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KEYNOTE LECTURE

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Solitary bone lesions: which ones to worry about?

Daniel Vanel[a], Eugenio Rimondi[a], Maia Vanel[b], Marco Gambarotti[c], Marco Alberghini[c]

[a]Department of Radiology, The Rizzoli Institute, Bologna, Italy; [b]Faculté Vétérinaire de Maison Alfort, Paris, France; [c]Department of Pathology, the Rizzoli Institute, Bologna, Italy

Corresponding address: Professor Daniel Vanel, Department of Anatomia Patologica, Istituti Ortopedici Rizzoli, via del Barbiano 1/10, Bologna 40106, Italy.
Email: daniel.vanel@ior.it

Abstract

The question is not classic: which signs suggest a possible malignancy when faced with a solitary bone lesion? Usually radiologists try to identify the leave me alone lesions, for which nothing is needed. Here we consider the suspicious lesions. Clinical and radiological indicators are proposed, leading to a probability. Nowadays, a biopsy is nevertheless always requested before treating a malignant lesion, even if suspicion is very high. But histology should integrate with the radiological signs.

Keywords: *Bone tumour; computed tomography; magnetic resonance imaging; malignant.*

Introduction

The diagnosis of a solitary bone lesion includes clinical, biological, and radiological signs, and then, of course, histology. From the first articles of Lodwick in 1968, using a computer program for the first time[1], the clever combination of well-analysed and well-recognized signs leads to an efficient diagnostic probability. Faced with a leave me alone lesion, nothing is done. Signs suggesting malignancy are less published, probably because no treatment is ever initiated before a biopsy. We propose signs, and then provide some practical examples.

The criteria

Clinical

A known cancer is a good reason to suspect a bone metastasis when faced with any bone lesion[2], even if the radiological pattern is not typical, leading sometimes to biopsies that would not have been performed otherwise. Malignant lesions are more frequent before the age of 20 years (from 0 to 5 years, metastases of neuroblastoma; from 5 to 20 years, Ewing sarcoma and osteosarcoma) and after 40 years of age (metastasis and myeloma). Location plays a major role[1]; the same lesion has a different behaviour (and diagnosis) in different locations. That is especially true in cartilaginous tumours, the probability of malignancy being higher in axial tumours. Tumours of the anterior cortex of the tibia are very often adamantinomas (Fig. 1) in adults (and

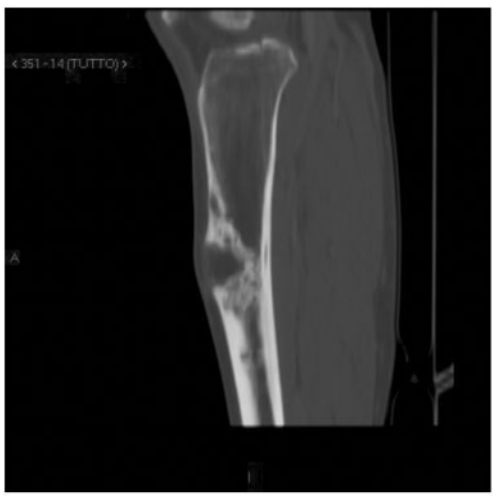

Figure 1 **Sagittal CT reconstruction. The tumour is centred on the anterior cortex of the shaft of the tibia of an adult: the location is very typical of an adamantinoma.**

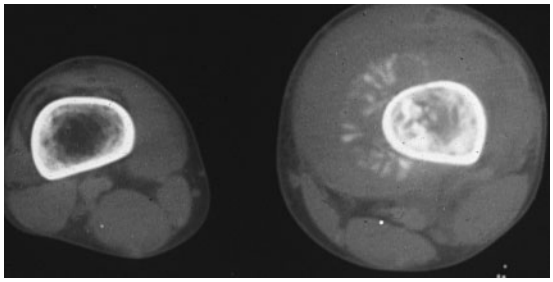

Figure 2 **Axial CT of the distal femur in a young patient. The tumour is inside and outside the bone, and the cortex looks normal. This pattern indicates a very aggressive tumour, here an osteosarcoma.**

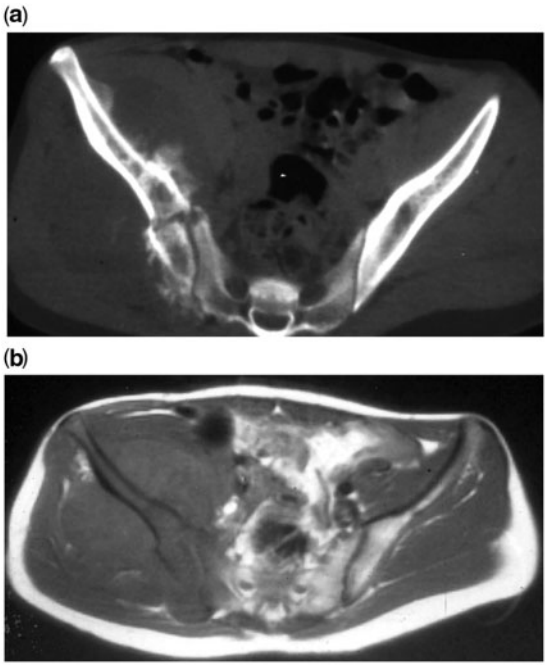

Figure 3 **Axial CT (a) and T1-weighted MR (b) images in a 16-year-old girl with an osteosarcoma. Ossifications and perpendicular periosteal bone formations are better detected on CT. On MRI, the exact extension of the tumour in the sacrum is much better evaluated.**

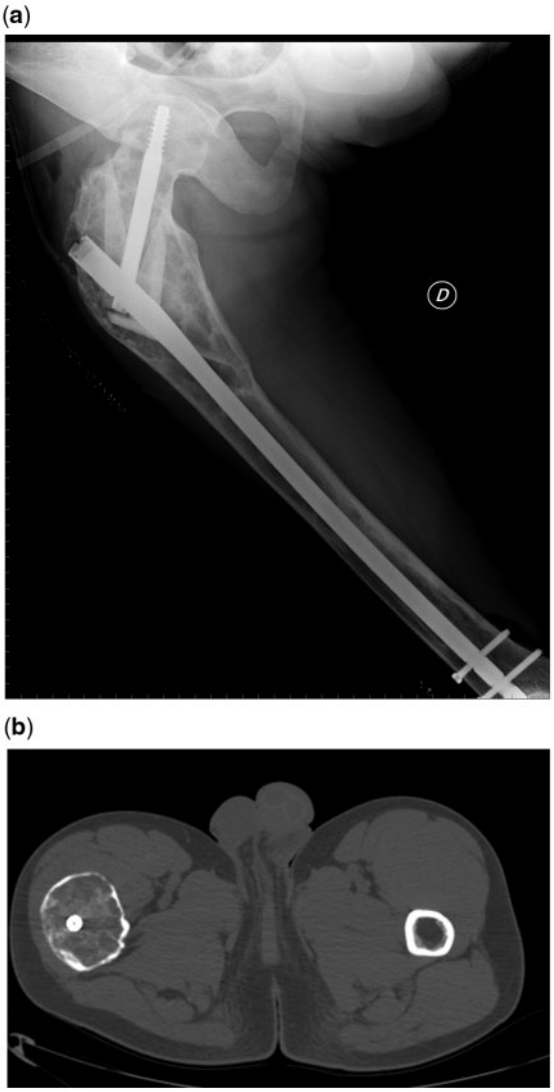

Figure 4 **Fibrous dysplasia of the femur. Radiograph (a) and axial CT (b). The thin non-interrupted periosteal bone formation is well detected on CT, and indicates a slow-growing process.**

osteofibrous dysplasias in children). Epiphyseal lesions are very rarely malignant (some clear cell sarcomas).

Radiological findings

Size is easy to use. Lesions that are less than 6 cm in the main diameter are very often benign (but the opposite is not true[1]). Limitation gives an efficient evaluation of the speed of tumour growth; a well-limited lesion with a sclerotic border is almost always benign, but a permeative border only indicates a fast-growing lesion (including, e.g. acute infection and Langerhans cell histiocytosis). This limitation appears completely different on radiographs and computed tomography (CT) on the one hand, and on magnetic resonance imaging (MRI) on the other hand. The destruction of bone trabeculae described by Lodwick[1] studied on radiographs and CT, and widely used, is completely different from the extension seen on MRI, and including the whole tumour, whatever the trabeculae involvement. The tumour looks better limited on MRI (Fig. 2). On MRI, peritumoral oedema is detected very easily. When very extensive, it usually indicates a benign lesion (osteoid osteoma, osteoblastoma, chondroblastoma, Langerhans cell histiocytosis).

A study of cortical involvement is also very efficient. When tumour is seen on both sides of a cortex, which looks uninvolved on imaging, the lesion is very aggressive, and has crossed the cortex without giving the osteoclasts the time to destroy it (Fig. 3)[3]. Conversely, if the

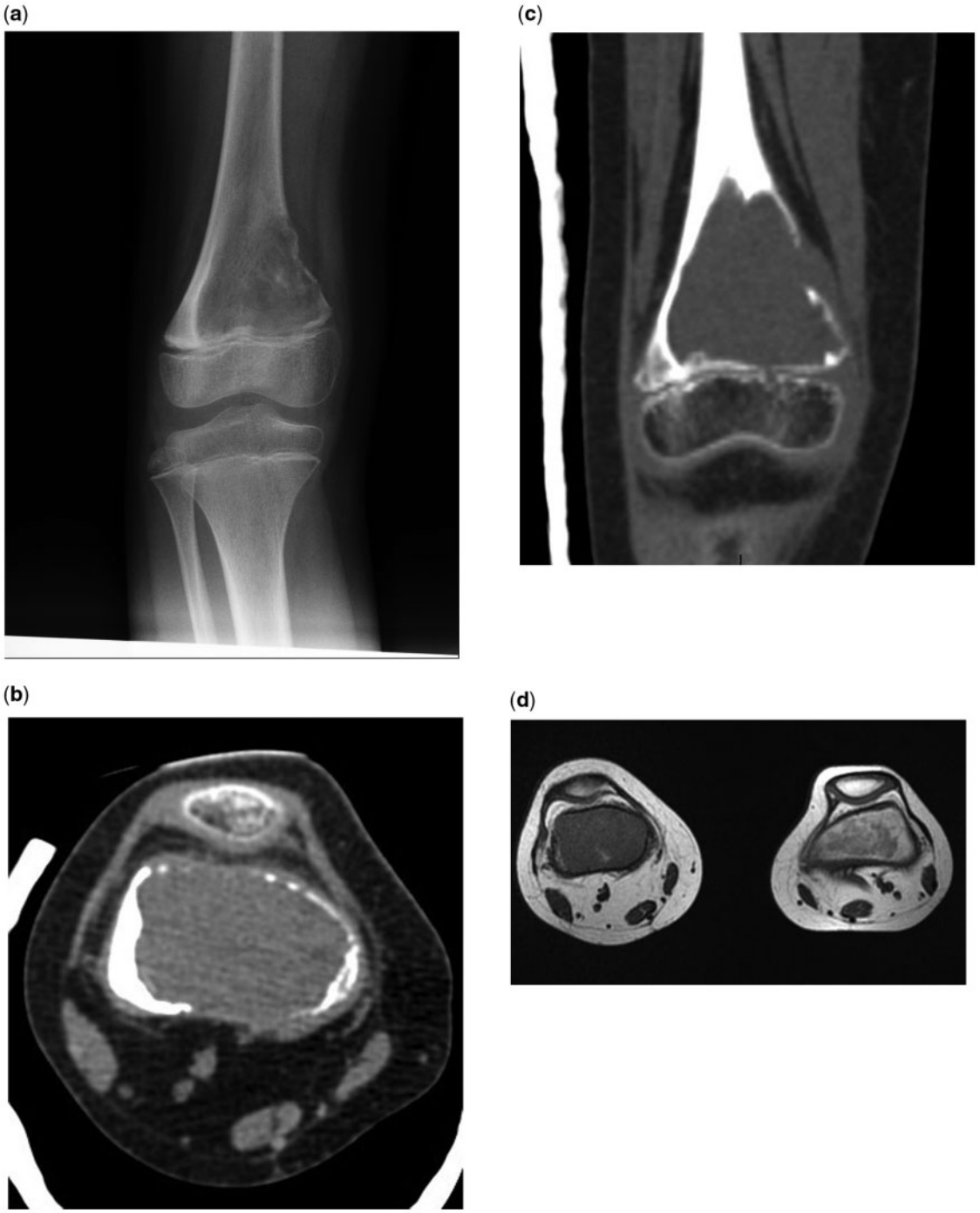

Figure 5 **Radiograph (a), axial (b) and coronal (c) CT, and axial T1-weighted MRI (d). In this low-grade osteosarcoma, minimal cortex destruction and soft tissue involvement indicate aggressiveness.**

cortex has completely disappeared, with a thin calcified periosteal reaction at the periphery of the lesion, this indicates a very slow-growing tumour, usually non-malignant.

The shape of periosteal bone formation is also very useful; perpendicular, it almost always indicates malignancy (in infection, enzymes make the periosteum disappear). Periosteal bone formations are better detected on CT (Fig. 3). The bone matrix may help, but ossifications, seen in osteosarcomas, are also detected in benign lesions. Cartilaginous lesions are discussed specifically. Osteosclerosis can be detected even when the lesion does not make bone. In 50% of Ewing sarcomas, it is visible on CT, and is secondary to deposits of calcium on remaining trabeculae. Fat inside a mass is a reliable indicator of a benign lesion[4].

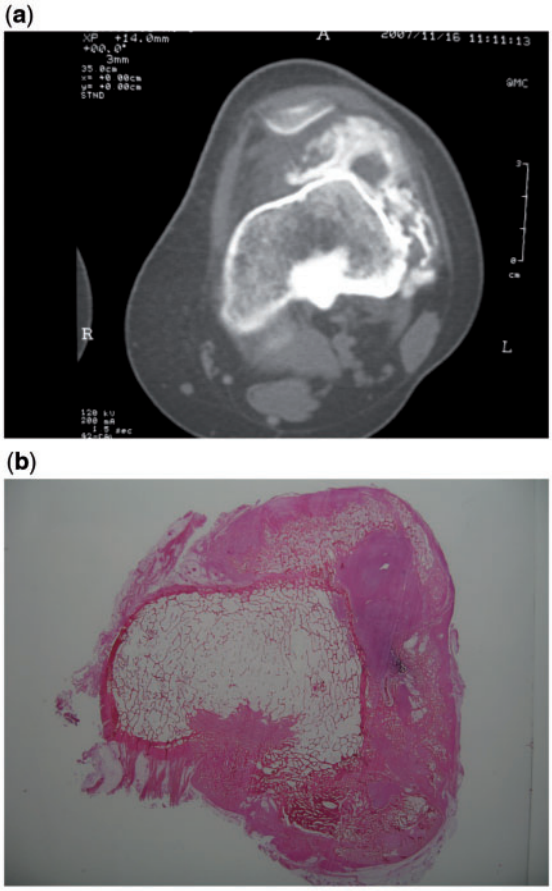

Figure 6 **Axial CT (a) and macroscopy of the specimen (b) of a parosteal osteosarcoma. The tumour is ossified in a homogeneous way, except the central lytic part, which corresponds histologically to a high-grade dedifferentiated sarcoma.**

New techniques, such as perfusion or spectroscopy MR, are not reliable enough to prevent the patient from having a biopsy[5,6].

Specific problems

Cartilaginous tumours

The diagnosis of cartilaginous tumours is a daily nightmare for the radiologist and the pathologist. There is no agreement between radiologists and pathologists, but not even between expert radiologists or pathologists[7]. Radiologically, size and location are used. When the lesion is huge (more than 5 cm), or axial, the probability of malignancy is higher. Two types of radiological criteria are used. (1) Morphologic criteria: the lesion is probably malignant if it has destroyed more than two-thirds of the cortex, invaded the soft tissues or has a periosteal reaction[8]. These criteria have a limited value when the lesion is eccentric[9]. Nodules of cartilage, surrounded by fat, and detected on MRI, indicate a benign tumour[10,11]. (2) Dynamic criteria: early uptake of contrast medium on MRI indicates an aggressive tumour and guides the biopsy[5].

Fibrous dysplasia or low-grade osteosarcoma

This diagnosis is very difficult, even for the pathologist. Limited signs of aggressiveness, such as limited cortical lysis, or soft tissue involvement, or periosteal reaction suggest malignancy[12] (Figs. 4 and 5). There is now a genetic marker to make the difference in difficult cases[13].

Dedifferentiated tumours

These are high-grade tumours developed on benign or low-grade lesions. They are frequent in cartilaginous lesions and in parosteal osteosarcomas. A purely lytic component and contrast medium uptake on MRI are excellent indicators of the high-grade part of the tumour[14] (Fig. 6a), guiding the biopsy.

Conclusion

The job of the radiologist is first to identify the leave me alone lesions. But suggesting malignancy may help guide the biopsy and push the pathologist to find minimal signs or use specific markers. The most suggestive radiological signs of malignancy are tumour on both sides of a non-destroyed cortex and perpendicular periosteal bone formations.

Conflict of interest

The authors have no conflicts of interest to declare.

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