CLOSED VERTEBRAL BIOPSY

I. S. FYFE, A. P. J. HENRY, R. C. MULHOLLAND

From Harlow Wood Orthopaedic Hospital and Derbyshire Royal Infirmary

A study of cadaveric vertebral biopsy and a review of 100 clinical biopsies has shown that needles and trephines producing tissue specimens of two millimetres or more in diameter can be expected to give a high degree of diagnostic accuracy. The erythrocyte sedimentation rate was a more useful screening investigation than were estimations of serum alkaline phosphatase. The complications are described. It is suggested that patients with painful thoracic metastases and evidence of progressive cord compression should have early decompression after open biopsy if further neurological compromise is to be prevented.

Closed biopsy of soft tissues was first described by Mixer in the early years of the twentieth century and has been considered to be a useful diagnostic procedure by many authors over the years (Ward 1914; Forkner 1927a, b; Martin and Ellis 1930). Coley, Sharp and Ellis (1931) published a series of aspiration biopsies of bone tumours, but noted difficulty with sclerotic and fibrotic lesions. This difficulty was overcome by the introduction of the fine bone trephine (Siffert and Arkin 1949). Robertson and Ball (1935) devised a technique of vertebral needle biopsy which has been refined by numerous authors. Ottolenghi has an unrivalled personal experience of needle aspiration biopsy of vertebrae (Ottolenghi 1955, 1969; Ottolenghi, Schajowicz and De Shant 1964), and quoted a 73 per cent positive diagnostic yield in a very large series. Many surgeons have not found this procedure so useful. This study was an attempt to clarify the factors influencing the results of vertebral biopsy, and the role of routine serological examination in the investigation of these patients.

A brief clinical review of spinal biopsies undertaken at Harlow Wood Orthopaedic Hospital and Derbyshire Royal Infirmary suggested a higher diagnostic accuracy when large biopsy instruments were used. Closed biopsies of the lumbar spine were therefore performed on fresh cadavers with sharp needles and trephines of varying diameters using the technique of Craig (1956). The specimens were decalcified, mounted in paraffin blocks, sectioned transversely and stained with haematoxylin and eosin. These histological preparations were compared for biopsy artefact and diagnostic value. It was found that specimens obtained with needles and trephines

Fig. 1

Fig. 2

Figure 1—Biopsy specimen using a 2.5 millimetre needle, showing normal cancellous bone architecture (haematoxylin and eosin, $\times 30$).
Figure 2—Biopsy specimen using a 1.5 millimetre needle, showing considerable tissue distortion (haematoxylin and eosin, $\times 30$).

I. S. Fyfe, FRCS, Senior Orthopaedic Registrar
R. C. Mulholland, FRCS, Consultant Orthopaedic Surgeon
Harlow Wood Orthopaedic Hospital, Near Mansfield, Nottinghamshire NG18 4TH, England.

A. P. J. Henry, FRCS, Consultant Orthopaedic Surgeon
Derbyshire Royal Infirmary, London Road, Derby DE1 2QX, England.
Requests for reprints should be sent to Mr I. S. Fyfe.

© 1983 British Editorial Society of Bone and Joint Surgery
0301-620X/83/2021-0140 \$2.00

of internal diameter of two millimetres or more almost invariably showed normal bone architecture with intact haemopoietic tissue (Fig. 1). Specimens obtained with small instruments showed considerable histological distortion, especially with trephining (Fig. 2).

PATIENTS AND METHODS

The records of 100 consecutive patients on whom spinal biopsy had been performed at Harlow Wood Orthopaedic Hospital and Derbyshire Royal Infirmary were reviewed. The maximal incidence of lesions was seen in patients of 50 to 70 years of age (Fig. 3). A broad spectrum of pathological conditions was investigated (Table I). Multifocal disease

Table I. Spectrum of pathological conditions biopsied

Pathological conditions	Number of patients
Acute osteomyelitis	11
Chronic osteitis	9
Tuberculosis	12
Myeloma plasmocytoma	11
Metastases	
no primary	18
breast	5
lung	3
kidney	3
oesophagus	2
ovary	1
prostate	1
thyroid	1
bowel	1
Osteoporotic fracture	4
Paget's disease	3
Lymphosarcoma	1
Ewing's sarcoma	1
Primary amyloid	1
Spondylosis	2
Polymyalgia rheumatica	1
Rheumatoid arthritis	1
No specific diagnosis	8
TOTAL	100

was seen in 35 patients. Ninety-four biopsies were performed in the lumbar and thoracic regions. The clinical signs, the erythrocyte sedimentation rates, the level of serum alkaline phosphatase, and the complications and accuracy of the biopsy were noted. The correct histological diagnoses were confirmed by other investigations, by the response to treatment, by open biopsy or at necropsy.

Technique of biopsy. For thoracic or lumbar regions, the patient may lie prone, with pillows supporting pelvis and shoulders but allowing free chest movement, or may lie on one side. Radiographic control can be achieved with the standard C-arm type of image intensifier when both

Fig. 3

Histogram of age distribution.

anteroposterior and lateral views can be obtained easily: bipolar fluoroscopy is an added refinement. After adequate premedication, the skin, soft tissues and vertebral periosteum should be thoroughly infiltrated with a local anaesthetic using a fine spinal needle, as introduction through the biopsy instruments is difficult and usually inadequate. Experience of cervical biopsy in this series is limited. In thoracic biopsy, the instrument is introduced through the skin medial to the angle of the ribs posteriorly (usually about four centimetres from the midline) and the vertebral body is approached at an angle of approximately 35 degrees to the vertical (Ottolenghi 1969). The instrument is advanced over the superior border of the respective rib to the vertebral body under strict radiographic control. If the whole vertebra is involved in the disease process, then the posterolateral quadrant of the body is the easiest to biopsy. The approach to the lumbar vertebrae is more posterolateral with the biopsy instrument being inserted 6.5 to 8.0 centimetres from the midline posteriorly, and the vertebral body approached almost at 60 degrees or more to avoid damaging the soft tissue anterior to the spinal column (Craig 1956).

The Harlow Wood vertebral biopsy needle has been designed specifically to provide a large tissue specimen with minimal damage to surrounding soft tissues. The needle uses a railroading technique for its introduction, and consists of a 1.5 millimetre stainless guide wire 25 centimetres in length, a tapered dilator of four millimetres external diameter, a trephine guide of five millimetres external diameter and a biopsy trephine of three millimetres internal diameter with an adjustable collet to control the depth (Fig. 4).

Fig. 4

Harlow Wood vertebral biopsy needle: the guide wire, the tapered dilator, the trephine guide, the biopsy trephine and the obturator.

Fig. 5

Fig. 6

Fig. 7

Figure 5—The introduction of the guide wire to the vertebral body. Figure 6—The tapered dilator advanced over the guide wire. Figure 7—Biopsy through the trephine guide with the large trephine.

The collet is adjusted to an appropriate position by comparing the lengths of the trephine and its guide. The guide wire is introduced through a stab wound and advanced under radiographic control (Fig. 5). The guide wire knob is then removed and the tapered dilator advanced gently over the wire to the vertebral body (Fig. 6). The position of the guide wire should be checked radiographically during this manoeuvre. The dilator knob is removed and the thin trephine guide slid over the dilator to the vertebral body, thus gently pushing aside the soft tissues. After removal of the guide wire and dilator, biopsy to the desired depth is performed through the trephine guide by a controlled advance of the trephine, rotating the instrument with the tommy bars provided (Fig. 7). To extract the specimen, a negative pressure is applied to the trephine with a small disposable syringe, the trephine is rotated to release the specimen and gently withdrawn. The specimen is expelled with the obturator, and a biopsy to a deeper tissue plane can be made by adjusting the collet. Usually two specimens are taken for histological and bacteriological examination. Fifty biopsies with this instrument have produced no further nerve root lesions.

CLINICAL REVIEW

Of the 100 patients 44 demonstrated marked tenderness over the spine at the level of the pathological lesion. Thirty-four had some degree of neurological involvement when first seen. The erythrocyte sedimentation rate was significantly raised in 76 patients with serious lesions, the highest levels being seen in acute osteomyelitis. Fourteen patients had lesions but normal rates, and the diagnoses are shown in Table II. The patient with a tuberculous osteitis was already receiving antituberculous therapy for pulmonary involvement. The serum alkaline phosphatase was raised in 41 patients but was normal in 30 who had severe pathological changes. One-third of the diagnoses were made with only routine radiography and biopsy, but tomography (18 patients) and technetium bone scanning (39 patients) provided more accurate localisation of some lesions.

The biopsies were divided into two groups by the size of the instrument: those taken with needles and trephines of two millimetres or more internal diameter and those taken with smaller instruments. The two groups were comparable for age range and site of biopsy. The number of correct histological diagnoses was called the "diagnostic yield".

Fifty-two large biopsies gave a 90.4 per cent diagnostic yield, but 48 small biopsies gave only a 50 per cent yield. Tuberculosis, osteomyelitis and myeloma required only small tissue samples for an accurate diagnosis. However, metastases, which were the com-

monest lesions, required larger tissue samples. The site of the primary tumour could often be suggested from these specimens.

Complications occurred in 15 small needle biopsies and 11 large needle biopsies (Table III). Patients with thoracic metastases and severe pain seemed more likely to develop signs of long tract damage. The pyogenic

Table II. Pathological conditions associated with normal erythrocyte sedimentation rates

Pathological conditions	Number of patients
Myeloma/plasmacytoma	4
Solitary breast metastases	3
Osteoporosis	2
Tuberculosis	1
Chronic osteitis	1
Paget's disease	1
Multiple metastases from the lung	1
Local invasion from thyroid carcinoma	1

Table III. Complications of vertebral biopsy encountered

Complications	Number of large biopsies	Number of small biopsies
<i>Neurological</i>		
Long tract signs deteriorated	2	4
Long tract signs produced	1	3
Increased root pain	2	0
Root signs	3	0
<i>Infective</i>		
Local pyogenic infection	2	2
Tuberculous abscess	0	1
Tuberculous sinus	1	0
<i>Pulmonary</i>		
Pneumothorax	0	3
Lobular collapse with effusions	0	2
TOTAL	11	15

complications settled with appropriate antibiotics. Pulmonary complications occurred only in the small instrument group. One pneumothorax, which was extremely distressing to the patient, occurred in a biopsy under local anaesthesia. No damage occurred to major vessels. The nerve root lesions all occurred in the large biopsy group.

DISCUSSION

Needle or trephine biopsy of bone has many advantages. It is simple and causes no interference with subsequent radiotherapy. It can be performed under either general or local anaesthesia, the latter having the advantage of making damage to the nerve root less likely.

Small needle aspiration biopsy tends to produce a cytological smear rather than a histological block of

tissue and small trephines can cause considerable damage to the specimen (Ottolenghi 1955). A cellular smear may be adequate for osteomyelitis and myeloma, but when more detailed histology is required a larger specimen must be obtained. It would seem from this study that instruments giving tissue cores of two millimetres or more in diameter give more reliable information. It would seem, however, unwise to subject patients with painful thoracic metastases and progressive cord compression to needle biopsy since further neurological compromise is likely to occur. These patients are better treated by early decompression and open biopsy.

The erythrocyte sedimentation rate appears to be a better screening procedure than serum alkaline phosphatase estimation in patients with active lesions of the vertebrae.

We would like to acknowledge the assistance received from Dr A. MacFarlane in his interpretation of the pathological preparations, Mr J. Pembleton for production of the Harlow Wood needle, Mr R. Lunt who introduced the concept of the large bore needle at Derbyshire Royal Infirmary, and Mrs S. Blythe for secretarial assistance.

REFERENCES

- Coley BL, Sharp GS, Ellis EB. Diagnosis of bone tumors by aspiration. *Am J Surg* 1931;13:215-24.
- Craig FS. Vertebral-body biopsy. *J Bone Joint Surg [Am]* 1956;38-A:93-102.
- Forkner CE. Material from lymph nodes of man: method to obtain material by puncture of lymph nodes for study with supravital and fixed stains. *Arch Intern Med* 1927a;40:532-7.
- Forkner CE. Material from lymph nodes of man: studies on living and fixed cells withdrawn from lymph nodes of man. *Arch Intern Med* 1927b;40:647-60.
- Martin HE, Ellis EB. Biopsy by needle puncture and aspiration. *Ann Surg* 1930;92:169-81.
- Ottolenghi CE. Diagnosis of orthopaedic lesions by aspiration biopsy: results of 1,061 punctures. *J Bone Joint Surg [Am]* 1955;37-A:443-64.
- Ottolenghi CE. Aspiration biopsy of the spine: technique for the thoracic spine and results of twenty-eight biopsies in this region and over-all results of 1050 biopsies of other spinal segments. *J Bone Joint Surg [Am]* 1969;51-A:1531-44.
- Ottolenghi CE, Schajowicz F, De Shant FA. Aspiration biopsy of the cervical spine: technique and results in thirty-four cases. *J Bone Joint Surg [Am]* 1964;46-A:715-33.
- Robertson RC, Ball RP. Destructive spine lesions: diagnosis by needle biopsy. *J Bone Joint Surg* 1935;17:749-58.
- Siffert RS, Arkin AM. Trephine biopsy of bone with special reference to the lumbar vertebral bodies. *J Bone Joint Surg [Am]* 1949;31-A:146-9.
- Ward GR. *Bedside haematology*. Philadelphia: WB Saunders Company, 1914:129.