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ORIGINAL STUDY

CT-guided percutaneous transpedicular biopsy for the diagnosis of vertebral lesions

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The authors report the results of a prospective study about CT-guided percutaneous transpedicular vertebral biopsy in 23 patients, 11 male and 12 female, with a mean age of 45 years (range, 17-90 years). Eleven biopsies were performed at a thoracic level, 12 at a lumbar or sacral (one) level. A diagnosis was obtained in 21 out of 23 patients (91.3%) ; in the remaining two cases an open biopsy was necessary, which led to the diagnosis of aneurysmal bone cyst. CT-guided percutaneous transpedicular biopsy is an effective and safe method. The transpedicular approach is especially useful for thoracic lesions, because it avoids pulmonary complications such as pneumothorax, without increasing the rate of neurologic problems. This method is not suitable for the diagnosis of aneurysmal bone cysts.

Keywords : computed tomography ; transpedicular ; biopsy ; percutaneous ; spine.

INTRODUCTION

The differential diagnosis of vertebral lesions is difficult. A definitive diagnosis is not always possible, based solely on radiological and laboratory investigations, particularly in primary and metastatic tumours, specific and nonspecific infections, and metabolic diseases. Therefore, a biopsy is generally necessary for accurate diagnosis (*1,12,18*).

Open biopsy is associated with problems, such as those related to general anesthesia, local spread of malignant tumours, longer hospitalization period, high costs, and resultant morbidity. Moreover, since anatomical structures can be injured during an open biopsy, it is difficult to perform a second surgical intervention using the same approach. A percutaneous biopsy can avoid most of these problems (*2,15*).

Posterolateral transpedicular curettage was first attempted by von Lackum in 1928 for a vertebral giant cell tumour L4 in an 8-year-old patient (*16*). Percutaneous needle biopsy involving lumbar vertebrae was first described by Robertson and Ball in 1935 (*6*). Craig (*6*) developed a percutaneous biopsy set that allowed to obtain samples from both soft tissues and bone. Later, Ackermann introduced a thinner needle. In 1991, Renfrew reported 6 patients in whom he had performed computed tomography (CT)-guided percutaneous transpedicular biopsies (CT-PTB) (*4,5,7,16*).

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MATERIALS AND METHODS

CT-guided percutaneous transpedicular biopsy (CT-PTB) was performed in 23 patients during a 4-year period. The mean age of the patients (11 males and 12 females) was 45 years (range 17-90). Eleven biopsies were performed at a thoracic level, 12 at a lumbar or sacral (one case : S2) level. Open biopsy, curettage, and grafting were subsequently performed in 2 patients with a vertebral aneurysmal bone cyst, undiagnosed by CT-PTB.

The indications for CT-guided transpedicular biopsy were possible metastatic lesions in patients with or without known primary tumour, primary tumours, metabolic diseases and spondylitis. Uncorrected bleeding diathesis was a contraindication.

Biopsies were performed with the patient in the prone position on the CT table. For lumbar lesions the lumbar lordosis was eliminated as much as possible by placing a support under the abdomen. Soft supports were placed under the upper extremities and the head. Thus it was ensured that the patient would be comfortable and that he would not move. The usual precautions for eventual complications were taken. The spinal processes of the affected vertebra and its upper and lower borders were marked with a surgical marker. For lumbar lesions the iliac crests were also marked. A scout film was taken first in order to determine the level of the lesion. The location of the lesion was determined by taking 2-mm axial sections at different pedicle levels. The penetration angle of the biopsy needle and the distance from the midline were calculated from the CT image. The entrance point was determined by measuring the transverse pedicle angle and the section angle from the area on the patient's skin that was demarcated by the light from the CT scanner. This entrance point was marked with radio-opaque material, and a control section was taken. Once the entrance point was established in this manner, it was indicated with a surgical marker. Asepsis was achieved with 10% povidone-iodine, after which the operative area was draped. Local anaesthesia (1 ml 0.1% lidocaine) was administered at the entrance point. A 0.5 cm incision was then made with a No. 11 blade. Subsequently, 10 ml of prilocaine was injected with a 17-gauge epidural needle up to the pedicle, at the angle measured previously. A Craig needle or a thinner Ackermann needle was used, respectively for lumbar and thoracic vertebrae. The needle, provided with a trocar, was moved through the soft tissues up to and subsequently into the pedicle, while taking control sections. Special care was taken to preserve the integrity of the inferior and medial walls of the pedicle, in order to avoid neurological problems. Control radiographic sections were taken at serial depth intervals of 1cm each when the needle went through the pedicle. The trocar was removed when the needle tip was at a distance of 0.5 cm from the lesion, after which the needle was carried further to perform the core biopsy. After confirming with a control section (fig 1) that the tip of the needle was in the lesion, material for culture and cytological analysis was sampled by means of aspiration. Cytological samples were prepared on glass slides and fixed. Finally, the needle containing the biopsy material was pulled back by a simple rotation maneuver. The core biopsy samples so obtained were fixed in formalin solution. The patients were hospitalized for 24 hours.

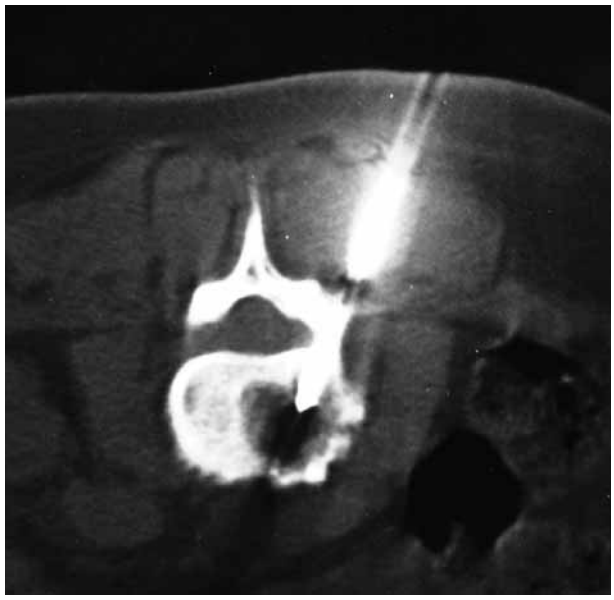

Fig. 1. — CT-scan : axial section. Patient with L4 nonspecific osteomyelitis. The needle tip has reached the lesion, transpedicularly.

RESULTS

Eleven biopsies were performed at the thoracic level, and 12 at the lumbar or sacral (one : S2) level. An accurate diagnosis was obtained in 21 out of 23 patients (91.3%) ; in the remaining 2 patients an open biopsy showed an aneurysmal bone cyst. A metastasis was detected in 6 cases (26%) ; a primary tumour (solitary plasmocytoma and lymphoma) in 2 cases (8.6%). An infection was established in 11 cases (48%), according to pathology, cytology

and culture. Of these 11 cases, 6 (26%) were assessed as Pott's disease, 4 (17%) as nonspecific osteomyelitis, and 1 (4%) as *Streptococcus pneumoniae* osteomyelitis. There was also a case of sarcoidosis (4%).

Complications occurred in 2 patients (8.6%). Radicular symptoms (burning pain in the lower extremity) were observed peroperatively in a single patient. The sagittal, coronal, and horizontal axes were immediately corrected and the symptoms did not recur during puncture in the corrected axis. A fistula developed in a case of Pott's disease ; it was surgically excised and did not recur.

DISCUSSION

In this study, only 2 cases (8.6%) out of 23 could not be diagnosed accurately ; 21 cases (91.3%) were diagnosed correctly. This compares favorably with the literature, where the percentage of correct diagnoses ranges from 71% to 94%. Open biopsy in the two undiagnosed cases suggested aneurysmal bone cysts. It is generally accepted that it is difficult to diagnose aneurysmal bone cysts by needle biopsy (*3,6,7,8,16,17,18*).

Metastases greatly outnumber primary tumours of the spine by a ratio of at least 5 to 1. This proportion was approximated in the current series : metastates were observed in 6 patients, while 2 had a primary vertebral tumour, namely a solitary plasmacytoma and a lymphoma : a proportion of 3 to one.

Although a transpedicular curettage for treatment of a vertebral giant cell tumour was first described in 1928, and percutaneous posterolateral vertebral biopsy was first descibed in 1935, percutaneous transpedicular biopsy has only recently attracted concern. Factors responsible for this are the close proximity of the pedicle to anatomical structures with a high possibility of injury, difficulty in covering the entire vertebral body by the transpedicular approach, and a higher accuracy of diagnosis by open biopsy. However, the development of new imaging techniques has changed this situation (*6,16,19*). The incidence of pneumothorax after paraspinal thoracic vertebral biopsy is 4%-11% ; the incidence of all complications is reported to be 0%-26%. Transient paresthesiae, transient spinal anesthesia, radiculopathy, paraplegia, meningitis, and sudden death have been reported. Cases of uncontrollable bleeding resistant to simple compression are rare. Bleeding from the pedicle can be controlled by introducing hemostatic substances (bonewax, Surgicel) from the entrance point. Excessive bleeding can be surgically drained to prevent haematoma formation. It is thought that the use of a thick biopsy needle increases the risk of complications. In our series, radicular symptoms were observed in one patient during intervention that resolved on changing the route of the needle : local anaesthesia allows feedback information from the patient. A fistula that developed in a patient with Pott's disease was successfully excised. The development of complications in 2 patients (8.6%) and the absence of any related long-term complications indicate a low rate of complications in our series (*9,10,18*).

There are important anatomical structures surrounding the pedicle ; therefore, interventions through the pedicle were avoided in the past. However, studies on vertebral anatomy and on pedicle screws have changed this attitude. According to Misenhimer *et al* (*13*) the average cancellous pedicle width (*inside* diameter) ranges from slightly more than 1 mm at T4 to slightly less than 6 mm at L5. Zindrick *et al* (*19*) reported average *outside* pedicular diameters to vary between 4.5 mm at T5 and 18 mm at L5. Where inside pedicular diameters measure less than the outside diameter of the biopsy needle, the outside diameter of the pedicle still allows transpedicular biopsy. In the current series a thin Ackerman needle (external diameters available from 1.4496 to 2.0527 mm), was used for the thoracic vertebrae, but at the risk that the material obtained would be insufficient for diagnosis (*11,13,16,19*). A Craig needle, with an outer diameter of 5 mm, was used at the lumbar level. It is necessary to preserve the integrity of the medial and inferior cortex, because of the proximity of neural structures. In other words, the needle should be placed close to the superior and lateral cortex of the pedicle.

As a conclusion, one can state that transpedicular biopsy is especially useful at the thoracic level, where it avoids complications.

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