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Technical method

A new bone marrow biopsy needle with core securing device

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The value of bone marrow biopsy in haematological as well as non-haematological malignant conditions is well established[1-4] but the problems of crushing and inadequate sample size remain the major limitations of most biopsy instruments. In order to obtain an adequate core of marrow tissue many instruments have been devised[5-9] and the Jamshidi needle is the most recent addition to this group of instruments.[9] It is widely used for core biopsy of the posterior iliac crest, but in about half the cases, the sample fractures while it is being extracted and only the outer portion is retrieved. Furthermore, in a small number of cases the core is not severed at its base and the whole specimen is left in situ as the needle is withdrawn, thus necessitating a second or third attempt to secure an adequate sample.

I have designed an instrument* with which it is possible consistently to obtain specimens of adequate size (2·1 mm in diameter and 18-20 mm in length) and unaltered architecture without the fear of damage or leaving the specimen in situ during extraction. This instrument has a device which makes it possible to secure the core while it is being extracted. The distal tip of the instrument has been designed for easy penetration of the cortex and has a sharp cutting edge. The proximal end of the instrument has been fitted with a large metal bar allowing firmer grip and has a smooth handle for operator comfort.

Material and methods

INSTRUMENT

The steel instrument (Fig. 1) consists of four parts. (a) *The needle* has an overall length of 122 mm, a uniform external diameter of 3·25 mm, and a constant internal diameter of 2·5 mm except for the 4·5 mm, distal portion where it is bevelled, grooved, and has a sharp cutting edge. The internal diameter of this portion (2·1 mm) is less than the overall internal diameter and ends in a short step of 0·2 mm. This

*Available from Downs Surgical Limited, Church Path, Mitcham, Surrey CR4 3UE.

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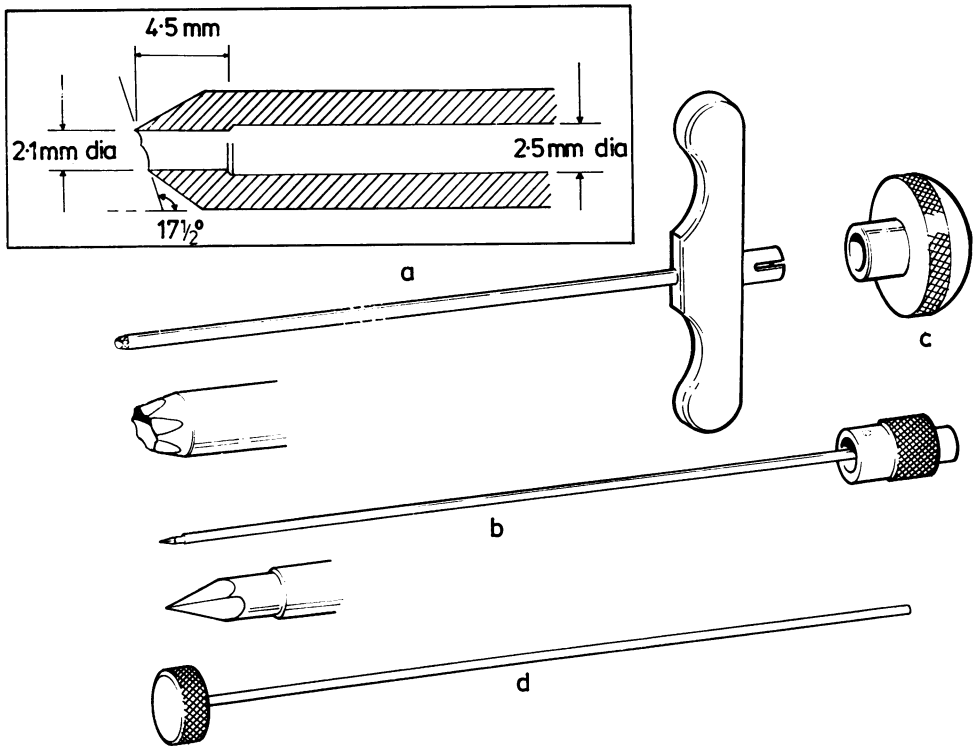

Fig. 1 *The needle (a), stilette (b), handle (c), and probe (d). The inset shows the details of the specially designed distal cutting end which secures and holds the core during the process of extraction.*

specially designed distal portion cuts all the trabecular connections which might keep the biopsy attached to its base and also holds on to the biopsy so that it does not slip out of the needle during the process of extraction. The larger internal diameter provides space within the interior of the instrument thus avoiding compression of the tissue; it also allows the specimen to be obtained without plugging the lumen of the needle. The proximal end of the instrument has been fitted with a large metal bar for firm grip and is round-ended to fit the stilette.

(b) *The stilette* is a solid shaft of 2·4 mm in diameter except for the distal portion where its diameter is 2·0 mm to fit the narrower distal cutting end of the needle. It ends with a 3·0 mm long three-faceted, sharp-pointed cutting tip which projects beyond the tip of the needle in order to protect the cutting edge of the needle and to provide a means of easy penetration of the bony cortex. The proximal end of the stilette has a round fitting for both the handle and the needle and a 10 mm outer circular shaft with serration for grip.

(c) *The probe* is used for extrusion of the biopsy. It is a solid shaft 1·9 mm in diameter and has an overall length of 140 mm. Its distal end is blunt and the proximal end is fitted with a 5 mm thick, flat, round knurled disc 15 mm in diameter.

(d) *The handle* is a semicircular smooth solid metal handle 30 mm in diameter and 15 mm deep with 5 mm lightly milled edge. It rests snugly in the hand and helps prevent blisters in the operator's hand during the biopsy procedure.

BIOPSY PROCEDURE (FIGS. 2 AND 3)

The instrument has been designed to obtain bone marrow biopsy specimens from the posterior iliac crest and the technique is very similar to that described by McFarland and Dameshek.[1] The patient is placed in a right or left lateral position with the knees drawn up and back comfortably flexed or in the prone position with a pillow beneath the hips. The posterior iliac crest is located and with the use of sterile technique, the skin is prepared with antiseptic and draped. Then the skin, subcutaneous tissue, and the periosteum are infiltrated with local anaesthesia. A small 3 mm skin incision is made with a pointed scalpel blade. The biopsy needle with the stilette and handle in place is advanced through the incision,

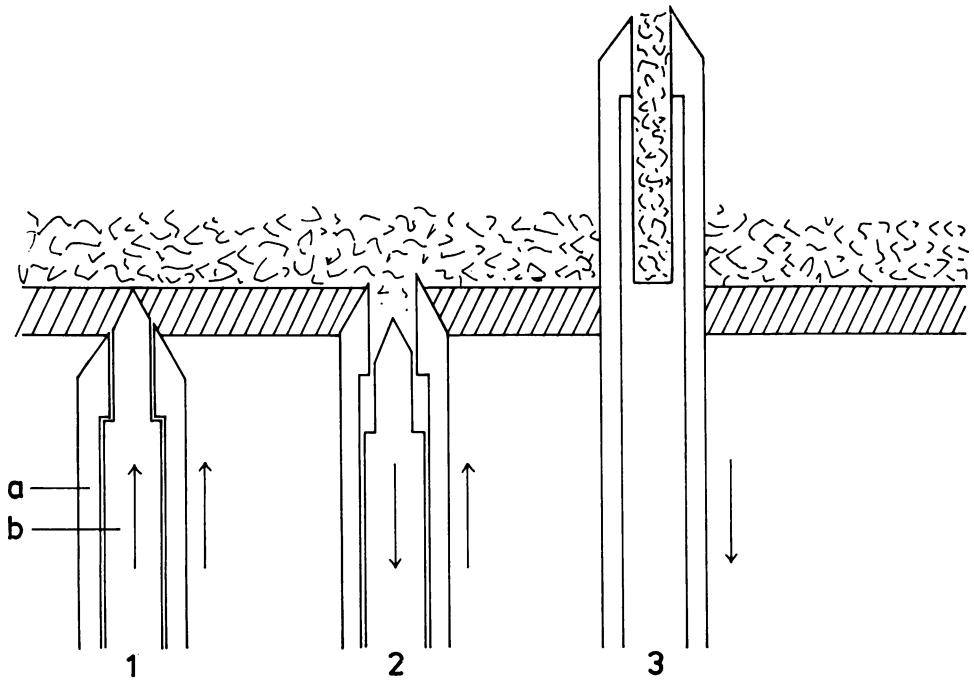

Fig. 2 *Schematic representation of the biopsy procedure. The outer needle (a) with stilette (b) is inserted down to the bone (1). The cortex over the posterior ilium is then penetrated by gently rotary motion of the needle with stilette in place and once this penetration has been achieved, the stilette is withdrawn (2). The needle is then advanced with slow, steady and controlled clockwise-counterclockwise rotary motion. When an adequate depth is reached the needle is rotated several times along its long axis and then slowly withdrawn with a straight pull. No rocking or sculling movements are necessary.*

pointing towards the anterior superior iliac spine and when the posterior iliac crest is reached it is penetrated by rotary motion of the needle. Once the cortex is penetrated the needle gets locked in the bone and the stilette with the handle is removed while holding the needle in place by one hand. The handle is disloged from the stilette and placed on the proximal end of the needle. The biopsy needle with the handle in place is slowly and gently advanced with slow, steady and controlled clockwise-counterclockwise motions until an adequate depth is reached. The biopsy needle is then rotated completely several times along the long axis to sever any trabecular connections and then slowly removed with a straight pull. No rocking or sculling movements or change in the direction of the tip of the needle is necessary. The specimen obtained is then gently removed with a long probe which must be introduced through the distal cutting end. Like the Jamshidi needle this instrument has a larger internal diameter than the distal cutting tip and this allows one to obtain specimens without plugging the lumen of the needle and avoids compression of the tissue. After the biopsy, the edges of the wound are pressed together with adhesive tape. A gauze dressing is applied on the top of the adhesive tape, and the patient is instructed to lie on his back for 15-20 min or longer if the patient has a low platelet count.

Results

The needle has been extensively tested on cadavers, obtaining more than 50 specimens from 30 cadavers, and later used it on 20 patients suffering from various haematological malignancies. An adequate sample was obtained with each attempt, bony trabeculae were clean cut (Fig. 4) and crushing was almost negligible even at the edges of the trephine. The quality of the specimen obtained with this needle has been excellent (Fig. 5a & b) in each case. The biopsies were processed in methyl-methacrylate[10] and semi-thin sections were obtained from the undecalcified bone with a special microtome (Autocut). The methacrylate was dissolved from the sections by

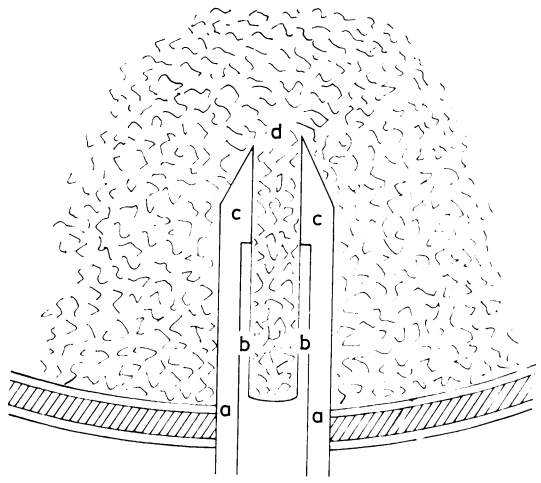

Fig. 3 *Schematic representation of the author's biopsy technique. (a) The needle wall, (b) space between the core and internal wall of the needle which avoids compression of the tissue and plugging the lumen of the needle. It also allows easy delivery of the core through the proximal end. (c) Specially tooled distal cutting end which cuts all the trabecular connections of the core with its base and holds the core during extraction so that it does not slip out of the needle. (d) Base of the marrow core in the bone.*

immersion in benzene and then stained with May-Grünwald-Giemsa stain.

Discussion

Available instruments[5-9] for obtaining bone-marrow trephine samples do not consistently provide high quality material because of crushing and distortion of tissue architecture especially those that yield small samples. The largest specimens are obtained with the Notter-Labhart[11] and Burkhardt[8] needles; both these procedures require an assistant and the process is complicated and time-consuming; it cannot be repeated on the same site for at least 4-6 months. The Jamshidi needle[9] appeared to offer the best compromise: it is acceptable to most patients, produces little crushing, and yields a moderately large core in all cases except those with very osteoporotic marrow.[11] In my experience the sample has fractured while being extracted in a large proportion of the cases and the length of the outer portion retrieved has been only 10-12 mm. Even in skilled hands a core cannot be extracted in a small percentage of cases: it remains firmly attached at the base and slips out of the needle during retraction thus requiring a second or third attempt to secure an adequate specimen; the technique also requires some rocking or sculling movements with the needle to detach the biopsy specimen at its base, and the needles are often bent and damaged. Some crushing is usually seen at the edges of the biopsy specimen. This narrows the total width of the section available for histological examination. In short specimens crushing becomes a

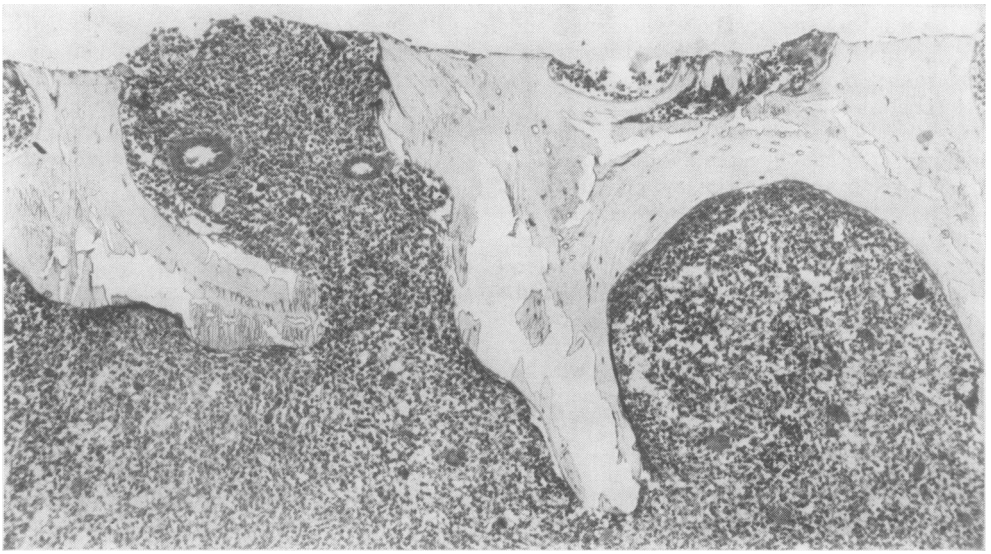

Fig. 4 *Photomicrograph of a section to show the clean cut of the bony trabeculae.* × *60.*

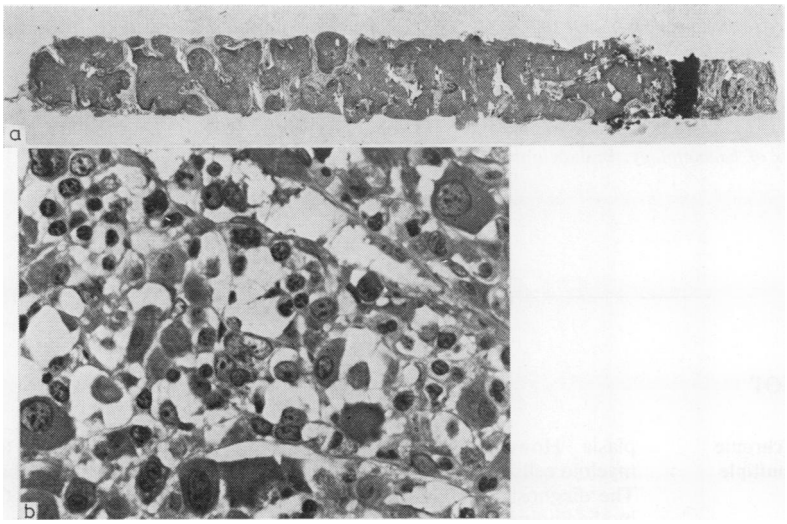

Fig. 5 *(a) Low power (original magnification × 8) photomicrograph of a whole section of a marrow core obtained by the author's needle, demonstrating intact marrow and undistorted bony architecture. (b) High power (original magnification × 600) view to show the excellent cytomorphological detail (biopsy processed in methyl-methacrylate and semithin section stained with May-Grünwald-Giemsa stain).*

major problem rendering histological evaluation much more difficult.

The biopsy device described here has been developed over more than three years by considering all the recognised disadvantages of the available instruments. The advantageous features of the new needle are as follows: (i) the three-edged, sharp-pointed cutting tip of the stilette is short and easily penetrates the soft tissue and bony cortex; (ii) the large metal bar at the proximal end of the needle permits a secure and firm grip, while the smooth handle rests comfortably in the palm of the hand so avoiding pain or blister formation during the biopsy procedure; (iii) the most important feature of the instrument is the carefully tooled distal cutting end of the needle with a core-securing device which makes it possible to obtain a long uniform core of marrow-containing bone with no distortion of the marrow architecture. The biopsy procedure is essentially that of the Jamshidi needle.

Aspiration of marrow before obtaining a core with the same instrument distorts the marrow structure as Block has found.[12] It is better not to use the same instrument for aspiration and coring at the same time. The easily accessible posterior iliac spinous area is the thickest marrow-containing area in the child and adult.[13]

The same puncture wound is used for both aspiration and biopsy but different needles and slightly different sites are chosen for the aspiration and biopsy procedures.

I wish to express my sincerest personal appreciation and thanks to Mr D Bevan of Downs Surgical Limited, for his useful and constructive advice and the keen interest that he has shown in the progress and development of this instrument. I am also greatly indebted to Mr O Madigan for his help and assistance with the cadavers.

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Letters to the Editor

Simultaneous presentation of chronic granulocytic leukaemia and multiple myeloma

The association of multiple myeloma (MM) and acute myelomonocytic leukaemia (AMML) either following long term treatment with alkylating agents[1] or occurring simultaneously without previous chemotherapy[2] is well documented, as is the association between MM and the myeloproliferative disorders[3] (polycythaemia rubra vera and myelofibrosis).

The occurrence of CGL in two patients with chronic lymphocytic leukaemia (CLL), one treated with total body irradiation and one untreated has also been reported.[4]

However, the simultaneous presentation of MM and CGL has, as far as we are aware, not yet been documented.

CASE REPORT

A 58-year-old caucasian man presented in April 1978 with a two month history of lower lumbar back pain, and a six month history of increasing lassitude.

On examination he was obese, but his spleen tip was just palpable on deep inspiration. A later liver and spleen scan revealed considerable splenic enlargement, but no hepatomegaly. His full blood count revealed haemoglobin 10·2 g/dl, WBC 140×10^9/l with a differential count of myelocytes 35%, metamyelocytes 29%, mature neutrophils 20%, promyelocytes 2%, lymphocytes 7%, eosinophils 4%, and basophils 3%. The platelet count was 309×10^9/l.

Chronic granulocytic leukaemia was suspected and a bone marrow aspiration was performed. The bone marrow was hypercellular with marked myeloid hyperplasia. However, scattered amongst the myeloid cells were numerous plasma cells. The diagnosis of CGL was substantiated by the finding of the Philadelphia chromosome 46 XY t (9; 22) (q 34; q 11). The leucocyte alkaline phosphatase (LAP) score was 0 (NR = 20-90).

The diagnosis of MM was substantiated by the presence of a paraprotein IgGk at a concentration of 26 g/l. There was an accompanying immune paresis. Bence-Jones protein was present in the urine. Skeletal survey revealed marked osteoporosis with wedge collapse of L2 and L3 and 4 thoracic vertebral bodies.

The patient was managed initially with irradiation to L2 and L3 with total pain relief. Subsequently he had 15 courses of melphalan (10 mg/day for 4 days) and prednisolone (40 mg/day for 4 days) at monthly intervals. The paraprotein concentration has remained static. The WBC fell dramatically following the spinal irradiation (total 3300 r) to 7×10^9/l, but gradually rose to $>100 \times 10^9$/l over the next four months. His CGL has subsequently been controlled with intermittent courses of hydroxyurea and more recently busulphan and thioguanine.

DISCUSSION

The chance occurrence of two distinct haematological malignancies is unlikely. A common aetiological agent, affecting two cell lines, is a possible explanation or the emergence of an abnormal clone of cells secondary to the immunological defect caused by the multiple myeloma.

However, the most attractive theory is for the existence of a totipotential myelolymphoid stem cell.[5] A malignant proliferation of this common stem cell could lead to the simultaneous occurrence of a lymphoid B cell tumour—MM and a tumour of the haemopoietic pluripotential stem cell—CGL. The existence of this totipotential stem cell is suggested by the now well documented occurrence of the lymphoblastic crisis in CGL. The proof, in our case, would be the finding of the Philadelphia chromosome in the malignant plasma cells, but divisions of plasma cells are very difficult to obtain even under the very best conditions without crowding out by other cell divisions. Alternatively, the presence of a marker X-linked isoenzyme in a female heterozygote where the malignant haemopoietic cells and plasma cells contain a single isoenzyme but other tissues exhibit both isoenzymes, might confirm the origin.

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