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SHORT COMMUNICATIONS

Influence of patient position on withdrawal forces during removal of lumbar extradural catheters

G. N. MORRIS, B. B. WARREN, E. W. HANSON, F. J. MAZZEO AND D. J. DIBENEDETTO

Summary

We have investigated the force required to remove lumbar extradural catheters from 88 parturients to determine the effects of patient positioning at removal, relative to the position at insertion. Parturients were allocated randomly to one of four groups: LS (lateral insertion, sitting withdrawal), LL (lateral insertion, flexed lateral withdrawal), SL (sitting insertion, lateral withdrawal) or SS (sitting insertion, sitting withdrawal). In both positions, the lumbar spine was kept maximally flexed. The force required to remove the catheter was measured at withdrawal. We found that the withdrawal force was influenced by the relationship between the position at removal and that at insertion, and we recommend that for ease of removal, patients should be placed in the same position as they were at the time of insertion. Compared with all other groups, the withdrawal force in patients in group LS was significantly greater ($P<0.05$). (*Br. J. Anaesth.* 1996;**77**:419–420)

Key words
Equipment, catheters extradural. Anaesthesia, obstetric.

Extradural catheters are usually removed without complications. However, there are reports of catheters that are difficult to remove, catheter breakage and shearing[1 3]. Fragments of catheter may be sequestered in the extradural space. Removal of an extradural catheter also has the potential for inducing extradural haematoma formation[4]. Hence, minimizing the extraction force is desirable. Previous studies have indicated that the force at extraction of lumbar extradural catheters was significantly greater with patients sitting compared with the lateral position[5 6]. These studies did not consider the position of the patient at insertion as an influencing factor. At insertion, the catheter is passed through a firm Tuohy needle and is held in a straight line to the extradural space. We hypothesized that if patients were placed in the same position for removal as they were at insertion, the catheter would again take a straight course and be less likely to be held by adjacent structures (lumbar fascia, vertebral arches and vertebral processes).

Methods and results

We studied 88 parturients at the University Hospital requesting analgesia for labour and delivery, Caesarean section, or both, using a standardized set (Baxter Healthcare Corporation, Cat. No. 2T0023). The study was approved by the Human Investigation Committee at the University of Virginia and informed consent was obtained from all patients. Patients were allocated randomly to one of four groups, depending on the position of the patient during insertion of the extradural catheter (sitting (S) or lateral (L)) and the position during removal of the catheter: LL, SS, LS or SL. Patients were ASA I or II and the usual exclusion criteria, including chronic low back ache or previous lumbar spine surgery, were applied.

All extradural catheters were inserted via the L2-3 or L3-4 intervertebral space using a 17-gauge Tuohy needle with loss of resistance to normal saline to identify the extradural space. A 19-gauge, styletted extradural catheter, with bullet tip and three lateral eyes, was threaded to allow 2–5 cm to remain in the extradural space. The position of the patient during insertion and removal was either lying in the lateral position or sitting with the legs over the edge of the bed, according to group allocation. In both positions the lumbar spine, hips and knees were kept maximally flexed. The catheter was left *in situ* until after vaginal or Caesarean section delivery. At removal, the catheter was connected to a portable force gauge using a knot tied at the 20–30-cm catheter mark, and slow incremental traction was applied in a direction perpendicular to the skin of the back. Peak tension during withdrawal was measured by a Normark digital force gauge (Normark Corporation, Minneapolis, MN, USA) with an accuracy to within 0.56 Newtons (N). The investigator who inserted the catheter also removed the catheter in all but three cases, when they were removed by another investigator. All catheters were removed intact, without stretching or kinking. The duration that the catheter was in place (h), depth of the lumbar extradural space from the skin and length of the catheter left *in situ* just before withdrawal (SD 0.5 cm), were noted.

Patient data were comparable in the four groups (table 1). Ten unused catheters were clamped at the tip and tested for break strength using the same equipment.

Data were analysed by Kruskal–Wallis one-way analysis of variance, followed by Dunn's method for pairwise multiple comparison, using SigmaStat

GEOFFREY N. MORRIS, FRCA, MRCGP, BRIAN B. WARREN, MD, ERIC W. HANSON, MD, FRANK J. MAZZEO, MD, DAVID J. DIBENEDETTO, MD, Department of Anesthesiology, PO Box 238, University of Virginia Health Sciences Center, Charlottesville, VA 22908, USA. Accepted for publication: April 25, 1996.

Correspondence to G. N. M.

Table 1 Patient data (mean (SD or range)) and extradural catheter withdrawal force (mean (SD) and median). Groups LL, SS, LS and SL = position of patient at catheter insertion and removal, where the first letter refers to insertion (lateral (L) or sitting (S)) and the second to removal (lateral (L) or sitting (S)). ⋆ $P < 0.05$, LS compared with LL, SS and SL

	Group LL	Group SS	Group LS	Group SL
n	21	23	22	22
Age (yr)	24.9 (15–36)	25.08 (16–40)	25.27 (15–44)	23.8 (16–35)
Height (m)	1.69 (0.06)	1.64 (0.05)	1.64 (0.05)	1.62 (0.07)
Weight (kg)	73.06 (14.25)	81.65 (20.85)	76.93 (14.34)	78.96 (21.58)
Length of catheter in extradural space (cm)	3.55 (0.59)	3.67 (0.67)	3.5 (0.74)	3.8 (0.73)
Depth of catheter in extradural space (cm)	4.98 (1.49)	6.04 (2.01)	5.73 (1.16)	5.61 (1.63)
Duration of catheter in extradural space (h)	5.92 (5.5)	10.0 (6.02)	7.11 (4.81)	5.9 (2.48)
Force required to remove extradural catheter				
Mean force (N)	1.71 (0.84)	2.04 (1.03)	3.17 (1.22)	1.25 (0.84)
Median force (N)	1.67	1.95	3.33⋆	0.97

(Jandel Scientific Software, San Rafael, CA, USA). $P<0.05$ was considered statistically significant. The power of the study was 0.79 (where difference in group mean to be detected was 1.0, expected SD of results = 1.0, number of groups = 4, group size = 22 and $\alpha = 0.05$). The force required to remove the catheters in group LS (lateral position at insertion, sitting position at removal) was significantly greater compared with all other groups (table 1). Comparison between the other groups revealed no significant differences. The greatest recorded force occurred in group LS (5.8 N). The mean break strength of 10 extradural catheters was 15.9 N, breakage occurring at the site of one of the three lateral eyes in all instances.

Comment

Minimizing the force at extraction of an extradural catheter may reduce the risk of breakage with sequestration. Previous studies advocated the lateral position for ease of removal[5,6] without considering the position of the patient at the time of insertion of the catheter. In this study we standardized all variables except that of position at insertion and removal.

We determined that significantly greater force was required to remove catheters in group LS compared with all other groups. Thus our findings agree with those of Boey and Carrie[4] who found that when catheters were inserted with patients in the lateral position, less force was needed if they were also removed in this position (group LL). We also identified a difference between groups LS and SS (different positions at insertion, both sitting at withdrawal) confirming the importance of the position of the patient at insertion in relation to the position at withdrawal, a fact that has not been documented previously. There was no detectable difference between groups SS and LL, implying that the sitting position at removal *per se* did not result in an elevated extraction force if the catheter was also inserted in this position. These are the groups in which the catheter was most likely to be held in a straight course at both insertion and removal. However, the significant difference between groups LS and SL (the position at removal differs from that at insertion in both groups) cannot be explained by a more tortuous course of the catheter alone, and indicates additional influencing factors.

We noted a large difference between the maximum recorded force at removal (5.8 N) and break strength of the catheters used (15.9 N). The weakest point of the catheter was at the site of the side wall perforations. However, should partial shearing occur inadvertently by manipulation of the catheter while the Tuohy needle is in place, the break strength may be reduced considerably.

In summary, the force required to remove lumbar extradural catheters was affected by the position of the patient both at insertion and removal. We agree with previous investigators that when an extradural catheter is placed with the patient in the lateral position, the withdrawal force is significantly elevated when this patient is seated at the time of removal[5,6]. However, when a catheter is placed in the sitting position, our results indicated that removal in this same position required no extra force. The position of the patient at extraction in relation to the position at insertion is an influencing factor which has not been recognized previously. Therefore, if resistance or stretching of the catheter occurs while attempting withdrawal, we recommend placing patients in the same position as they were at the time of insertion.

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