Deflection of spinal needles by the bevel

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Summary

Bevelled spinal needles sizes 22 and 25 gauge were passed through tough meat to assess the influence of bevel orientation on the path of the needle. The needle bent away from the bevel surface by about 1 mm for each centimetre of needle travel through the tissue. With an introducer, the deviation was reduced by a reduction of the distance of unsupported travel. Pencil-point needles were less deviated.

Key words

Anaesthetic techniques; spinal, intradural.
Equipment; needles.

When a spinal needle is inserted for subarachnoid block, it is often oriented with the bevel facing towards the patient’s side. This is said to allow the needle tip to penetrate the dura by parting the fibres rather than by cutting them, because the fibres run mainly in a cranial–caudal direction. However, in patients who were unable to flex their lumbar spine fully, the authors found that insertion as far as the dura was impossible when the needle bevel was oriented laterally. They thought that the tip of the needle could be pushed sideways by the bevel face as it passed through the tissues and therefore the needle would be pushed away from a midline path. Subarachnoid insertion became possible when the bevel was re-oriented to face caudally, and the needle would then not have deviated from the midline. They have tried to confirm this hypothesis.

Method

Needles. Three types of disposable needle with stilette were used: Needles of 22 and 25 gauge with Quincke type points (Becton, Dickinson & Co.) and 22 gauge needles with pencil-shaped points I (Monoject). Three samples of each needle were tested. Each needle was 8.9 cm long.

The needles were inserted into a wedge-shaped piece of tough beef weighing about 300 g, with the usual speed and force used when performing a block. The meat was laid on a sheet of polythene and placed on a piece of paper. The position at which the needle tip emerged after its passage through the meat was recorded by the mark left in the paper after needle insertion.

Introducers. Two types were used. The first was a Sise introducer with stilette, 4 cm long, made to take a 22 gauge disposable needle. The second was a disposable 19 gauge hypodermic needle, 5 cm long, which is used as an introducer for 25 gauge spinal needles.

Measurements using introducers. Both introducers were clamped in an accurately vertical position in a bench stand. The distance from the
tip of the introducer to a firm rubber pad placed on the bench below was measured. The clamp stand and introducer were then lifted, a piece of meat placed on a sheet of paper on the pad, and the stand lowered so that the introducer entered the meat. The appropriate spinal needle was passed through the introducer until its tip was felt to touch the pad and a mark was left in the paper. The needle was withdrawn fully, the needle rotated through 90°, and re-inserted for a total of four insertions. The paper between the meat and the pad was removed and measurements made of the distances between opposite puncture marks (caused by insertions with the bevel facing in opposite directions). The average of the two distances was halved to give an expression of the mean deviation of the needle tip from a straight course.

Without introducer. Each type of needle was cut just below the hub with the stilette retained accurately in position within the shaft, and then carefully clamped in the chuck of a drill stand so that the needle was vertical and 7.5 cm protruded. This allowed the needle to be lowered repeatedly along the same axis. The chuck and needle were then lowered to mark a centre point on a piece of paper placed on a rubber mat on the drill stand base. A piece of meat was placed on the paper and the needle lowered again. No attempt was made to prevent the exposed needle from bending although a distinct curve often developed in the length between the chuck and the surface of the meat. After marking the paper with the needle tip, the needle was withdrawn. The chuck was turned through 90° and the needle re-inserted for a total of four insertions. The chuck descent when the needle tip just touched the surface of the meat was noted. The meat thickness, and hence the distance of needle travel, was calculated from the difference between the descent to touch the paper and the descent to touch the meat surface. The distance from the mark made by the needle tip to the centre mark was measured for each of the four orientations of the needle and the average deviation of the needle tip was calculated.

Results

A consistent pattern of tip marks was seen on almost every occasion when the bevelled needles were studied (Fig 1). Needle-tip deviation increased with increasing distance of travel through the tissue.

![Fig. 1. Typical pattern of tip marks made by passing a 22 gauge bevelled needle through 5.4 cm of tissue](image)

Needle travel through the tissue was less when an introducer was used. The 25 gauge needles were deviated more than the 22 gauge needles, for the same distance of passage through the tissue (Fig. 2). As an indication of the amount of deviation, the mean value of the ratio tip deviation/distance of insertion was calculated. For 25 gauge needles this index was 0.070 and for the 22 gauge needles it was 0.042. When the needles were used without introducer, the tissue path was longer, and the 22 gauge needle was deviated more than the 25 gauge needle (deviation/insertion ratios of 0.150 and 0.063 respectively) (Fig. 3). The pencil point needle was consistently deviated when it was used without introducer but this deviation

![Fig. 2. Average deviation of needle tip related to distance of needle travel, when used with an introducer: • 25 gauge bevelled needle; ○ 22 gauge bevelled needle; □ 22 gauge pencil point needle.](image)
was very small. When an introducer was used, no deviation was found.

The deviation became more variable with greater distances of passage through the tissue, particularly for the 25 gauge needle without introducer.

Discussion

Deviation could vary with different types of tissue. It was not possible to obtain suitable samples of other tissues to verify this but the tissue used gave consistent results. The 'feel' of the tissue was not dissimilar to that encountered in lumbar puncture.

Data analysis by linear regression was inappropriate because the variation in displacement increased with increasing needle travel. Nevertheless, inspection of the results shows that the needle bevel consistently alters the needle path.

The 22 gauge needle fitted its introducer more snugly and was deviated less than the 25 gauge needle, but the converse was found when the needles were unsupported. Perhaps the force on the bevel is proportional to the area of its face whereas needle rigidity is proportional to diameter. In clinical practice, where the part of the needle that is not in the tissue can be held, and prevented from bending, the deviation found with the 22 gauge needles might be lessened.

In several patients in whom needle insertion was difficult, needle insertion was easily done when the needle bevel faced caudally. Presumably the space between adjacent vertebral laminae in these patients would be small, and would not be penetrated by a needle that was not accurately in the midline.

If the needle is used with the bevel facing caudally to ensure that its path is in the midline, it could still be rotated just before dural puncture was anticipated so that the tip passed through the dura with the bevel facing sideways. Alternatively, an introducer would increase accuracy by reducing the distance of unsupported needle travel.

The practice of orienting the needle bevel laterally to reduce the size of residual hole in the dura has been advocated for a long time. Greene, experimenting with excised dural sacs, did not mention this factor although he noted that the majority of fibres were longitudinal and would be better parted than cut. No study has investigated the influence of needle orientation on headache.

Several needles have been designed to reduce the size of the dural hole. A pencil-point needle reduced the incidence of postspinal headache, and also seems to be more likely to go straight. This may be an advantage: however, it was found that bevelled needles were used easily if the movement of their tips away from the line of advancement was anticipated.

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References