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Techniques for identifying the epidural space: a survey of practice amongst anaesthetists in the UK

A. Wantman,[1] N. Hancox[2] and P. R. Howell[3]

1 Consultant Anaesthetist, St Bartholomew's Hospital, London, EC1A 7BE, UK
2 Anaesthetic SHO, 3 Consultant Anaesthetist, Homerton Hospital, London E9 6SR, UK

Summary

A postal survey of all UK members of the Obstetric Anaesthetists' Association was carried out to ascertain their preferred method for identifying the epidural space in obstetric and non-obstetric patients. Over 1200 questionnaires were returned (79.3% response rate). In obstetric patients, the single most common technique (used by 58% of anaesthetists) was continuous advancement of the epidural needle and loss of resistance with saline, followed by intermittent needle advancement with air (21%). A minority of respondents used other variants, including intermittent advancement with saline (16%) and continuous advancement with air (4%). Consultant anaesthetists showed greater variety in techniques used than did trainees ($p < 0.001$). Less than 5% of respondents used a paramedian approach, and these were almost exclusively senior staff. Only 48% of anaesthetists said they would try an alternative if they experienced difficulty with their preferred technique. A similar pattern was seen for lumbar epidurals in non-obstetric surgical patients (89% used the same technique as in obstetrics), although for thoracic epidurals, 23% used a different technique to that which they would use for obstetrics, and the paramedian approach was more popular (21%). When inserting lumbar epidurals to supplement general anaesthesia in surgical patients, 18% of anaesthetists said they usually performed the block with the patient asleep, whereas for thoracic epidurals, this figure fell to 14%.

Correspondence to: Dr Adam Wantman
E-mail: adam.wantman@bartsandthelondon.nhs.uk
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Most methods currently in use for identifying the epidural space in adults derive from the 'loss of resistance to injection' technique (LOR) as originally described in the early 20th century [1]. A variety of techniques and modifications have been described over the years, including the 'hanging drop' [2], the Macintosh balloon [3], the running infusion drip described by Baraka [4], the Oxford detector [5], and recently a 'membrane in syringe' device [6]. In the 1970s, Doughty popularised the technique of continuous advancement of the epidural needle by pushing on the plunger of the LOR syringe containing saline [7, 8]. More recently, the use of pressure generated acoustic signals [9, 10] and ultrasound [11, 12] has been advocated, but their role in general clinical practice is not yet clear.

Previous surveys have confirmed that LOR with saline is the most commonly used technique for finding the epidural space [13, 14]. It is generally assumed that anaesthetists either use continuous advancement of the epidural needle and LOR with saline, or intermittent needle advancement and LOR with air. However, observation of local practice (in East London) suggested that there were a number of additional hybrid techniques in use with respect to the LOR fluid used and the method of Tuohy needle advancement.

This postal survey was devised to discover which techniques were currently preferred by obstetric anaesthetists for obstetric patients, separating out the LOR fluid and the method of needle advancement, and enquiring whether they used the same techniques for lumbar and thoracic epidurals for non-obstetric patients. In addition, since there is growing anxiety about performing regional anaesthesia for surgical patients once general anaesthesia has been administered, the opportunity was also taken to enquire about this issue.

Method

A questionnaire enquiring about the techniques used by individual anaesthetists for identifying the epidural space in obstetric and non-obstetric patients was devised. Recipients were questioned specifically about the loss of resistance technique and about the advancement of the Tuohy needle. The questionnaire was reviewed and approved by the Audit Sub-Committee of the Obstetric Anaesthetists' Association (OAA), and then sent out by post to all 1620 members of the OAA in the UK. The survey was conducted between August and December 2003 and one follow-up mailing was sent to those members who had not replied after 6 weeks. The completed data were analysed using the SAS statistical analysis package (SAS Institute Inc., Cary, NC).

Results

In total, 1285 questionnaires were returned, a response rate of 79.3%. Of the responders, 942 (73%) were consultants, 238 (19%) were trainees, 96 (7%) were non-consultant career grade (NCCG) anaesthetists and nine were unspecified.

Preferred technique for obstetric lumbar epidurals

Loss of resistance to saline using continuous needle advancement was the single most popular first-line technique, being used by 58% of anaesthetists (Fig. 1). Less popular were the LOR to air with intermittent advancement of the needle and LOR to saline with intermittent advancement, with only 4% using LOR to air with continuous advancement of the needle. The remaining 1% used a variety of other combinations of the basic techniques, including six who used both air and saline in the LOR syringe, three who used the Macintosh balloon or Oxford device and two who used LOR to local anaesthetic solutions (lidocaine or bupivacaine). Only one of these 17 respondents was a trainee. The diversity of techniques used increased with experience (Table 1) and consultants used a greater range of techniques compared to trainees ($p < 0.001$; Table 2).

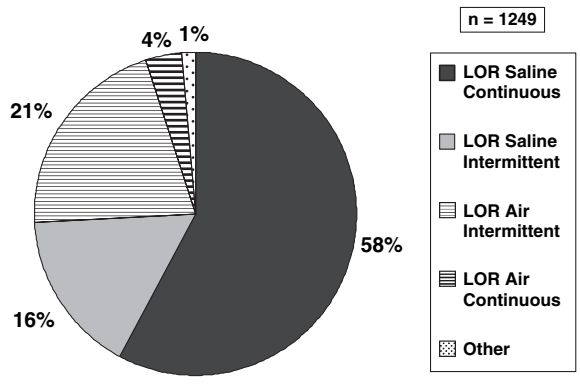

Figure 1 Answers to the question 'In obstetrics, what is your usual, preferred, first-line technique for identifying the lumbar epidural space?'

Overall, LOR to saline was used more frequently ($n = 933$, 74%) than LOR to air ($n = 307$, 25%; Table 2). Senior staff were more likely to use LOR to air than trainees, who almost exclusively use LOR to saline, and this was particularly favoured by the NCCG anaesthetists (41/95 vs. 266/1162, $p < 0.0001$). In terms of approach, 96% of anaesthetists ($n = 1211$) used the midline approach, and only one of the 37 anaesthetists who preferred paramedian insertion was a trainee.

In the case of their first-line technique for finding the epidural space being unsuccessful, just under half of all respondents (591/1232, 48%) said they would try an alternative technique. Junior anaesthetists with under 5 years' experience were less likely to try an alternative technique than those with more experience (14/44 vs. 577/1188, $p = 0.03$; Fig. 2).

The preferred second-line technique was LOR to saline with intermittent needle advancement, followed by LOR to air with intermittent advancement (Table 3). Again, more experienced anaesthetists tended to show a greater diversity of techniques (Table 3).

Non-obstetric lumbar epidurals

Most people (1138/1276, 89%) used the same technique for both obstetric and non-obstetric patients. Loss of resistance to saline with continuous needle advancement was again the most popular technique; senior staff showed more variety of technique, with consultants and NCCGs using LOR to air more commonly than trainees (286/969 vs. 16/231, $p < 0.001$; Table 4). Twelve respondents said they use a combination of techniques, three used a deflating balloon, one used the hanging drop, and one used LOR to bupivacaine.

Looking at the approach used for non-obstetric epidurals, the results are similar to those for obstetric patients, with over 95% (1167/1210) of all anaesthetists using the midline approach.

When inserting a lumbar epidural in a non-obstetric patient to supplement general anaesthesia, 82% of anaesthetists (996/1216) stated that they would usually perform the epidural with the patient awake, 16% (199/1216) with the patient asleep and the remaining 2% ($n = 21$) said they would perform it either way (see Fig. 3). Anaesthetists with greater than 20 years' experience were most likely to perform epidurals with patients asleep (25% of respondents in this group, compared to 15% or 16% in all other groups).

Experience	LOR to saline continuous	LOR to air intermittent	LOR to saline intermittent	LOR to air continuous	Other	Total
< 5 years	39 (89%)	1 (2%)	4 (9%)	0 (N/S)	0 (N/S)	44 (3%)
5–10 years	223 (69%)	34 (10%)	60 (19%)	2 (1%)	2 (1%)	321 (26%)
10–20 years	314 (61%)	89 (17%)	91 (18%)	18 (3%)	7 (1%)	519 (42%)
> 20 years	148 (41%)	130 (36%)	52 (14%)	27 (7%)	8 (2%)	365 (29%)
Total	724 (58%)	254 (21%)	207 (16%)	47 (4%)	17 (1%)	1249

N/S, not significant (less than 0.5%).

Table 1 Techniques used by anaesthetists of different experience for identifying the lumbar epidural space in obstetric patients. Values are number (proportion).

	LOR to saline continuous	LOR to air intermittent	LOR to saline intermittent	LOR to air continuous	Other	Total
Trainee	172 (73%)	15 (6%)	49 (21%)	1	1	238 (19%)
NCCG	34 (36%)	35 (37%)	19 (20%)	6 (6%)	1 (1%)	95 (7%)
Consultant	520 (56%)	210 (23%)	139 (15%)	40 (4%)	15 (2%)	924 (74%)
Total	726 (58%)	260 (21%)	207 (16%)	47 (4%)	17 (1%)	1257

Table 2 Techniques used by different grades of anaesthetist for identifying the lumbar epidural space in obstetric patients. Values are number (proportion).

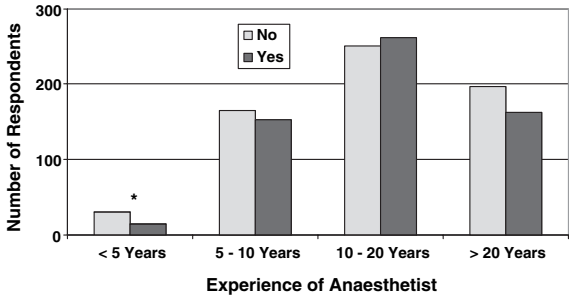

Figure 2 Responses to the question: 'In obstetrics, if you couldn't get in with your usual, preferred, first-line technique for identifying the lumbar epidural space, or weren't sure about it, would you be likely to try another technique?' *p = 0.03.

Thoracic epidurals

Loss of resistance to saline with continuous needle advancement was also the most popular technique for thoracic epidurals, being used by more than half of all respondents (Table 5).

The use of LOR to air with intermittent needle advancement (overall, the second most popular technique) rose with increasing experience, from 8% in those with less than 5 years' experience to 36% in those with more than 20 years' experience.

The paramedian approach was used by 27% of consultants (218/816), 12% of NCCGs (9/76) and 16% of trainees (35/221) who performed thoracic epidurals.

When inserting epidurals in non-obstetric surgical patients, 23% of respondents (290/1276) used a different technique for finding the lumbar and thoracic epidural spaces and 29% (374/1276) used a different approach (i.e. paramedian vs. midline).

When inserting a thoracic epidural to supplement general anaesthesia in a non-obstetric patient, 86% of anaesthetists ($n = 972$) stated that they would usually perform the epidural with the patient awake, 13% ($n = 152$) with the patient asleep, and the remaining 1% ($n = 11$) said they would perform it either way (Fig. 4). Willingness to perform epidurals in asleep patients increased steadily with anaesthetic experience, from 5% in those with less than 5 years' experience to 21% in the most senior group (more than 20 years' experience).

Experience	LOR to saline continuous	LOR to air intermittent	LOR to saline intermittent	LOR to air continuous	Other	Total
< 5 years	1 (7%)	3 (23%)	9 (70%)	0	0	13 (3%)
5–10 years	10 (8%)	45 (35%)	65 (52%)	2 (2%)	4 (3%)	126 (26%)
10–20 years	13 (6%)	88 (42%)	81 (38%)	7 (3%)	24 (11%)	213 (44%)
> 20 years	15 (11%)	43 (33%)	55 (42%)	6 (4%)	13 (10%)	132 (27%)
Total	39 (8%)	179 (37%)	210 (44%)	15 (3%)	41 (8%)	484

Table 3 Second-line techniques used by anaesthetists of different experience for identifying the lumbar epidural space in obstetric patients when having difficulty with preferred first-line technique. Values are number (proportion).

Table 4 Techniques used by different grades of anaesthetist for identifying the lumbar epidural space in non-obstetric patients. Values are number (proportion).

	LOR to saline continuous	LOR to air intermittent	LOR to saline intermittent	LOR to air continuous	Other	Total
Trainee	163 (71%)	15 (7%)	51 (22%)	1	1	231 (19%)
NCCG	33 (36%)	34 (37%)	18 (19%)	7 (7%)	1 (1%)	93 (8%)
Consultant	486 (55%)	207 (24%)	129 (15%)	38 (4%)	15 (2%)	875 (73%)
Total	682 (57%)	256 (21%)	198 (16%)	46 (4%)	17 (1%)	1199

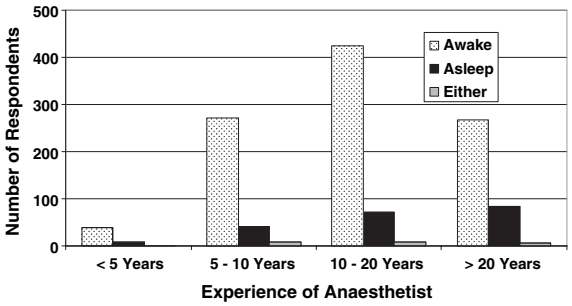

Figure 3 Answers to the question: 'If you were inserting a *lumbar* epidural as an adjunct to general anaesthesia in a surgical patient in theatre, would you usually do so with the patient awake or asleep?'

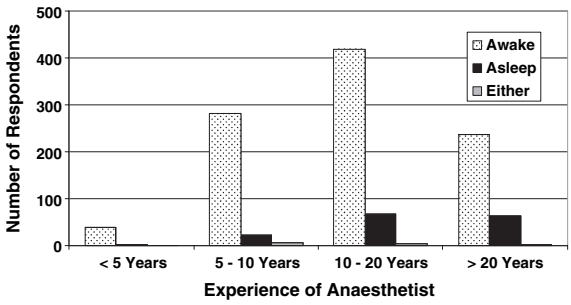

Figure 4 Answers to the question: 'If you were inserting a *thoracic* epidural as an adjunct to general anaesthesia in a surgical patient in theatre, would you usually do so with the patient awake or asleep?'

Discussion

Recent surveys of obstetric anaesthetists show a progressive increase in the use of LOR to saline in the UK, from 60% in 1998 [14] and 70% in 2001 [13] to 74% in this report. Interestingly, Howell *et al.* [14] reported in 1998 that whilst over half of the respondents had originally learned to perform epidurals using the LOR with air technique, almost half of these had converted to using saline.

Data from the current survey confirms that LOR with saline is now three times more popular than LOR with air for obstetric epidurals. Despite some theoretical advantages of the paramedian approach [15], almost everyone (> 95%) now uses the midline approach for lumbar epidurals, although the paramedian approach remains more popular for thoracic epidurals, being used by one fifth of respondents.

There has long been debate over whether LOR with air or saline is the better technique [16, 17], and there is no clear answer. However, advocates of LOR with saline suggest that it is superior, being associated with more successful and less patchy blocks [18–20], and fewer complications such as dural tap [21–23], venous migration of the epidural catheter [24], venous air embolism [25] and pneumocephalus [26]. This survey confirms that (for whatever reason) obstetric anaesthetists are increasingly using LOR with saline. As previously reported [13], senior staff show a greater diversity of practice and are more likely to use LOR to air than trainees, who almost exclusively use LOR to saline.

It is interesting that the majority of those anaesthetists who use saline for LOR tend to use continuous needle advancement, whereas intermittent advancement is the favoured technique in those who use LOR to air. There are a number of possible reasons for this. Firstly, since saline is non-compressible, pressure on the syringe plunger alone may be used to advance the epidural needle, as in the technique taught by Andrew Doughty.

Table 5 Techniques used by anaesthetists of different experience for identifying the thoracic epidural space. Values are number (proportion).

Experience	LOR to saline continuous	LOR to air intermittent	LOR to saline intermittent	LOR to air continuous	Other	Total
< 5 years	29 (76%)	3 (8%)	6 (16%)	0	0	38 (4%)
5–10 years	169 (57%)	44 (15%)	76 (26%)	3 (1%)	4 (1%)	296 (27%)
10–20 years	243 (53%)	98 (21%)	93 (20%)	14 (3%)	14 (3%)	462 (43%)
> 20 years	117 (41%)	100 (36%)	46 (16%)	17 (6%)	2 (1%)	282 (26%)
Total	558 (52%)	245 (23%)	221 (20%)	34 (3%)	20 (2%)	1078

Air is compressible, which makes this technique more difficult since the plunger will advance, albeit with more pressure, well before the epidural space is reached. Second, and perhaps more importantly, there is a safety aspect. It is widely considered (although unproven) that the 'whoosh' of saline on passing through the ligamentum flavum may push the dura away from the Tuohy needle and hence reduce the risk of accidental dural tap. If LOR occurs due to entry of the epidural needle into a blood vessel, the injection of saline should do no harm. However, if continuous pressure is used with air, intravascular placement of the needle tip may not be apparent until a significant volume of air has been injected. Also, in the event of a dural tap, injecting saline into the cerebrospinal fluid will be relatively benign, but pneumocephalus is a serious complication which may occur with the use of air, particularly if a continuous technique is used.

Although described many years ago by Moir [27] and more recently by Evron *et al*. [28], the use of local anaesthetic solution as the LOR fluid is uncommon, presumably due to the potential risk of total spinal blockade in the event of accidental dural puncture. Only two anaesthetists reported using this technique in this survey. Similarly, only a handful of anaesthetists currently use the Macintosh balloon or Oxford device.

It seems rather surprising that amongst a group of anaesthetists who regularly perform epidural techniques, only half would consider changing to an alternative technique if they were not able to find the epidural space by their preferred first-line technique. Perhaps this represents an increasing degree of conservatism, or reflects the fact that fewer anaesthetists are being taught more than one technique.

There is also debate at present about whether it is safe and acceptable to perform regional techniques on patients who are already anaesthetised [29]. The returns from this survey suggest that although the majority of anaesthetists who perform epidurals on surgical patients to supplement general anaesthesia usually do so with the patient awake, a significant minority prefer the patient asleep (18% for lumbar epidurals, 14% for thoracic epidurals). However, this appears to be a big change over just a few years, since a survey published in 1998 reported that the majority of anaesthetists (60%) at that time would usually have performed thoracic epidurals with patients asleep [30]. Since our survey has found that this practice is most commonly used by senior anaesthetists, particularly those with over 20 years' experience in anaesthesia, it is to be expected that the practice may further decline in future as these anaesthetists retire.

Clinical practice evolves over time, and it is interesting to note that current trainees use a relatively limited repertoire of techniques for identifying the epidural space. This poses the question of whether, when these trainees become the senior staff of the future, they will continue to practice in this more limited manner, or will diversify and learn the differing techniques still used by (some of) the older generation of anaesthetists. In addition, is the relative conformity of practice amongst trainees a good thing, or a cause for concern?

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