AN ANALYSIS OF THE RADIOLOGICAL VISUALIZATION OF THE CATHETERS PLACED IN THE EPIDURAL SPACE

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SUMMARY
Radiographs of the position of the epidural catheter were taken in each of 90 patients in whom this form of analgesia was employed for surgery. Radiopaque dye was injected through the catheter. In 33 patients the average length of catheter threaded into the epidural space was 20 cm; the desired cephalad direction was followed in 16. When the average length of catheter inserted was 12.5 cm the tip followed the cephalad direction in 27 of 57 patients. Straight, curled up, and winding patterns were observed, and in 6 of 90 patients the catheter passed out of the epidural space.

In describing techniques for continuous epidural lumbar block several authors state that the Tuohy needle with curved directional Huber point makes it possible to direct the catheter up or down the epidural space, according to the way the needle tip is orientated (Bromage, 1954; Moore, 1965; Collins, 1960; Duncan and Lewis, 1963; Bonica, 1953; Morris, 1966; Hingson, 1964; Lund, 1966). Moore (1965) states that the catheter will follow a certain direction provided the plastic tubing is inserted for only 5 cm, when its position in the epidural space can be predicted precisely. Others (Bromage, 1954; Collins, 1960; Duncan and Lewis, 1963) state that a catheter will often continue for a short way in the direction in which it is started, but that there is a tendency for it to be deflected by the many structures lying within the epidural space, so that it may curl up or double back on itself (spaghetti-like tangle) (fig. 2), sometimes even passing out through an intervertebral foramen (fig. 9). Bonica (1953) states that it is possible to pass the catheter either cephalad or caudad by directing the bevel of the needle accordingly.

This communication describes an investigation which was carried out to examine further the position of catheters inserted into the epidural space.

METHOD
A radiograph of a catheter placed in the epidural space was taken in 90 patients in whom this form of analgesia was employed for the performance of a surgical procedure.

No selection was made regarding factors such as age, weight, height, etc. Patients with abnormalities of the spine were not excluded and the investigation was exclusively confined to the behaviour of the catheter.

Lumbar epidural analgesia was carried out in 90 patients, using vinyl plastic tubing specially designed for continuous epidural anaesthesia.
(Vinyl tubing i.d. 0.02 mm x wall 0.008 mm, Becton Dickinson & Co.; Portex Epidural Cannula, Portland Plastics Limited). In this series the wire stilette used by several workers was not employed for reasons referred to later.

The 90 cases of lumbar epidural block were divided into two groups: in group I (33 patients) the length of catheter threaded within the epidural space was practically unlimited. Since on average the length threaded was 20 cm (taking the skin as a reference), this is referred to as the “without control” group. The length of the catheter was determined by observing the markings on the vinyl tubing made at 5-cm intervals from the end to be placed in the epidural space up to 20 cm.

In group II (57 patients) the length of the catheter was limited to an average of 12.5 cm, considering also the skin as the point reference, and is referred to as the “with control” group. In all cases it was intended to impart a cephalad direction to the catheter. At the end of the surgical procedure and while the patient was still on the operating table, a radiograph of the epidural catheter was taken employing the technique now described.

The patency of the catheter was checked by means of the injection of 0.5 ml of saline solution or 1 per cent lignocaine before introducing the radiopaque dye. The X-ray film was placed carefully under the patient's lumbar region centring the catheter on the film. The radiopaque dye used in the great majority of the cases was Ultrafluid Lipiodol.* In the remaining patients Lipiodol* was employed, having previously been warmed to make its passage through the catheter easier. An insulin-type syringe was utilized in order to measure accurately the amount of dye injected. Care was taken to eliminate air bubbles from the syringe because the induction of even minute bubbles into the catheter results in loss of visualization of segments of the catheter. The amount of dye necessary to fill the catheter was 0.3 ml and after injection the radiograph was taken without removing the syringe. The radiopaque material was immediately aspirated. There were no spontaneously reported complications attributable to the method.

RESULTS

Examination of the radiographs of the 33 patients in whom the length of catheter threaded into the epidural space was on average 20 cm (group I) showed that the tip followed a cephalad direction in only 16 (48.4 per cent); in 14 (42.4 per cent) the catheter remained within one interspace above or below the site of puncture (fig. 2); in the remaining 3 patients (9 per cent) the tip of the catheter followed a caudal direction (fig. 3). The behaviour of the section of the catheter within the epidural space was examined and it was concluded that it followed three main patterns (fig. 4): in 16 (48.4 per cent) the length of the catheter was straight (fig. 5); in 11 (33.3 per cent) the catheter was curled up or doubled on itself (fig. 6); and in 4 (12.1 per cent) the catheter showed a winding pattern (figs. 1 and 7); and in 2 (6 per cent) the catheter had passed out of the epidural space through an intervertebral foramen (figs. 8 and 9).

Examination of the radiographs of the 57 patients in whom the length of catheter threaded into the epidural space was on average 12.5 cm (group II) showed that the tip followed a cephalad direction (fig. 5) in only 27 (47.3 per cent); in 24 (42.1 per cent) the catheter remained within one interspace above or below the site of puncture; in the remaining 6 (10.5 per cent) the tip of the catheter followed a caudal direction (fig. 10). Examination of the behaviour of the section of the catheter threaded within the epidural space (fig. 11) showed that the length of the catheter was straight in 23 (40.3 per cent); in 22 (38.5 per cent) the catheter was twisted around one or more times; in 8 (14 per cent) the section of the catheter showed a winding pattern; and in the remaining 4 (7 per cent) the catheter had passed out of the epidural space through an intervertebral foramen.

DISCUSSION

In this investigation it was found that when an attempt was made to pass a catheter in the cephalad direction about 40 per cent failed to pass upwards beyond the first interspace when the catheter was threaded on average 12.5 cm (group II) or on average 20 cm (group I) beyond the tip of the needle. In the two series a similar
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Fig. 2
Showing the catheter curled up with the tip remaining at the same site.

Fig. 5
The catheter followed a straight upward cephalad direction.

Fig. 3
Direction followed by the tip of the catheter threaded into the epidural space in 33 patients in whom the catheter was threaded on average 20 cm from the skin.

Fig. 6
An interesting shape is observed in this photograph—a spiral pattern with a final straight upward cephalad direction.

Fig. 4
Course followed by the catheter within the epidural space in 33 patients in whom the length threaded averaged 20 cm from the skin.

The catheter can be seen to form a figure-of-eight type pattern. The tip is located at about the same level as that at which the lumbar puncture was performed.
In this photograph the catheter and the radiopaque dye are outside the epidural space. This was an unsuccessful block despite careful technique.

Observe the neatness of the exit of the catheter through the intervertebral foramen.

It is probable that the use of a stainless steel wire stilette would make it possible to direct the catheter accurately in a higher proportion of patients. Despite the lack of detailed figures concerning the incidence of dural puncture, the authors believed that this technique increases the incidence of dural perforation, even in the hands of the experienced. The passage of the catheter through an intervertebral foramen no doubt accounts for lack of analgesia, and when the tip of the catheter lies close to an intervertebral foramen (fig. 1) it leads to the occurrence of unilateral analgesia, the local anaesthetic solution escaping from the epidural space.

When a catheter was accidentally passed into the subarachnoid space (fig. 12) it seemed to follow a straight pattern and the radiopaque dye formed droplets emerging from the tip; the pattern contrasted with the irregularities observed both in the pattern of the length of the catheter
and the appearance of the dye emerging from the tip when a catheter is placed in the epidural space. If accidental passage of the catheter into the subarachnoid space occurs, the radiopaque material is aspirated completely. In our hospital in a series comprising over 200 myelograms employing Lipiodol, no complications have been observed in the careful follow-up of these patients.

The authors suggest that radiography may have a useful place when it is desired to find why a block is not working satisfactorily or to check that its position is placed so as to lead to the expected result after injection of local anaesthetic solution.

REFERENCES