Computed tomography-guided percutaneous biopsy of bone lesions: rate of diagnostic success and complications

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Abstract

Objective: To determine the rates of diagnostic success and complications of computed tomography (CT)-guided percutaneous biopsy of bone lesions suspected for malignancy.

Materials and Methods: Retrospective study including 186 cases of CT-guided percutaneous biopsies of bone lesions in the period from January, 2010 to December, 2012. All the specimens were obtained with 8–10 gauge needles. The following data were collected: demographics, previous history of malignancy, data related to the lesion, to the procedure, and to histological results.

Results: Most patients were women (57%), and the mean age was 53.0 ± 16.4 years. In 139 cases (74.6%), there was diagnostic suspicion of metastasis and the most common primary tumors were breast (32.1%) and prostate (11.8%). The bones most commonly involved were spine (36.0%), hip (32.8%) and long bones (18.3%). Complications occurred in only three cases (1.6%) including bone fracture, paresthesia with functional impairment, and needle breakage requiring surgical removal. The specimens collected from 183 lesions (98.4%) were considered appropriate for diagnosis. Malignant results were more frequently found in patients who had a suspected secondary lesion and history of known malignancy (p < 0.001), and in patients who underwent PET/CT-guided procedures (p = 0.011).

Conclusion: CT-guided percutaneous biopsy is a safe and effective procedure for the diagnosis of suspicious bone lesions.

Keywords: Bone neoplasms; Needle biopsy; Computed tomography; Interventional radiology; Complications.

INTRODUCTION

Recent studies published in Brazil have highlighted the relevance of interventional radiology in the appropriate collection of specimens for the diagnosis and treatment of dis-
cases affecting different parts of the body\cite{1-6}. Percutaneous biopsy is an important tool in the evaluation of bone lesions suspicious for malignancy. Suspicious primary bone tumors, or systemic cancer recurrence such as bone metastases constitute frequent indications for computed tomography (CT)-guided percutaneous biopsy. The presumptive decision to approach a lesion as recurrence of a known primary malignant tumor without pathological confirmation may erroneously lead to inappropriate treatment of benign diseases or even incorrect management of a second primary tumor different from the first one.

The CT-guided procedure is a safe and accurate method to define the diagnosis\cite{7-11}. The diagnostic results are variable according to the location of the lesion; those observed in lesions of extremities and pelvic bones are more accurate as compared with those observed in lesions located in the vertebral column\cite{12}. The rate of complications in CT-guided bone biopsies is very low (1.1%), while in open biopsy it may be as high as 16\%\cite{13}. Even considering that it is generally a low risk procedure, minor side effects and complications such as infections, fractures and bleeding may occur\cite{14-16}.

A successful bone biopsy is the procedure that gets enough material for an appropriate histopathological analysis and definition of the diagnosis, i.e., a specific diagnostic result capable of guiding the requesting physician in the decision making regarding to the approach to be adopted either in relation to treatment, follow-up or discharge of the patient\cite{17}. The ideal result should be definite, with no possibility of differential diagnosis, and reliable enough to allow the physician to make a decision on the approach to be adopted. In the literature, the rate of diagnostic definition of percutaneous biopsies of musculoskeletal lesions is 69–88\%\cite{13,18-22}.

The present study was aimed at determining the rates of diagnostic definition and complications of CT-guided percutaneous biopsy of bone lesions suspicious for malignancy.

**MATERIALS AND METHODS**

Retrospective study developed at the Imaging Department of A.C. Camargo Cancer Center, including patients submitted to CT-guided percutaneous biopsy of bone lesions, in the period from January 2010 to December 2012. The present study followed the principles of the Helsinki Statement on Health in all Policies and was approved by the Committee for Ethics in Research of the institution. A written term of free and informed consent for the biopsy and verbal consent for inclusion of biopsy data in the study were obtained from the patients.

Previously to the procedures, in all the cases, all the available CT images were reviewed, as well as bone scintigraphy, magnetic resonance imaging (MRI) and positron emission computed tomography (PET/CT) images, as available. Such images were analyzed by a radiologist who determined the most appropriate site for specimen collection with a safe approach, considering the lesion characteristics, possible complications and chances for collection of sufficient material. Before all the procedures, coagulation tests, including platelet count, prothrombin time, international normalized ratio, and partial thromboplastin time were performed. Coagulopathy cases were corrected before the procedure.

The patient positioning for biopsy was based on the location of the target lesion. The selected site was confirmed by 5.0 mm-thick CT sections and a single section of the lesion was selected. The best access to the lesion was planned and drawn from the target lesion to the skin surface. The selection of depth of the lesion and the skin entrance site was based on the metal marker previously placed on the patient’s skin (Figure 1).

All the CT-guided bone biopsies were performed under general anesthesia. The skin and adjacent soft tissues were also locally anesthetized with lidocaine or ropivacaine in order

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**Figure 1.** CT-guided percutaneous bone biopsy of a sclerotic rib lesion. Suspicion of metastasis from prostate adenocarcinoma confirmed after histopathological analysis. **A:** Planning computed tomography with metal skin marker. **B:** Biopsy needle positioned within the lesion.
to optimize the post-procedural analgesia. The specimens were collected with 8 to 10 gauge needles and sent to the department of pathological anatomy in a jar with formaldehyde. All the specimens were analyzed by oncologic pathologists. Information about the follow-up of these patients during at least six months after the procedure was researched in the cases where the histological results were benign or indeterminate.

A standard data form was filled out for all the patients included in the study, with demographic data (sex and age), previous history of malignant neoplasm, data related to the lesion, to the procedure and to the histological result. Lesion data included the affected bone, lesion size, aspect at CT (lytic, sclerotic or mixed), and diagnostic suspicion. Data regarding the procedure included type of needle utilized, presence of complications and if another imaging method (MRI or PET/CT) was utilized as guidance in the procedure. Data regarding the histological results included information on the specimen appropriateness and final diagnosis. Benign lesions were followed-up for diagnostic confirmation.

All the data were stored in a databank for the purpose of statistical analysis utilizing the software SPSS 20.0. Descriptive analysis was performed to calculate simple and relative frequencies of the variables. The Student's t test (or non-parametric Mann-Whitney test, as indicated) was utilized for comparison of scalar variables between groups. In cases of three or more groups, the variance analysis (Anova) or the non-parametric Kruskal-Wallis test was utilized. For the categorical variables the tables 2 × 2 and 2 × 3 were utilized, with evaluation of the statistical significance by the chisquared Pearson calculator with Yates correction or exact Fisher test, as indicated. Results with type I error probability ≤ 5% (p ≤ 0.05) were considered as statistically significant.

RESULTS

In the study period 186 CT-guided bone biopsies were performed. Most patients were women (57%) and the mean age was 53.0 ± 16.4 years (ranging between 3 and 83 years).

In 47 procedures (24.4%) the diagnostic suspicion was of primary bone lesion, and in 139 (74.6%) there was a suspicion of secondary lesion (metastasis) from other known site – among others the most common were breast (32.1%) and prostate (11.8%).

In frequency order, the most commonly involved bones were the following: vertebral column (36.0%), hip bones (32.8%), long bones (18.3%), sternum (4.8%), costal arches (4.3%) and others (3.7%). Mean lesion size was 3.1 ± 1.9 cm, ranging from 0.6 to 9.8 cm. In 18 cases (9.7%) the lesion could not be identified at CT, and the biopsy was guided by MRI findings in 8 cases (4.3%) and by PET/CT in 10 cases (5.4%). In such cases, the MRI or PET/CT images were evaluated side by side with the non contrast-enhanced CT images before the procedure to identify the lesion or area of interest to be biopsied. In the other 168 cases (90.3%) the lesion was identified at CT, being characterized as lytic lesion in 49.4%, blastic lesion in 35.1%, and mixed in 15.5% of cases.

In most patients (83.1%) the biopsy was performed with an 8-gauge needle. A 10-gauge needle was utilized in 16.9% of the procedures. Severe complications were observed in only three cases (1.6%), including one bone fracture, one patient who presented paresthesia with functional compromise, and one procedure with needle breakage requiring surgical removal.

In only three cases (1.6%) the collected specimen was considered inappropriate for diagnosis, including two lytic lesions in the vertebral column and one lytic lesion in the femur. In one of such cases no information about follow-up was available, and in the other two cases no lesion progression was observed at follow-up.

Amongst the 183 procedures with appropriate specimens (98.4%), the pathological diagnosis was normal bone tissue/absence of malignancy in 85 cases (45.7%), benign primary bone tumor in 13 (7.0%), malignant primary bone tumor in 9 (4.8%), and metastasis in 76 cases (40.9%).

Amongst the 85 patients whose histological diagnosis of the biopsy specimen was normal bone tissue/absence of malignancy, 64 (75.3%) were followed-up and the following events were observed: 6 (6.4%) patients were submitted to open surgery (4 confirmed the diagnosis and 2 were characterized as primary bone tumors – Langerhans cell histiocytosis and non-Hodgkin's lymphoma); 2 (3.1%) were treated as infectious process (osteomyelitis); 49 (76.5%) did not present any alteration at follow-up, and were considered as benign lesions; and 7 (10.9%) presented lesion progression at follow-up, being considered as malignant.

Malignant results were most frequently observed in the patients under suspicion of secondary lesion with history of a known malignant neoplasia (Table 1) and at PET/CT-guided procedures (Table 2). No correlation was observed between rate of malignancy at biopsy, size and appearance of the lesion at CT.

DISCUSSION

Imaging methods play a fundamental role in the screening, detection and characterization of bone lesions, besides

| Histological result | Primary lesion | Secondary lesion |
|---------------------|----------------|------------------|
| Healthy bone tissue/absence of malignancy | 28 (59.6%) | 57 (41.0%) |
| Benign primary tumor | 10 (21.3%) | 3 (2.2%) |
| Malignant primary tumor | 3 (6.4%) | 6 (4.3%) |
| Metastasis | 5 (10.6%) | 73 (51.1%) |
| Total | 46 (100%) | 137 (100%) |

p < 0.001.
providing guidance in percutaneous biopsies of lesions suspicious for malignancy. The distribution of the different diagnosis (metastases, primary tumors, benign diseases and others) is quite variable among studies in the literature. The main indication for biopsy is the investigation of a suspicious metastatic lesion. Even in patients with suspicious lesions and history of malignant primary neoplasm, whose chance of a diagnosis different from metastasis is low, the confirmation of the diagnosis is required because it will influence the management and prognosis of these patients.

The results of the present study have demonstrated that CT-guided percutaneous biopsy of bone lesions produces a high percentage of specimens sufficient for histological analysis, allowing for a correct diagnosis in the greatest majority of cases. The rates of diagnostic definition and accuracy reported in the literature range from 69% to 96%.

| Healthy bone tissue/absence of malignancy | CT       | MRI       | PET/CT |
|------------------------------------------|----------|-----------|--------|
| Benign primary tumor                     | 13 (7.9%)| —         | —      |
| Malignant primary tumor                  | 9 (5.4%) | —         | —      |
| Metastasis                               | 67 (40.6%)| —         | 9 (90%) |
| Total                                    | 165 (100%)| 8 (100%)  | 10 (100%) |

Some authors have already demonstrated that PET/CT-guided biopsies of bone lesions and other organs provide a high percentage of appropriate specimens as well of malignant results. On the other hand, in the present study, all the lesions identified at MRI which did not present correspondence at CT had benign biopsy results, suggesting that one should be careful about indicating a biopsy in such cases. Despite the high sensitivity of MRI for the diagnosis of bone metastases, its specificity is variable and might be increased by means of an appropriate analysis of the several sequences of the study, including contrast-enhanced and diffusion-weighted images.

The rate of complications observed in the present study was low and compatible with data in the literature, corroborating the fact that percutaneous biopsy of bones lesions is a safe procedure. Rimondi et al. have described 22 complications (1.1%) in 2,027 CT-guided biopsies of lesions in the musculoskeletal system – 18 cases of transient lower limbs paresthesia, 3 hematomas in the psoas muscle, and 1 retroperitoneal hematoma.

Finally, CT-guided percutaneous biopsy is a safe and effective method for the diagnosis of suspicious bone lesions, with less morbidity and lower cost than open bone biopsy.

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