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Review Article

Use of percutaneous core needle biopsy for diagnosing acral bone tumors

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ABSTRACT

This study aims to evaluate the diagnostic value of percutaneous core needle biopsy (PCNB) in diagnosing acral bone tumors. The clinical PCNB data of 341 patients with bone tumors were retrospectively analyzed. The diagnostic accuracy was calculated according to the lesion components (sclerotic, parenchymatous, or cystic), benign or malignant character, and whether a soft tissue mass was present. The chi-square test was performed to assess diagnostic accuracy. The accuracy rate for sclerotic and substantive lesions was high (87.5% and 90.1%, respectively), while that for cystic lesions was the lowest. The accuracy difference in diagnosing benign and malignant lesions was significant ($P < 0.001$). The existence of an extraskeletal soft tissue mass significantly affected the diagnostic accuracy (P=0.007). PCNB is a safe, accurate, rapid, and effective screening method in diagnosing bone tumors; however, the diagnostic accuracy for cystic lesions was poorest. The lesions without a diagnostic biopsy result were most likely to be benign, and the existence of an extraskeletal soft tissue mass significantly affected diagnostic accuracy; therefore, the correct diagnosis of skeletal system lesions still relies on the coordinated efforts of clinics, pathology, and imaging.

1. Introduction

Because the clinical manifestations and treatment methods of patients with bone and soft tissue tumors are diverse, determination of the best treatment options requires a complete assessment before starting comprehensive treatment. Therefore, obtaining tissue samples for histopathological diagnosis is an important step prior to the treatment of bone and soft tissue tumors. Biopsy plays a critical role, with the purpose of obtaining tissues for diagnosis in order to reduce complications, prevent potential tumor spread, and avoid interfering with future treatments [1].

Currently, open or closed biopsy (needle-aspiration or core needle biopsy) is used to obtain tissue samples. Inappropriate biopsy fails to provide a tissue diagnosis, and affects limb salvage and survival rates [2]. Although open biopsy is considered to be the diagnostic reference standard, with accuracy as high as 98%, it also has an up to 16% risk of complications such as bleeding, infection, nerve damage, and tumor spread [3,4]. Because many malignant tumors required amputation in the past, biopsy had little significance for treatment. With the development of limb salvage methods, changes in biopsy techniques, with reduced complications, especially tissue contamination, have become very important. Percutaneous and open biopsy had similar diagnostic accuracy [5], but the complication rate of percutaneous biopsy was as low as 0–10% [1]. Since the rate of false negatives with needle aspiration biopsy was high and the diagnostic accuracy was low [6], it could not be used to assess tissue structures, but could only provide cytological material, and was not the preferred method for the diagnosis of bone tumors [1]. Therefore, instead of open biopsy, percutaneous core needle biopsy (PCNB) was developed, and has become the most simple and economical method for the diagnosis of bone and soft tissue tumors, with high diagnostic accuracy and low complication rates [1,7,8].

This study retrospectively analyzed the clinical PCNB data of 341 patients with bone tumors seen in our department from March 2007 to March 2015; the positive diagnostic rate and accuracy of PCNB was determined according to lesion components (sclerotic, parenchymatous, or cystic), benign or malignant character, and whether a soft tissue mass was present, in order to analyze and evaluate diagnostic results, and to assess diagnostic value and safety.

2. Materials and methods

2.1. General information

Between March 2007 and March 2015, a total of 341 patients underwent PCNB in our department for pathological diagnosis; there

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were 179 men and 162 women, with an average age of 46 years 3–84 years). The lesions were located in the femur (126 cases), tibia (80), humerus (47), radius (29), pelvis (20), ulna (17), and hand-foot-scapula (22). This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Xi'an Jiaotong University. Written informed consent was obtained from all participants.

2.2. Biopsy procedures

The lesion imaging data, including radiography (Type C arm X-ray machine from SHIMADZU WHA–200, Japan), computed tomography (CT) (PHILIPS brilliance-16, Netherland), and magnetic resonance imaging (MRI) (Siemens 3.0T Magnetom verio, Germany), were carefully studied before the biopsy; then, a direct and appropriate puncture approach was selected, which would avoid damaging the mesooecium, blood vessels, nerves, and vital organs. A total of 255 patients were operated on under local anesthesia, 86 received epidural anesthesia, and 42 were operated on under CT guidance, and 74 were operated on under radiography guidance; based on visual inspection of the samples, the biopsy specimens were expected to contain tumor tissue, necrotic tumor, necrotic tissue, or regenerated fiber vessels. Usually, three puncture attempts were able to obtain satisfactory samples; specimens 1–3 cm long were adequate, but cystic samples were difficult to obtain by puncture and were sampled repeatedly up to 5–6 times. All lesions, including coagulated blood, were fixed in 10% formaldehyde solution for examination.

2.3. Evaluation of PCNB results

The lesions were divided according to imaging features into sclerotic, parenchymatous, or cystic lesions; sclerotic lesions referred to those with more than 50% intralesional density equal to or higher than that of surrounding normal bone tissue. Parenchymatous lesions were those with more than 50% intralesional tumor component as parenchymatous soft tissue; cystic lesions referred to those with more than 50% intralesional component displaying liquid, blood, or air-fluid levels on CT or MRI. Soft tissue masses were classified according to their imaging features for evaluation. The biopsy results were assessed and compared with the gross specimen pathological results and clinical course of benign lesions, in order to calculate the positive diagnostic and accuracy rates of PCNB; complications of PCNB were also recorded.

2.4. Statistical methods

SPSS 17 was used for the chi-square trend test, with $P < 0.05$ considered as statistically significant.

Table 1
Final diagnostic results by PCNB (n=341).

Benign (n=178)	n	Malignant (n=165)	n
Bone giant cell tumor	55	Metastatic tumor	58
Chondroblastoma	16	Osteosarcoma	35
Tuberculosis	7	Myeloma	15
Fibrous dysplasia	13	Lymphoma	8
Osteomyelitis	6	Chondrosarcoma	16
Enchondroma	11	Pleomorphic sarcoma	13
Aneurysmal bone cyst	15	Alveolar sarcoma	3
Eosinophilic granuloma	7	Synovial sarcoma	4
Non-ossifying fibroma	4	Ewing's sarcoma	6
Hemangioma	4	Liposarcoma	2
Simple bone cyst	11	Fibrosarcoma	1
Desmoid tumor	5	Leiomyosarcoma	1
Bone infarction	4	Paraganglioma	1
Benign fibrous histiocytoma	6		
Hematoma	3		
Myositis ossificans	4		
Ossifying fibroma	1		
Post-GCT necrosis	1		
Cartilage fibroma	3		
Lipoma	1		

3. Results

The 341 patients underwent 354 punctures; 11 patients were punctured twice in the same lesion, and 13 were punctured at two different lesions. The most common benign tumors were bone giant cell tumor (n=55), cartilage blastoma (n=16), and aneurysmal bone cyst (n=15); the most common malignant tumors were metastatic tumor (n=58), osteosarcoma (n=35), chondrosarcoma (n=15), and myeloma (n=15). The final diagnostic results are shown in Table 1.

3.1. Positive diagnostic rate and accuracy rate of PCNB

A total 312 cases exhibited yielded PCNB results, and 29 cases had unclear or no diagnosis (among whom 9 then underwent open biopsy); the overall positive diagnostic rate was 91.5% (312/341), with accuracy of 85.6% (292/314). The statistical results are shown in Tables 2–4. There was no significant difference in the accuracy rates for sclerotic (87.5%) and parenchymatous lesions (90.1%) (P=0.481), while the accuracy rate of cystic lesions was the poorest (55%) ($P < 0.001$). The positive rates for sclerotic (90.3%) and parenchymatous lesions (95.6%) showed no statistical difference, while the differences in positive rates of sclerotic/parenchymatous and cystic lesions were statistically significant ($P < 0.05$). The accuracy rates for malignant (93.3%) and benign lesions (78.7%) showed a significant difference ($P < 0.001$), and the positive diagnostic rates for malignant (97.5%) and benign lesions (86%) were significantly different ($P < 0.001$). The

Table 2
Positive rate and accuracy rate of PCNB towards sclerotic, parenchymatous, or cystic lesions.

Classification	Total	PCNB diagnosis			Final diagnosis	
		Positive rate	Unclear or no diagnosis	Positive rat%	Correct diagnosis	Accuracy rat%
Sclerotic, lesions	72	65	7	90.3	63	87.5
Parenchymatous, lesions	229	219	10	95.6	207	90.1
Cystic lesions	40	28	12	70	22	55
Total	341	312	29	91.5	292	85.6

Note: Positive diagnostic rate: sclerotic and parenchymatous lesions: X^2=2.948, P=0.086; sclerotic and cystic lesions: X^2=7.506, P=0.006; parenchymatous and cystic lesions: X^2=29.794, $P < 0.001$; accuracy rate: sclerotic and parenchymatous lesions: X^2=0.496, P=0.481; sclerotic and cystic lesions: X^2=14.845, $P < 0.001$; parenchymatous and cystic lesions: X^2=33.697, $P < 0.001$.