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Fine-Needle Aspiration Biopsy in Primary Malignant and Metastatic Bone Tumors

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Key Words. Aspiration biopsy · Bone tumor · Cytology

Abstract. 56 malignant bone neoplasms (15 primary and 41 metastatic), diagnosed by fine-needle aspiration biopsy, are reported. 100% diagnostic accuracy was achieved. The results indicate that fine-needle aspiration biopsy can be a substitute for open surgical biopsy in selected cases.

Introduction

It is well known that combined clinical, radiological and pathological study is the optimal procedure in bone pathology [14]. Traditionally, open surgical biopsy has been a prerequisite for pathological diagnosis. Since many primary and metastatic bone tumors tend to be lytic, adequate material can often be obtained by needle aspiration biopsy [4, 6–8, 10–12, 15, 18, 20, 22]. Yet several authors object to the adoption of needle biopsy techniques [1, 3, 9]. This study was undertaken to demonstrate the feasibility and role of fine-needle aspiration biopsy in the diagnosis of malignant bone tumors.

[1] The authors wish to thank Prof. *Nicola Misasi* who made this diagnostic project possible.

Material and Methods

This report is based on the analysis of 56 consecutive cases of malignant bone tumors (15 primary and 41 metastatic) studied from January 1, 1978, to December 31, 1979. Figure 1 shows the sites of the aspiration biopsies.

The method of collection and preparation of the cytologic specimens used in our laboratory has been outlined in detail elsewhere [18, 21]. We would only like to point out that we use an ordinary 22-gauge spinal needle fitted with an obturator with a length varying between 25 and 80 mm. Longer needles tend to bend and must never be used.

On all occasions, aspiration has been performed under TV fluoroscopic control, after local anesthesia, by a team composed of an orthopedic surgeon and a cytopathologist. With the needle diameter we used, the trajectory of the needle does not have to take into consideration the local anatomy, and the shortest way to puncture the lesion may thus be taken. Nevertheless, large blood vessels and especially nerves must be avoided (fig. 2–5).

We generally work on smeared material stained with May-Grünwald-Giemsa and Papanicolaou, which are complementary stains.

Any residual material is further fixed in picric acid-alcohol, embedded in paraffin as a cell button, step-sectioned and stained with hematoxylin-eosin.

Results

A sufficient quantity of cells has always been obtained by aspiration. Only twice was it necessary to repeat it because sufficient cells were not available. The diagnosis was based 53 times on smears and only 3 times on cell buttons. We diagnosed malignancies in all of the 56 cases; typing of the primary malignant bone tumors has been done according to *Hajdu and Hajdu* [7], while the cell typing of metastases followed the criteria established by *Takahashi* [19] (tables I, II; fig. 2–5). No serious complications were encountered; local discomfort was the only common complaint. Tumor spreading through the needle tract was not encountered and, relying on other reports [2, 5, 13, 17], we feel we can exclude this possibility, while it is well known that this does not hold true in respect of surgical biopsies [1].

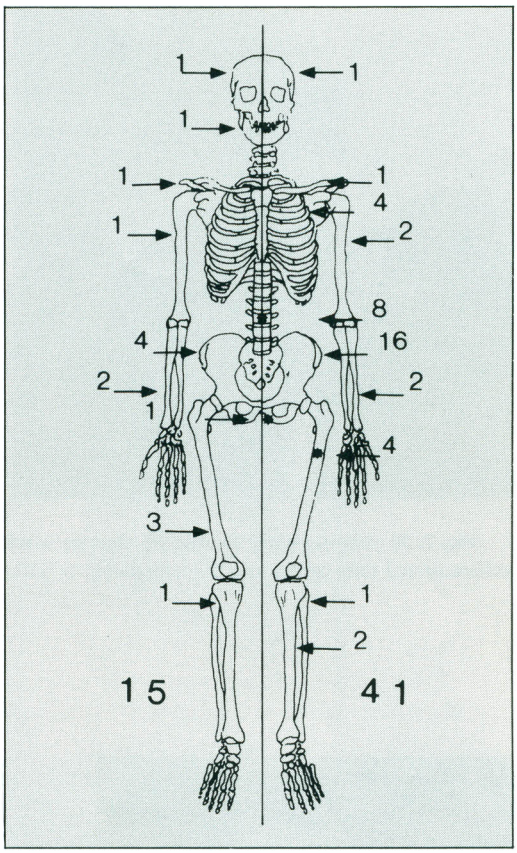

Fig. 1. Anatomical distribution of the lesions. Right: metastases; left: primary lesions.

Discussion

The purpose of open surgical bone biopsy is to obtain material for histopathological examination in order to assess the nature of the lesion prior to initiation of definitive therapy [14].

Bone surgical biopsy, usually incisional biopsy, may lead to contamination of neighboring tissues by the tumor, requires general anesthesia in most instances, and furthermore in some cases may be an elaborate procedure (i.e., shoulder, pelvis, spine). Moreover, one must realize that treatment following tissue examination can be quite different not only depending on whether the tumor is a primary or a metastatic tumor but also according to the kind of primary bone tumor. Thus an incisional biopsy may be too little or too much as far as the subsequent treatment (surgical or nonsurgical) is concerned.

On the other hand, the frozen-section technique, which may also present technical difficulties [16, 23] in this field of application, requires surgical biopsy thus sharing with it the above-mentioned limitations.

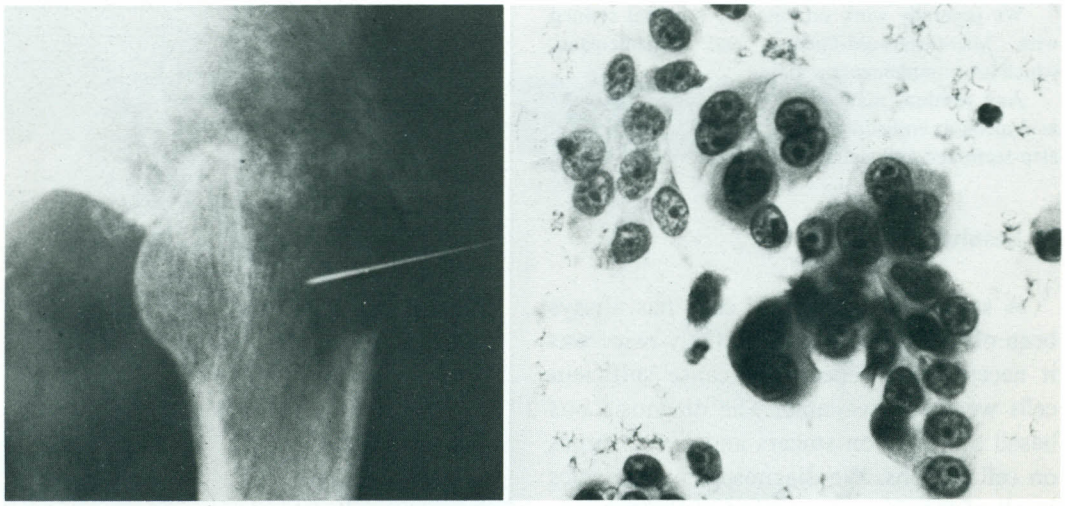

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Fig. 2. 58-year-old male. Femur. Metastases. **a** Radiological appearance. **b** Clusters of metastatic moderately differentiated lung carcinoma. Papanicolaou. × 112.

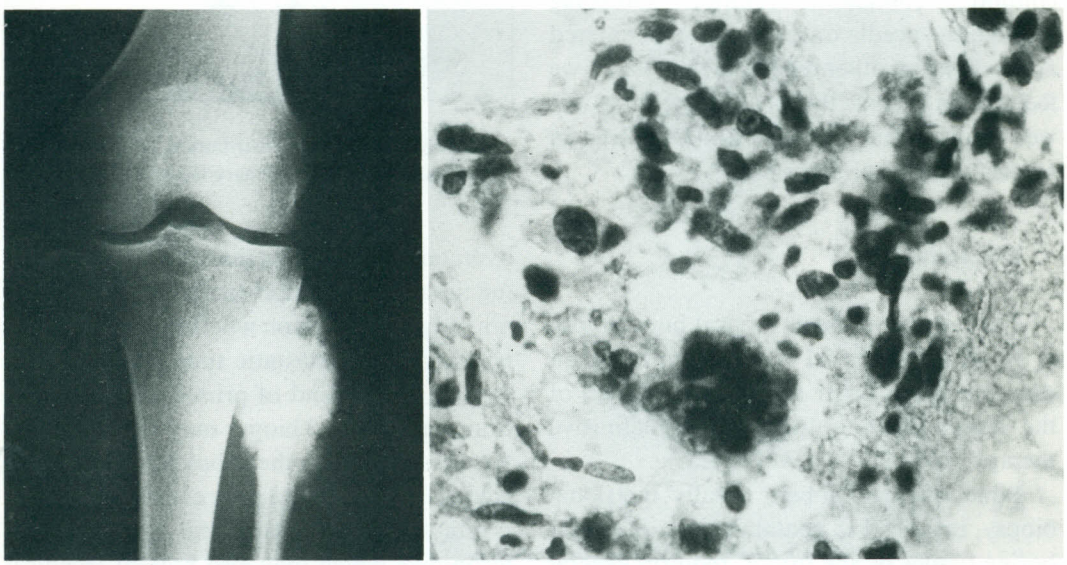

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Fig. 3. 22-year-old female. Fibula. Osteosarcoma. **a** Radiological appearance. **b** Dissociated spindle cells with hyperchromatic round or oval nuclei and intermingled multinucleated cells are the characteristics of this malignant tumor. Note the significant variation in size, shape and nuclear structure. Papanicolaou. × 112.

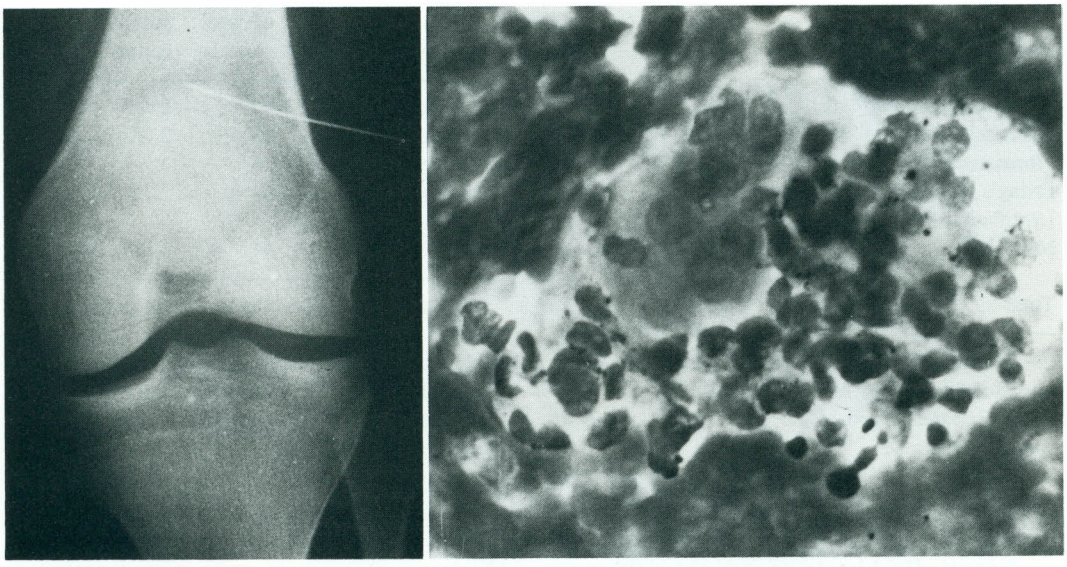

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Fig. 4. 31-year-old female. Femur. Giant cell tumor. **a** Radiological appearance. **b** Multinucleated giant cells with attached clusters of uniform, hyperchromatic, ovoid cells are the basic microscopic pattern of this tumor. Papanicolaou. × 112.

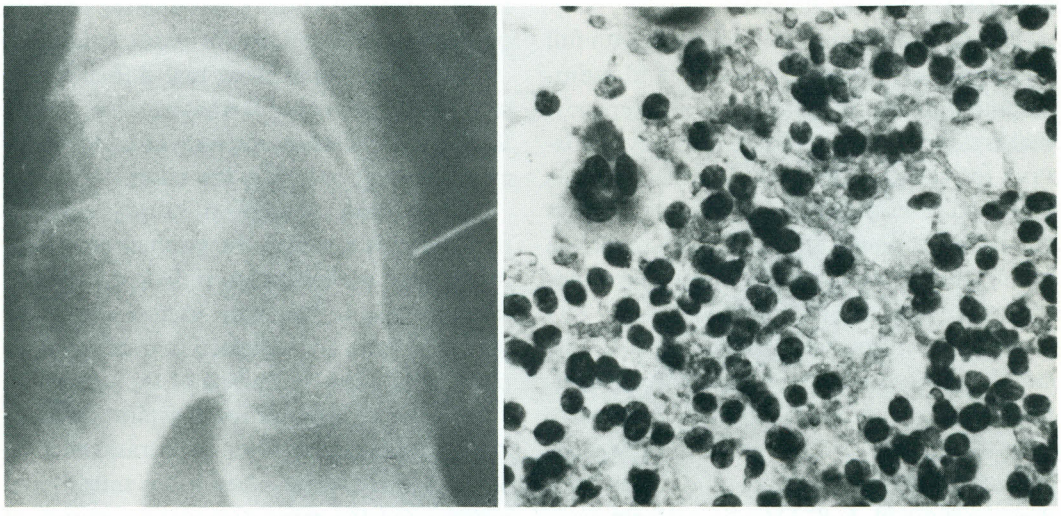

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Fig. 5. 18-year-old female. Pubis. Lymphosarcoma. **a** Radiological appearance. **b** The cytologic specimen is characterized by monotonous round, small, mononucleated, nucleolated, dissociated malignant lymphocytes. In the upper left corner a benign multinucleated osteoclast can be observed. Papanicolaou. × 112.

Table I. Primary malignant bone tumors

Cytologic diagnosis	Number of cases	Histopathologic control	
Osteosarcoma	3	2	(1)
Chondrosarcoma	1		(1)
Giant cell tumor	1	1	
Fibrosarcoma	1	1	
Ewing's sarcoma	4	3	(1)
Lymphoma	2	1	(1)
Myeloma	3	3	
Total	15	11	(4)

The accuracy of cytologic diagnosis was determined in 11 cases by histopathologic control and in 4 cases (in parentheses) by the clinical course and response to therapy.

Table II. Metastatic bone lesions

Cytologic diagnosis	Number of cases	Cyto-histopathologic control			
Glandular type	17	2	15		(2)
Epidermoid type	12	2	10		
Undifferentiated type	8		4		(2)
Transitional type	4		4		
Total	41	4	33	80.5%	(4)

The accuracy of cytologic diagnosis was determined in 33 cases by the histopathologic control of the primary carcinoma; 4 cases had only a cytologic correlation (2 fine-needle prostatic aspirations and 2 sputa), 4 cases remained unproven (in parentheses) and were lost to follow-up.

Admittedly, histologic sections yield more information than aspiration smears as for the precise nature of bone malignancies. Nevertheless, one cannot overlook that in experienced hands the majority of bone metastatic neoplasms as well as most primary malignant bone lesions can be accurately diagnosed [4, 6–8, 10–12, 15, 18, 20, 22].

The smears should be interpreted with full knowledge of the clinical history and radiographic findings. If there is any discrepancy, that is if the clinical-radiological study is positive for cancer and cytology is negative, as well as in cases in which cytologically there is the slightest doubt about the nature of the lesion, confirmatory tissue biopsy is mandatory prior to definitive therapy.

Another important point has to be stressed: in order to perform a correct diagnosis, the smears must be technically more than satisfactory. In this connection, we, according to the Swedish school, disagree with those authors [4, 6–8, 15] who perform aspiration with needles of large diameter (18 gauge or larger). This type of needle may be dangerous for those anatomic structures which it comes across, may cause intratumoral hemorrhage, while the cytologic specimen is always too rich in blood. The latter makes difficult the preparation and the interpretation of the smear. Besides, the aspirated material should be representative of the whole tumor, so bone lesions must always be punctured in several areas; this sampling practice proves useful especially for larger lesions.

We never experienced real difficulties to cross the bone cortex; it was necessary to perform a slow rotatory movement under moderate pressure only in a few cases.

In addition, aspiration biopsy cytology may provide a means for pretreatment staging of bone malignancies, if, before penetrating the lesions, the soft tissues about the involved bone are aspirated in order to evaluate the possible spreading of the tumor.

Despite the limitations of aspiration biopsy, a significant number of intraskeletal lesions can be distinguished using smear techniques, and the same diagnostic accuracy of aspiration biopsy of bone tumors is well documented in the literature and supported by our results.

We would like to point out that fine-needle aspiration biopsy can be performed as an ambulatory procedure, it is well accepted by most patients, can be repeated if needed and, according to our experience, it is practically free of morbidity and mortality as well as of any risk of spreading the tumor.

Cytological diagnosis of malignant bone tumors on material obtained by needle biopsy is a real challenge and requires experience. It must never be regarded as a substitute for tissue examination but, in selected instances, it may yield meaningful and dependable information for therapeutic purposes.

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