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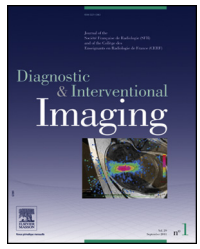

ORIGINAL ARTICLE /*Musculoskeletal imaging*

Accuracy of core needle biopsy for the diagnosis of osteosarcoma: A retrospective analysis of 73 patients

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KEYWORDS
Core needle biopsy;
Surgical biopsy;
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Abstract
Purpose: The goals of this retrospective study were to evaluate the accuracy of core needle biopsy (CNB) for the diagnosis of osteosarcoma and to identify criteria that may predict failed CNB.
Materials and methods: From 2002 to 2012, 73 patients with a total of 73 osteosarcomas underwent CNB. Patients demographics and procedure details were recorded, including tumor size, tumor characteristics (hemorrhagic or not, lytic, sclerotic [> 50% bone condensation], or mixed), the type of anesthesia, the number of tissue samples, the size of the biopsy needle and pathology report. Procedures were analyzed in terms of sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).
Results: A diagnosis was not made in 5/73 patients (6.8%) with an overall sensitivity of 93.1%, a specificity of 100%, a PPV of 100% and a NPV of 99.9%. No complications due to CNB were observed. No criteria were identified as predictors of CNB failure.
Conclusion: Even in the presence of sclerotic tumors, CNB should be the first line diagnostic test for suspected osteosarcomas, pending performance by a well-trained radiologist and reading by a specialized pathologist.
Level of evidence: IV.

Abbreviations: MRI, magnetic resonance imaging; CNB, core needle biopsy; PPV, positive predictive value; NPV, negative predictive value; G, Gauge; CI, confidence interval; C, contributive; NC, non-contributive.

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Osteosarcoma is the most frequent malignant bone tumor in adolescents and young adults [1]. It represents 15% of all primary bone tumors confirmed by biopsy. There are different types of primary osteosarcoma and the most frequent one is intramedullary high-grade osteosarcoma, which represents 75% of all osteosarcomas [2]. When the diagnosis of osteosarcoma is suggested by imaging findings, a biopsy must be performed to obtain a tissue sample of the tumor. For many years surgical biopsy was the first line technique for musculoskeletal tumors, because it provided an adequate tissue specimen for further histopathological assessment [3,4].

Some authors have suggested that core needle biopsy (CNB) should be the first line diagnostic technique for osteosarcoma [5—8]. On the other hand the value of CNB as the first line diagnostic test in osteosclerotic tumors has not been confirmed in the literature, compared to surgical biopsies, which are highly sensitive and specific, but at the penalty of invasiveness and extra costs [9—11].

Some studies have not identified any factors of failure for CNB [12]. In others the failure rate of CNB was greater for bone tumors compared to soft tissue tumors [13]. Sclerotic or necrotic elements can be a risk factor of diagnostic failure of CNB [14,15]. The portion of lytic tumor and the size of the tumor were also shown to influence the diagnostic accuracy of CNB in a study in 88 bone tumors [16]. The accuracy of percutaneous biopsy has been confirmed for mixed bone tumors [5,17].

The goals of this retrospective study were to evaluate the accuracy of core needle biopsy (CNB) for the diagnosis of osteosarcoma and to identify criteria that may predict failed CNB.

Materials and methods

Patients

The study population consisted of 73 patients with a total of 73 osteosarcomas. They were 48 boys (65.7%) and 25 girls (34.2%) with a mean age of 25 years ± 18.45 (SD) (range: 2—88 years). All these patients underwent primary or secondary CNB after an unsuccessful surgical biopsy ($n = 3$). They were investigated in our institution from the year 2002 to the year 2012. Imaging examinations and imaging reports were available for all patients. Thirty-three patients (33/73; 45%) have died at the time of the study. The study was conducted following the guidelines of our institutional review board.

Procedure

CNB was performed by different radiologists (fellows or staff physicians throughout the 10 years of the study). All were senior radiologists with at least one year of experience in CNB, without a surgeon by their side. The biopsy site was sterilized and anesthetized, then an incision was made using the surgical approach that would be taken in case of future surgery and after consultation with the surgeon to avoid any seeding during CNB [18]. Tissue samples (from 1 to 12) were obtained using an 8- to 18-G (Gauge) automatic or semi-automatic needle with a coaxial system. When possible, the different passes through the tumor targeted the non-necrotic tissues that surrounded these osteosarcomas as showed by pre-biopsy magnetic resonance imaging examination or the soft tissue when it was invaded and more easily accessible.

If necessary a trephine needle was used in the sclerotic portions, after placement of a bone trocar (Osteo-Site® 11 G 10 cm beveled bone biopsy needle, Cook Medical, Bloomington USA; Monopty® 14 G 10 cm Bard Biopsy Systems, Tempe, USA). The material was used according to the manufacturer instructions. The site of entry of the skin was tattooed with India ink. The patients were then monitored for 30 minutes before discharge accompanied by a third party. In case of general anesthesia, the patient spent the night in the hospital.

In the pathology department a portion of the biopsy sample was fixed in 10%, buffered formol and the other portion was either kept in a cool place, or in a liquid preservative such as RPMI medium and decalcified before analysis [19,20].

Methods of evaluation

The following data were obtained from the files of each individual patient:

- the smallest and largest tumor dimensions (taking into account extraosseous extension), hemorrhagic or not, the location and whether the tumor was lytic, sclerotic (at least 50% bone condensation) or mixed;
- the type of anesthesia (oral premedication 1 h before the procedure, then local anesthesia ± inhaled nitrous oxide);
- the number of tissue specimens and the size of the needle used;
- the pathology reports used as judgment criteria.

Statistical analysis

The diagnostic accuracy of CNB for the diagnosis of osteosarcoma (pathological diagnosis) as well as sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated. The odds ratio (OR) were used to identify criteria that may be associated with failed CNB. Statistical analysis was performed using S.A.S 9.3 software. Differences were searched for using the Fisher exact test for qualitative variables and the Student t test for quantitative variables. The normality of the distribution of the quantitative variables was confirmed.

Results

Three of the 73 lesions (3/73, 4.1%) were hemorrhagic. The mean largest tumor size was 105 ± 51.2 mm (SD) (range: 35—260) and of the second largest tumor size was 59 ± 27.2 mm (SD) (range: 17—160).

Seven tumors were biopsied with an 8-G system (7/73, 9.5%), 3 with 11-G (3/73, 4.1%), 34 with 14-G (34/73, 46.5%), 1 with 16-G (1/73, 1.4%), and 28 with an 18-G (28/73, 38.3%), after using a manual bone marrow biopsy needle if necessary.

Besides premedication and local anesthesia, 25/73 patients (38.3%) received an inhalation of nitrous oxide, 4/73 (5.5%) received an Emlapatch 5% (AstraZeneca,