Anesthesiology
1996; 84:1312–6

Thoracic Epidural Anesthesia Via *the Lumbar Approach in Infants and Children*

D. Blanco, M.D., Ph.D., J. Llamazares, M.D., Ph.D., † R. Rincón, M.D.,* M. Ortiz, M.D., Ph.D.,* F. Vidal, M.D.‡*

Background: **In upper abdominal or chest surgery, the segmental approach to thoracic epidural space has the advantage of reducing the total dose of local anesthetic needed. This approach, however, is associated with greater risk of neurologic damage or dural puncture. The aim of this study was to assess the success and the degree of difficulty in advancing a 19-G catheter from the lumbar epidural space to the thoracic level in patients aged 0–96 months.**

Methods: **In 39 patients undergoing abdominal surgery, the cutaneous distance between the L4–L5 and T10–T11 interspaces was measured, and an appropriate length of 19-G catheter was inserted into the epidural space through an 18-G Tuohy needle with bevel directed cephalad. The intent was to advance the full length of catheter measured to reach the objective. The tips were observed radiologically, and all those positioned cephalad to the T12 level were considered well placed. The degree of difficulty in advancing the catheter was classified as easy, difficult, or impossible. Complications reported were vascular and/or spinal puncture and difficulty removing the catheter.**

Results: **The catheter tip reached T10–T12 in 7 patients, L2 in 1, L3 in 8, and L4–L5 in 23. Forty-eight percent of the catheters described as easily advanced remained at the L4–L5 level, and only 22% reached the desired level. Difficult insertions occurred in eight patients, in whom the objective was never reached. One case of intravascular insertion was reported. All catheters were removed without difficulty.**

Conclusions: **The 19-G catheter is inappropriate for use in reaching the thoracic epidural space by the lumbar approach. Easy entrance of a catheter is not a reliable sign of having reached the desired level. (Key words: Anesthesia: pediatric. Anesthetic techniques, regional: epidural; lumbar; thoracic.)**

CONTINUOUS epidural anesthesia is useful during pediatric surgery and for postoperative analgesia. In upper abdominal or chest surgery, the segmental approach to the thoracic epidural space has the advantage of reducing the total dose of local anesthetic. The technique requires a highly experienced anesthesiologist, however, and there still is greater risk of neurologic damage or dural puncture.[1] The sacrocaudal approach to the thoracic epidural space using various catheter sizes[2–4] has been used with patients of various ages. However, when a catheter for controlling postoperative analgesia is necessary, the caudal approach is not recommended, because the risk of infection is greater.[5] The introduction and advance of a catheter from the lumbar epidural space to the thoracic level could reduce the risk of spinal cord damage and contamination, but this technique has not been described to date in children. The aim of this study was to assess the success and degree of difficulty in advancing a 19-G catheter from the lumbar epidural space to the thoracic level in 39 patients aged 0–96 months.

Methods and Materials

After approval by the hospital ethics committee and informed consent from parents were obtained, 39 ASA physical status 1 patients scheduled for abdominal surgery were enrolled in a prospective study. All patients older than 1 yr received nasal midazolam (0.2 $mg \cdot kg^{-1}$) 1 h before surgery. Monitoring was by electrocardiography, noninvasive arterial pressure, pulse oximetry, and end-tidal carbon dioxide pressure (Endstron, Engström Eliza Duo, Bromma, Sweden). The lumbar blocks were performed under general anesthesia induced with atropine (0.02 $mg \cdot kg^{-1}$), thiopental (5–10 $mg \cdot kg^{-1}$), and fentanyl (1–2 $\mu g \cdot kg^{-1}$). Tracheal intubation was facilitated by succinylcholine (1 $mg \cdot kg^{-1}$) followed by vecuronium (0.05–0.1 $mg \cdot kg^{-1}$) for neuromuscular block. A nonrebreathing technique with 50% N_2O/50% O_2 and 0.3–0.5% halothane was used for maintenance of general anesthesia.

The patients were placed in the lateral decubitus position for measurement of the cutaneous distance be-

* Staff Anesthesiologist

† Professor of Surgery. Department of Surgery

‡ Professor of Anesthesiology. Department of Surgery

Received from the Servei d'Anestesiologia, Reanimació i Teràpia del Dolor Hospital Universitari "Germans Trías i Pujol" Badalona, Barcelona, Spain. Submitted for publication August 7, 1995. Accepted for publication February 2, 1996.

Address reprint requests to Dr. Blanco: Servei d'Anestesiologia i Reanimació, Hospital Universitari "Germans Trías i Pujol," Carretera del Canyet S/N, Badalona 08916, Barcelona, Spain.

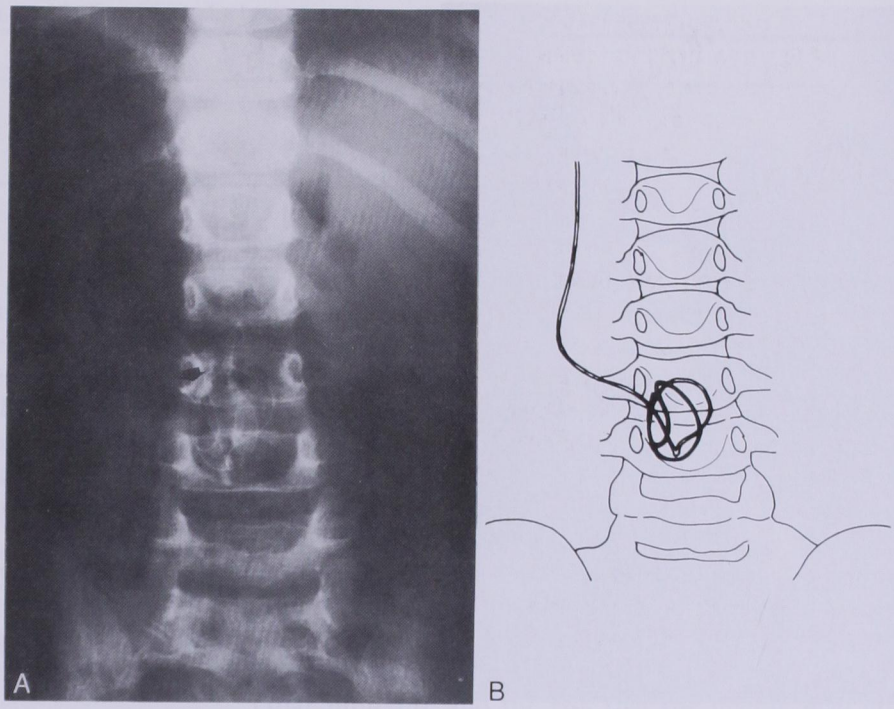

Fig. 1. (*A, B*) Common placement of catheter tip.

tween the L4–L5 and T10–T11 interspaces. The same length was marked on a 19-G multiorifice catheter (Portex, Barcelona, Spain). Using a median approach, the epidural space at the L4–L5 level was identified by loss of resistance to air with an 18-G Tuohy needle with bevel directed cephalad. We inserted the entire length of the previously measured 19-G catheter through the needle, secured the catheter to the back with a sterile porous dressing, and placed the patient in the supine decubitus position. After negative aspiration and administration of a test dose of 1 ml of local anesthetic, 0.5 ml $\cdot$ kg^{-1} 0.25% bupivacaine with epinephrine 1:200,000 was administered through the catheter followed by a continuous infusion of 0.125% bupivacaine and 0.25 μg $\cdot$ kg^{-1} $\cdot$ h^{-1} fentanyl.

The tip of the catheter was located radiologically with 0.3 ml iohexol (Omnipaque 300, Schering, Madrid, Spain) administered through the catheter and with the infant's genital organs shielded by a lead plate. We considered all catheters with the tip cephalad to T12 be well placed and classified the difficulty in advancing the catheter as follows: easy, the entire length of catheter measured entered with no difficulty; difficult, flexion of the lower extremities on the abdomen was needed to advance the catheter; and impossible, we could not introduce the full length of the catheter measured. Vascular and/or spinal puncture and difficulty in removing the catheter were reported as complications.

Statistical comparisons were performed with Fisher's exact test, with $P < 0.05$ considered significant.

Results

The patients had a mean age of 41.9 $\pm$ 33.3 months (range 0–96 months), mean weight of 15.9 $\pm$ 7.1 kg (range 5–38 kg), and mean height of 97.3 $\pm$ 22.7 cm (range 57–135 cm). The tip of the catheter and the level reached was visible in all patients; the level was T10–T12 in 7 cases, L2 in 1, L3 in 8, and L4–L5 in 23.

The catheters appeared in the epidural space in three main positions. The most common placement is shown in figure 1, in which the catheter is circling itself near the point of entrance without advancing in any direction. In figure 2, the catheter is forming a figure eight. Figure 3 shows the distal tip in the epidural space well above the insertion point, as though the catheter is forming a wavy line below. Although all the catheters were removed without difficulty, the first two figures suggest a potential risk of vascular and neurologic damage.

Table 1 shows the degree of difficulty in advancing the catheter and the location of the tip in the epidural

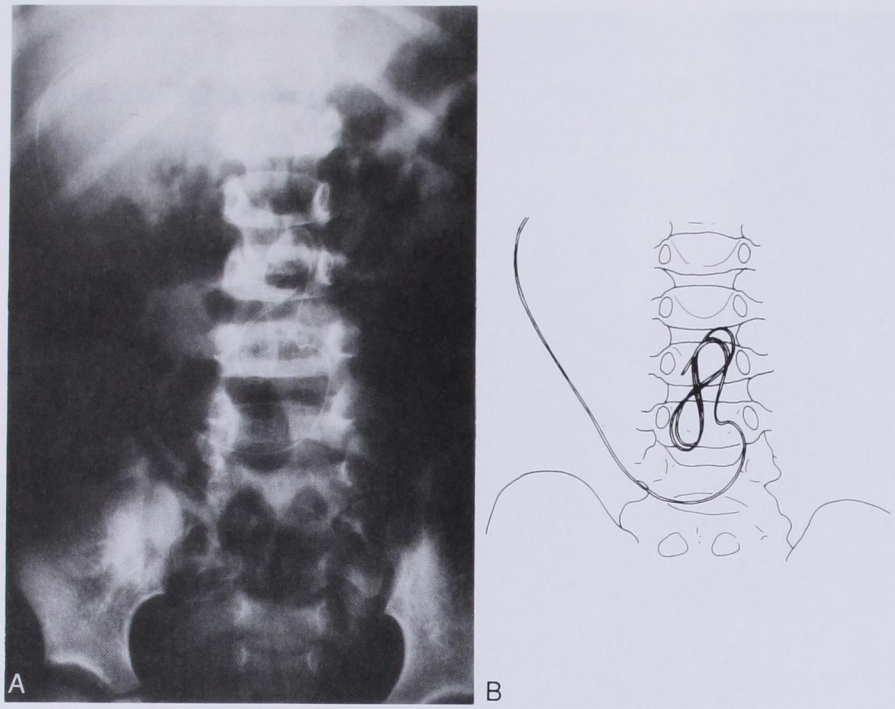

Fig. 2. (*A, B*) The catheter is forming a figure eight.

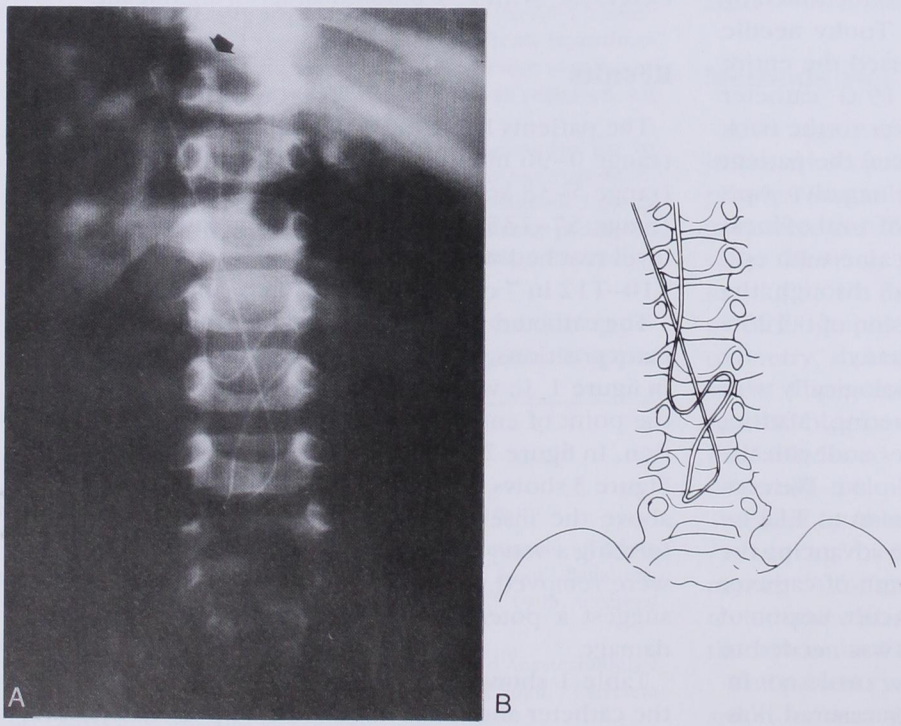

Fig. 3. (*A, B*) The distal tip of the catheter is well above the insertion point.

Table 1. Degree of Difficulty in Advancing the Catheter and the Location of the Tip in the Epidural Space

	T10–T12	T12–L1	L1–L2	L2–L3	L3–L4	L4–L5
Easy	7	0	0	1	8	15
Difficult	0	0	0	0	0	8
Impossible	0	0	0	0	0	0

Values are the number of the catheters reaching the space named.

space. We found no significant statistical relation between easy advance and success in reaching the T10–T12 level. If threading is easy, there is a chance that the catheter is advanced to thoracic levels, but this is not guaranteed; conversely, if threading is difficult, the catheter is almost certainly not threading to thoracic levels even though we were always able to introduce the full length previously marked.

The single complication reported was one instance of intravascular insertion. The catheter in this case was replaced by another with no further adverse events. There were no dural punctures.

Discussion

Thoracic epidural anesthesia through a catheter inserted by the caudal approach has been tested by several authors with differing results. In the third phase of a study by Bösenberg *et al.*[2] in which an 18-G catheter was used, the thoracic level was reached in all the neonates enrolled. However, in the first phase of the study, involving older children, only the epidural lumbar space was reached. Those surprising results agree with ours for patients older than 1 yr, in only 17% of whom the thoracic epidural space was reached. We believe this low success rate may be due to the lumbosacral curvature that appears after age 1 yr as a consequence of standing and walking.[3] Gunter and Eng[4] solved this problem by threading a styletted 24-G catheter into the caudal space, reaching the thoracic epidural level in 19 of 20 children. This solution is less than ideal, however, as it involves introducing an element that is less flexible than the simple 19-G catheter, as well as more expensive.

We tested the possibility of providing thoracic epidural anesthesia by inserting the catheter at the lumbar level. We were able to reach the objective in only 7 of 39 patients, however. The 19-G polyethylene catheter may be too flexible even for a lumbar approach, bending and hitting against nearby structures. Alternatively, our poor rate of success may be due to contact of the tip with the dura as a result of the perpendicular, median insertion of the needle, a phenomenon described by Blomberg[6] in adult patients. Using an epiduroscope, Blomberg noticed that a tip inserted along the medial line raised the dura like a tent, interfering with movement of the catheter cephalad. Approaching the epidural space at an angle of 120–135° may facilitate catheter entry and ascent, as has been described in adults.[7] Ascent also might be facilitated by a paramedian insertion, as described by other authors,[8,9] although this approach presents an arguably greater risk of vascular puncture and the risk that the needle may not follow the desired route between the skin and the epidural space. We reported a case in which we inserted a catheter into the epidural space using a paramedian approach only to observe that the tip followed a route to the side opposite that desired.[10]

Neither ease/difficulty of entrance nor age predicted successful placement in our patients. Our data suggest that, although difficulty advancing the catheter indicates that failure is likely, ease is not a sign of success. The catheters advancing with difficulty never reached the desired level, and the maneuver of flexing the lower extremities on the abdomen and thorax did not improve outcome. Analyzing the ages of the six patients with easy entrance and success in reaching the desired level, we found that two were younger than 1 yr and four were older. Age, therefore, was not a factor that predicted successful placement in our patients.

In summary, we consider lumbar insertion of an unstiffened 19-G catheter to be a poor technique for reaching the thoracic epidural space. If the technique is tried, it is essential to verify placement of the tip radiologically. We also suggest that an unstiffened catheter should not be advanced farther than 2–3 cm if the potential knotting observed in figures 1A and 2A is to be avoided. At this time, the pediatric anesthesiologist must assess whether the patient is at less risk for neurologic damage, vascular damage, or dural puncture if the needle is inserted segmentally to deliver

an unstiffened catheter or if the styletted catheter is used.

References

1. Murat I, Delleur MM, Esteve C, Egu JF, Raynaud P, Saint-Maurice C: Continuous extradural anaesthesia in children: Clinical and haemodynamic implications. Br J Anaesth 1987; 69:1441–50

2. Bösenberg AT, Bland BAR, Schulte-Steinberg O, Downing JW: Thoracic epidural anesthesia via caudal route in infants. ANESTHESIOLOGY 1988; 69:265–9

3. Blanco D, Llamazares J, Martinez-Mora J, Vidal F: Anesthesia epidural torácica por vía caudal en anestesia pediátrica: La edad es un factor limitante. Rev Esp Anestesiol Reanim 1994; 41:214–6

4. Gunter JB, Eng C: Thoracic epidural anesthesia *via* the caudal approach in children. ANESTHESIOLOGY 1992; 76:935–8

5. Dalens B: L'anesthésie locorégionale en pédiatrie. Ann Fr Anesth Réanim 1989; 8:51–66

6. Blomberg RG: Technical advantages of the paramedian approach for lumbar epidural puncture and catheter introduction. Anaesthesia 1988; 43:837–43

7. Bromage PR: Analgesia epidural. Barcelona, Salvat Editores SA, 1983, p 142

8. Barretto C, Hook R, Seah CH: Use of the Tuohy needle in paramedian approach for peridural block. Anesth Analg 1977; 56:582–4

9. Jaucot J: Paramedian approach of the peridural space in obstetrics. Acta Anaesthesiol Belg 1986; 37:187–92

10. Gallart JL, Blanco D, Samsó E, Vidal F: Clinical and radiologic evidence of the epidural plica mediana dorsalis. Anesth Analg 1990; 71:698–701