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Factors influencing epidural catheter migration

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Summary

The incidence and amount of migration of epidural catheters was investigated in a prospective randomised study of 153 women who required analgesia in labour. Inward or outward migration occurred in 36% of patients. Inward migration by 1–3 cm occurred in 21 (13.7%) patients and outward migration by 1 cm or more occurred in 34 (22.2%); three (2%) catheters migrated out through the skin. There were significant positive correlations between outward migration and weight, body mass index, and depth of the epidural space. There was no relationship between migration and height, age, intervertebral space used or duration of catheterisation. Problems with epidural block were no more likely in patients in whom migration of 1 cm or more occurred compared with those in whom migration was limited to a maximum of ±0.5 cm. However, the pattern of problems was different. All cases of failed epidural block occurred in patients whose epidural catheter migrated outward by 2.5 cm or more. Unilateral blockade was not more likely if migration of 1 cm or more occurred.

Key words

Equipment; epdural catheters.
Complications; migration.

Epidural catheters are used during labour in approximately 30% of patients who deliver in our hospital. Migration of the epidural catheter after it has been fixed to the skin has already been shown to occur [1]. Hazards of migration include inadvertent intravenous [2,3] or subarachnoid [4,5] injection and unilateral or failed block [6]. A fixation method with a low incidence of migration, and a means of predicting patients in whom migration is likely, are both desirable. Duffy [7] reported that none of 200 catheters migrated when secured with Opsite transparent dressing. We collected data in order to identify factors which might influence the degree of epidural migration. We used three different standard techniques of fixing the catheter to the skin.

Patients and methods

Women who requested analgesia in normal labour, and those in whom epidural analgesia was indicated for medical reasons (breech presentation, intra-uterine death, or pregnancy-induced hypertension) were eligible for entry into the trial. Patients were not studied if the coagulation profile was abnormal, if it was not technically possible to site the epidural catheter with the patient in the left lateral position, if epidural analgesia was ineffective after injection of 10 ml bupivacaine 0.5% and 10 ml bupivacaine 0.25%, or if dural puncture occurred.

Patients were allocated randomly to receive one of three methods of skin fixation according to a previously prepared list. The age, height and most recent weight in the antenatal clinic were recorded for each patient, and body mass index (BMI) calculated from the equation: BMI = weight (kg)/height^2(m).

After establishing an intravenous infusion of compound sodium lactate solution an epidural catheter was inserted by one of four anaesthetists, with the patient in the left lateral position. The L_{2-3} or L_{3-4} interspace was identified by palpation of the iliac crests and spinous processes. Lignocaine 1% in a volume of up to 10 ml was used to infiltrate the skin and subcutaneous tissue and the skin was incised using a number 11 blade. A 16-gauge Tuohy needle and a catheter from a Portex Minipack, both graduated at 1-cm intervals, were used. The epidural space was identified by loss of resistance to air using a midline approach with the needle bevel facing the right flank. The bevel was then turned cranially and the distance from the skin to the epidural space noted. The epidural catheter was threaded through the needle and the needle removed. The catheter was adjusted to leave 3 cm in the epidural space, and the length of catheter which remained deep to the skin was recorded to the nearest 0.5 cm. A test dose of 3 ml bupivacaine 0.5% plain was given and the catheter was fixed to the skin using one of the three methods described below.

Method 1. The epidural catheter was formed into a circular loop at the skin exit site and then directed over the right shoulder. The skin and catheter were sprayed with 'Opsite' plastic spray (Smith & Nephew Medical Limited). A dressing of two green gauze swabs was placed over the loop and these swabs were sprayed with Opsite and covered with Sleek adhesive tape.

Method 2. The catheter was looped, directed and sprayed as in Method 1. The dressing was transparent 10 × 12 cm Opsite adhesive plastic dressing (Smith & Nephew Medical Limited). No gauze swabs were used.

Method 3. The epidural catheter was looped and directed as in Method 1. A green gauze swab was placed above the skin exit site and another one below, so that the swabs lay between the loop and the skin. A third gauze swab over the loop was used to sandwich the catheter. These swabs were sprayed with Opsite and covered with Sleek adhesive tape.

After taping the catheter over the right shoulder the position of the patient was changed to recline at 45° and a further dose of 7 ml bupivacaine 0.5% plain was given. If the patient had inadequate analgesia at 30 min, the pattern of block was assessed and a further dose of 10 ml bupivacaine 0.25% was given with the patient in an appropriate

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Table 1. Distribution of catheter insertion, migration and catheter removal among investigators.

	Doctor A	Doctor B	Doctor C	Doctor D
Number of epidurals	73	58	14	8
Mean (SD) migration; cm	−0.3 (1.0)	+0.7 (2.1)	+0.3 (1.0)	+0.1 (1.0)
Number removed by same doctor	52	51	8	5

position. If this dose was unsuccessful, she was not studied. Further top-up doses of 10 ml bupivacaine 0.25% for first stage analgesia and 10 ml bupivacaine 0.5% for instrumental delivery were given by the attending anaesthetist and their efficacy was recorded. Maternal posture at delivery was recorded.

Following delivery and any perineal suturing, the patient was positioned in the left lateral position as for insertion of the catheter and the epidural catheter was removed by the duty obstetric anaesthetist. The length of catheter deep to the skin was recorded to the nearest 0.5 cm. Inward migration was given a negative, and outward migration a positive, value. The results were analysed by one-way analysis of variance or the Chi-squared test to evaluate differences between the different methods of fixation, and by linear regression analysis of data from all patients to evaluate the effect of each factor studied.

Results

One hundred and fifty-three women completed the study. The four authors inserted all epidural catheters (Table 1). One hundred and sixteen (76%) of the catheters were removed by the same anaesthetist who inserted it and another five (3%) were removed by other authors. The remaining 32 (21%) were removed by one of 12 other duty anaesthetists. There were no differences among authors in the degree of migration (ANOVA $p = 0.08$). Fifty-five (36%) of the catheters migrated 1 cm or more from their original position. The mean (SD) migration was +0.3 cm (1.5) with a range −3.0 cm to +9.0 cm (Fig. 1).

Twenty-one (14%) catheters migrated inwards by 1 cm or more. Ninety-eight (64%) catheters remained within 0.5 cm of their original position and 34 (22%) migrated 1 cm or more out of the skin, including three which migrated totally out, although the dressings were intact on inspection. Of these three, two were fixed using method 2 and one by method 3. The three outward migration values of 8.5, 9 and 9 cm were treated as outliers and not included in the analysis of variance or linear regression analysis.

There were significant correlations between the amount of outward migration and body weight, migration and body mass index, and migration and depth of the epidural space from the skin. The correlation coefficients and the regression equations are shown in Table 2. Not only was there a tendency to outward migration in more obese patients with a deep epidural space, but there was also a tendency to inward migration in thinner subjects with a shallow epidural space. There was no significant correlation between migration and duration of epidural catheter insertion or the height or age of the patients. All three catheters that migrated totally out of the skin were inserted at the L_{3-4} interspace. In the other patients, there was no difference in migration between catheters inserted at the L_{2-3} or L_{3-4} interspaces.

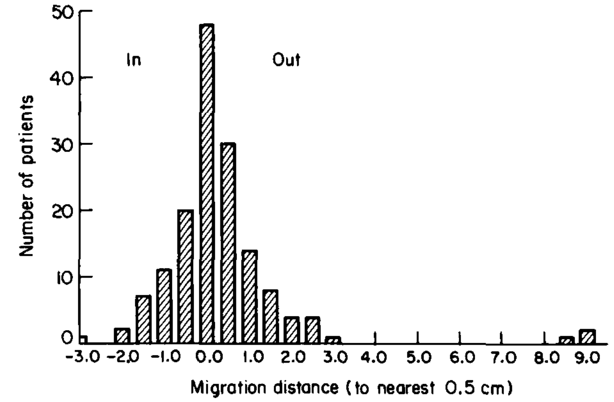

Fig. 1. Distribution of length of migration of epidural catheters.

There were no significant differences in height, weight, BMI, level of puncture, depth of the epidural space or duration of catheterisation in the three groups of patients allocated to each method of fixation. There were no significant differences in migration among the different methods of fixation (Table 3). The power to detect a difference of 1 cm migration with a standard deviation of 1.5 cm between groups of 50 patients was 0.90.

There were 11 (20%) problems with analgesia in the 55 patients whose epidural catheter migrated 1 cm or more inwards or outwards. There were 13 (13%) problems with analgesia in the 98 patients whose epidural catheter migrated 0.5 cm or less. There was no incident of subarachnoid or intravenous injection in either group (Table 4). In the group in which the catheter migrated 1 cm or more, three epidural catheters were resited because analgesia failed (outward migration of 3, 9 and 9 cm). At removal, a further three catheters were found to have migrated 8.5 cm, 3 cm and 2.5 cm outwards and the block had been ineffective for delivery and/or suturing, although the anaesthetist had not been informed. Another four patients required an extra epidural top-up dose for left unilateral blockade; two catheters had migrated in and two migrated out. One catheter was withdrawn to its original position after migrating inwards by 2 cm, associated with right unilateral block.

Table 3. Extent of migration of epidural catheter related to method of catheter fixation.

	Migration			
	In	±0.5 cm	Out	Total
Fixation 1	9	33	7	49
Fixation 2	7	32	13	52
Fixation 3	5	33	14	52
Total	21	98	34	

df = 4; Chi-squared = 3.63; p = not significant

Table 2. Relationships between distance of catheter migration and body mass index (BMI), depth of epidural space from skin and weight of the patient.

Migration = −3.27+0.12 BMI, correlation coefficient $r = 0.31$, $p < 0.0001$
Migration = −1.80+0.43 Depth, correlation coefficient $r = 0.22$, $p < 0.005$
Migration = −2.33+0.03 Weight, correlation coefficient $r = 0.25$, $p < 0.002$

Table 4. Complications of epidural analgesia related to extent of migration of catheter

Problems with analgesia	Migration ⩾ 1 cm $n = 55$	Migration ⩽ 0.5 cm $n = 98$
Extra top-up	4	12
Withdraw catheter	1	0
Failure during/after delivery	3	0
Resite catheter (failure before delivery)	3	0
Caudal blockade	0	1
Total	11	13

In patients whose catheter migrated by 0.5 cm or less, 12 patients required extra epidural top-up doses for unilateral block and one patient required a caudal epidural injection for inadequate perineal analgesia.

There was no significant difference in the number of problems between patients whose catheter migrated 1 cm or more and those in whom the catheter migrated by 0.5 cm or less. There was no significant difference in the incidence of unilateral block between those groups of patients.

Discussion

Previous studies have shown different incidences of epidural catheter migration. Phillips and Macdonald [1] studied 100 patients and found that 46 of the epidural catheters migrated by 1 cm or more. Thirty-one catheters migrated by more than 0.5 cm inwards and 15 catheters migrated by more than 0.5 cm outwards. No failure of epidural analgesia was found to be due to migration out of the epidural space. However, an unstated number of anaesthetists inserted the catheters, there was no standard technique for fixing the catheter, the length of catheter in the epidural space was 2–4 cm, the patients' posture for removal was not stated and the number of midwives who removed the catheters was not stated.

In our study, the incidence of migration of 1 cm or more was 36% (14% inward and 22% outward). The range was 3 cm inward to 9 cm outward. We attempted to reduce between-observer error by using four anaesthetists to site the epidural catheters and standardising the methods of fixation, posture for insertion and posture for removal. However, in only 116 (76%) patients was the catheter removed by the same anaesthetist who inserted it.

Duffy [7] reported 'no untoward movement' of the catheter into or out of the epidural space in 200 obstetric patients and stated that the Opsite transparent adhesive dressing had solved completely the problem of the migrating epidural catheter. One of our three study groups used the same Opsite dressing. The mean (SD) migration was 0.54 (2.0) cm in that group, a value not significantly different from the other two methods of fixation.

We found statistically significant relationships between migration and BMI, migration and body weight and migration and depth to the epidural space. It is possible that a large amount of subcutaneous fat may affect the accuracy of readings of the depth of catheter by allowing more indentation or tenting of the skin around the catheter exit site, or it may allow greater relative movement between the skin exit site and the point of entry into the supraspinous ligament. This would allow greater migration into or out of the epidural space or allow more catheter to coil up in the subcutaneous tissue. It is not clear why the patients with lower BMI had a tendency to inward migration.

This study showed that the incidence of clinical problems was no different between the patients whose catheter migrated 1 cm or more in or out and the remainder. However, the nature of the problems was different. There were no failures of epidural block in the group whose catheter migrated 0.5 cm or less; epidural block failed in six patients whose catheter migrated outwards by 2.5 cm or more. We suggest that a catheter found to have migrated 2.5 cm or more outwards is unlikely to be effective and should be resited. Fifty-five catheters migrated ± 1 cm or more, and in five of those patients unilateral block occurred. There were 12 cases of unilateral block from 98 catheters which migrated 0.5 cm or less. This suggests that epidural catheter migration is not a major cause of unilateral block. Narang and Linter [8] found that unilateral block was more likely if there was a deep epidural space because of the greater chance of positioning the epidural catheter laterally within the space.

There was only one problem (unilateral block) associated with inward migration of 1 cm or more, which was resolved by withdrawing the catheter by 2 cm, to its original position. We suggest that insertion of more than 3 cm of catheter into the epidural space would reduce the number of failures of analgesia because of outward migration without increasing the incidence of unilateral block. However, the small number of problems associated with inward migration may be related to the catheter becoming coiled in the subcutaneous tissues rather than moving further into the epidural space.

Although securing epidural catheters with a transparent dressing does not reduce the incidence of migration, it does allow inspection of the skin entry site without disturbing the dressing. This would facilitate the detection of catheters which are likely to be ineffective because of outward migration (6 out of 153 in our study).

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