metastasis stages was evaluated, but the differentiation between these stages and final clinical diagnosis was not well established. In addition, correlation between the part of the body affected and resulting malignancies was not evaluated.

Conclusion

The present study has concluded CT-guided percutaneous biopsy as a safe and effective diagnostic modality for the diagnosis of bone lesions suspected for malignancy. Meticulous planning and precision of the technique are crucial for the success of the procedure and to avoid associated complications.

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