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Administration of Local Anesthetic Through the Epidural Needle Before Catheter Insertion Improves the Quality of Anesthesia and Reduces Catheter-Related Complications

Mehmet Cesur, Haci A. Alici, Ali F. Erdem, Fikret Silbir, and Mustafa S. Yuksek

Department of Anesthesiology and Reanimation, Atatürk University, Erzurum, Turkey

Epidural catheter placement offers flexibility in block management. However, during epidural catheter insertion, complications such as paresthesia and venous and subarachnoid cannulation may occur, and suboptimal catheter placement can affect the quality of anesthesia. We performed this prospective, randomized, double-blind study to assess the effect of a single-injection dose of local anesthetic (20 mL of 2% lidocaine) through the epidural needle as a priming solution into the epidural space before catheter insertion. We randomized 240 patients into 2 equal groups and measured the quality of anesthesia and the incidence of complications. In the needle group ($n = 100$), catheters were inserted after injection of a full dose of local anesthetic through the needle. In the catheter group ($n = 98$), the catheters were inserted immediately after identification of the epidural space. Local anesthetic was then injected via the catheter. We noted the occurrence of paresthesia, inability to advance the catheter, or IV or subarachnoid catheter placement. Sensory and motor block were assessed 20 min after the injection of local anesthetic. Surgery was initiated when adequate sensory loss was confirmed. In the catheter group, the incidence of paresthesia during catheter placement was 31.6% compared with 11% in the needle group ($P = 0.00038$). IV catheterization occurred in 8.2% versus 2% of patients in the catheter and needle groups, respectively ($P = 0.048$). More patients in the needle group had excellent surgical conditions than the catheter group (89.6% versus 72.9; $P < 0.003$). We conclude that giving a single-injection dose via the epidural needle before catheter placement improves the quality of epidural anesthesia and reduces catheter-related complications.

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Continuous epidural anesthesia is popular for many surgical, obstetric, and analgesic procedures because placement of a catheter offers flexibility to extend, intensify, and maintain block. However, during epidural catheter insertion, complications such as paresthesia and inadvertent venous and subarachnoid cannulation may occur; these, in turn, may lead to transient or permanent paralysis, convulsion, and postdural-puncture headache (1). Furthermore, suboptimal catheter placement within the epidural space affects the spread and quality of anesthesia (1–3), risking failure of the anesthetic and requiring placement of a second epidural catheter or the need for general anesthesia. Some studies suggest that the incidence of complications and failures may be reduced by injecting a "priming" dose of local anesthetic or saline through the epidural needle before catheter insertion (4–6). This has been disputed (7,8), but in studies showing a lack of effect, either a small and possibly inadequate volume of local anesthetic or normal saline, which would dilute local anesthetic subsequently injected, was given. The use of a large priming dose of local anesthetic has not been studied. The purpose of this prospective, randomized, double-blind study was to assess the effect on anesthetic quality and complications of single-injection of local anesthetic through the needle as a priming solution into the epidural space before insertion of the catheter.

Methods

After obtaining institutional ethics committee approval and informed consent, 240 ASA class I-II consecutive adult patients undergoing elective surgery with epidural anesthesia were enrolled in this prospective, randomized, double-blind study. Patients in whom central blocks were contraindicated and patients with spinal column disorders, including scoliosis and herniated disks, or previous spinal surgery were excluded. In addition, obstetric patients (20 in

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Address correspondence and reprint requests to Mehmet Cesur, Yunus Emre Mah Tomurcuk Sok, Ikizler Apt. B Blok No: 7/7, 25080 Yenisehir/Erzurum, Turkey. Address e-mail to mcesur@atauni.edu.tr.

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the needle group and 22 in the catheter group) were excluded because they differ anatomically from other surgical patients.

Patients were assigned into two equal groups using a computer-generated randomization list. In the needle group, the epidural catheters were advanced into the epidural space after a single injection of a full dose of local anesthetic (20 mL of 2% lidocaine) through the needle. In the catheter group, the epidural catheters were inserted without injection of any solution and local anesthetic was then injected via the catheter. All procedures were performed by the same experienced anesthesiologist.

On arrival in the operating room, automatic noninvasive arterial blood pressure monitoring, electrocardiograph, and pulse oximetry were commenced, and 10–15 mL/kg of Ringer's lactate solution was infused before the procedure. Baseline demographic data and vital signs were recorded before surgery. All patients were premedicated with 3 mg of midazolam and 0.5 mg of atropine IM. With the patient in the left lateral position, lumbar epidural punctures were performed at the L4-5 or L3-4 interspace using a midline approach with 18-gauge Tuohy needles and the loss-of-resistance technique with 1-2 mL of saline. In the needle group, after identification of epidural space and a negative aspiration test for blood or cerebrospinal fluid, 3 mL of 2% lidocaine with epinephrine 5 μg/mL was injected through the needle as a test dose. The syringe was then disconnected to observe for drip back. The patients were also observed for any increase in heart rate that would indicate an intravascular injection of epinephrine and were questioned about dizziness, tinnitus, a metallic taste in the mouth, or sudden warmth or numbness in the legs. If these responses were negative after 5 min, the remainder of the full 20 mL of local anesthetic was injected in 3 divided doses. A 20-gauge multiorifice epidural catheter (Minipack; Portex Ltd., Kent, UK) was inserted 3 cm into the epidural space through the cranially directed tip of the epidural needle. After removal of the Tuohy needle, the catheter was fixed to the skin, and the patients were turned to the supine position. In the catheter group, identification of the epidural space, aspiration test, test dose, and incremental injection were performed as before, except that no local anesthetic was injected before catheter placement.

Paresthesia during insertion of the catheter, inability to advance the catheter, and IV and subarachnoid cannulation were noted by the attending anesthesiologist (i.e., not a blinded independent observer). IV or subarachnoid cannulation was detected by aspiration of frank blood or cerebrospinal fluid through the catheter. If intravascular or subarachnoid cannulation occurred, the catheter was withdrawn 1 cm. If this did not lead to withdrawal from the vein or subarachnoid space, the catheter was removed. If it was not possible to thread the catheter, it and the needle were withdrawn together. The procedure was then repeated at a different level; if unsuccessful again, general anesthesia was given. In the needle group, if the catheter could not be advanced and the surgery was of short duration, surgery was commenced under single-injection epidural anesthesia. These patients were excluded from the analysis.

Table 1. Patient Characteristics (mean ± SD)

	Needle group (n = 100)	Catheter group (n = 98)
Sex (m/f)	78/22	82/16
Age (yr)	52 ± 24	55 ± 22
Weight (kg)	70 ± 24	74 ± 18
Height (cm)	172 ± 16	166 ± 24
ASA I/II	90/10	82/16

There were no differences between groups.

Table 2. Surgical Procedures and Durations (mean ± SD)

	Needle group (n = 100)	Catheter group (n = 98)
Hysterectomy	11	13
Prostatectomy	34	37
Varicocelectomy	13	9
Inguinal herniorrhaphy	42	39
Duration of surgery	54 ± 24	51 ± 20

There were no differences between groups.

Twenty minutes after the main dose, sensory block levels and the degree of motor block were assessed bilaterally by a blinded independent observer. Sensory block was assessed with ice and motor block by the Bromage scale (0 = no block, 1 = hip movement block, 2 = hip and knee block, and 3 = complete block in hip, knee, and ankle). Complete loss of cold sensation to T8 on both sides was regarded as sufficient for surgery.

The term "failed epidural" was used for situations in which either it was impossible to insert the catheter or there was no sensory block after injection of the local anesthetic (9). Unilateral block, unblocked sacral segments, low level and unblocked segments, or a patchy block were regarded as "incomplete block" before surgery (9). If these situations were observed, an additional 10 mL (5 mL + 5 mL) of anesthetic solution was administered in both groups. If they persisted despite the additional dose, they were accepted as persistent incomplete block before surgery, and general anesthesia was administered. Preoperative bilateral complete loss of cold sensation to T8 and the absence of a patient complaining of discomfort during surgery was defined as "excellent surgical conditions." In patients complaining of discomfort, if the additional dose had not previously been administered, it was now given. Patients complaining of discomfort despite the additional injection already given

Table 3. Characteristics of Epidural Block (median [range]) or mean ± SD)

	Needle group ($n = 100$)	Catheter group ($n = 96$)[a]
Lumbar puncture interspace L4–5/L3–4	70/30	67/29
Median peak dermatomal level at 20 min	T10 (T11–5)	T9 (T12–4)
Motor block at 20 min (Bromage)	2 (0–3)	2 (2–3)
Lidocaine (mg)	450 ± 50	435 ± 46
Ephedrin (mg)	24 ± 12	28 ± 10
Perioperative fluid infusion (mL)	976 ± 122	980 ± 136

[a] Two patients in the catheter group, in whom repeated IV catheterizations occurred and underwent a general anesthesia, were not included. There were no differences between groups.

were asked if they would like sedation. This was given as propofol and fentanyl (bolus induction dose 0.5 mg/kg of propofol and 1 μg/kg of fentanyl IV followed by propofol 1–2 mL/min and 1 μg/kg of fentanyl bolus every half hour). If complaints persisted despite this sedation, they were accepted as inadequate anesthesia, and general anesthesia was given.

Arterial blood pressure, heart rate, and oxygen saturation were measured and recorded every 5 min for the duration of the surgical procedure. Hypotension (systolic blood pressure <70% of baseline), bradycardia, (heart rate <50 bpm), and desaturation (Spo_2 <90%) were recorded. Hypotension was treated with IV ephedrine 5–15 mg and bradycardia with 0.5 mg of IV atropine; desaturation was treated with oxygen via a face mask. The type and duration of surgical procedures, and amount of perioperative IV fluid given were documented.

The primary outcome was excellent surgical condition, and a 15% difference in the incidence of the excellent surgical condition was considered to be clinically important. According to *a priori* power analysis, 114 patients were sufficient to provide 90% power to detect this difference between groups, accepting a two-tailed (α) error of 5%. However, obstetric patients (20 in the needle group and 22 in the catheter group) were excluded because they differ anatomically from other surgical patients. A *post hoc* power analysis was performed with respect to the observed difference of 89.6%–72.9%, with the sample size of 96 in each group. The power was calculated as 84% with a two-tailed (α) error of 5%. Catheter-related complications, including paresthesia during catheterization, inability to thread the catheter, and inadvertent intrathecal and IV catheterization were secondary outcomes.

Statistical analysis was performed by SPSS for Windows (version 10.0) statistical package (SPSS Inc., Chicago, IL). Patient characteristics were analyzed using the *t*-test for independent groups. Block height was compared using Wilcoxon rank sum test. Perioperative anesthesia quality and incidences of catheter-related complications were analyzed using the χ^2 test in a 2 × 2 contingency table or Fisher exact test in 2 × 2 contingency table. Values are presented as numbers (%), mean ± SD, or median (range). A P value < 0.05 was considered statistically significant.

Table 4. Incidence of Perioperative Complications

	Needle group ($n = 96$)[a]	Catheter group ($n = 85$)[a]
Hypotension	18 (18.8)	15 (17.7)
Bradycardia	2 (2.1)	1 (1.2)
Nausea	10 (10.4)	8 (9.4)
Vomiting	1 (1.0)	1 (1.2)

Values are *n* (%).
[a] Four patients in the needle group and 11 patients in the catheter group, who experienced discomfort and required sedation or general anesthesia, were not considered. There were no differences between groups.

Results

There were no significant differences in demographic or surgical data, epidural block characteristics, or incidence of perioperative complications between the groups (Table 1, Table 2, Table 3, and Table 4). There were no failed or incomplete blocks. The incidence of catheter-related complications is shown in Table 5. During catheter placement, the incidences of paresthesia and IV catheterization were more frequent in the catheter group: 31 (31.6%) versus 11 (11%) ($P < 0.00038$) and 8 (8.2%) versus 2 (2%) ($P < 0.048$), respectively.

Significantly more patients required catheter removal because of IV or subarachnoid cannulation or inability to advance the catheter in the catheter group (13 [13.3%] versus 4 [4%]; $P < 0.02$). In 13 patients in the catheter group, catheter insertion was attempted through another space. In two of these, IV placement was again detected, and general anesthesia was instituted.

Anesthesia quality is shown in Table 6. Excellent surgical conditions were more frequently encountered in the needle group (86 [89.6%] versus 70 [72.9%]; $P < 0.003$). The catheters were reinjected during the surgery as required. There was no difference between the groups in the number of patients who required reinjection through the catheter as demonstrated in Table 6. Despite the additional injections, 4 (4.2%) patients in

Table 5. Incidence of Preoperative Catheter-Related Complications

	Needle group ($n = 100$)	Catheter group ($n = 98$)	*P*-value
Paresthesia during catheter insertion	11 (11)	31 (31.6)	0.00038
Intrathecal catheterization	1 (1)	3 (3.1)	NS
Intravenous catheterization	2 (2)	8 (8.2)[a]	0.048
Inability to advance the catheter	1 (1)	2 (2.0)	NS

Values are *n* (%).
NS = not significant ($P > 0.05$).
[a] Repeated IV catheterizations were observed in two patients in the catheter group, and each were analyzed as a single event.

Table 6. Anesthesia Quality During Operation

	Needle group ($n = 96$)[a]	Catheter group ($n = 96$)[b]	*P*-value
Excellent surgical conditions	86 (89.6)	70 (72.9)	0.003
Discomfort, but intervention not necessary	4 (4.2)	14 (14.6)	0.013
Required reinjection through catheter	15 (15.6)	18 (18.8)	NS
Inadequate anesthesia despite reinjection	4 (4.2)	11 (11.5)	NS

Values are *n* (%).
NS = Not significant ($P > 0.05$).
[a] 4 patients in the needle group, in whom a catheter could not be placed into the epidural space, and [b] 2 patients in the catheter group, in whom repeated IV catheterizations occurred and underwent to general anesthesia, were not included in the analysis.

the needle group and 11 (11.5%) in the catheter group complained of discomfort. Therefore, they were accepted as having inadequate anesthesia and were either sedated or underwent general anesthesia.

Discussion

We have demonstrated improved surgical conditions with the administration of a single-injection dose through an epidural needle before epidural catheter placement. Also, the single-injection administration followed by catheter insertion was associated with fewer paresthesias during insertion and fewer IV catheterizations. In addition, fewer anesthetic interventions were required.

Paresthesia during epidural catheter insertion has been reported in up to 60% of parturients (10), and the frequency of venous and subarachnoid cannulation has been reported between 0.2% and 11% and between 0.26% (11) and 0.6% (12), respectively. Paresthesia may be associated with transient or permanent neurological injury (13) and may be unpleasant for the patient. Unnoticed venous and subarachnoid cannulation may lead to convulsions, total spinal anesthesia, or postdural puncture headache.

Expansion of the epidural space by priming it with local anesthetic before advancement of the catheter may reduce the likelihood of both paresthesia and inadvertent venous or subarachnoid cannulation (14,15). Rolbin et al. (7) and Scott and Beilby (8) reported no advantage in injecting fluid into the epidural space before catheter insertion, but they administered much smaller volumes of fluid (3 and 5 mL, respectively) for priming. However, Mannion et al. (4), Tseng et al. (5), and Gadalla et al. (6) all noted a significant reduction in the incidence of extradural vein cannulation by routinely injecting 10 mL of saline priming fluid into the epidural space before catheter insertion. Saline, however, dilutes the local anesthetic injected; in this study, we therefore administered a single-injection dose of local anesthetic (20 mL) as a priming solution.

Despite a correct technique, some segments may remain unblocked because of inadequate spread of local anesthetic within the epidural space. This may be related to variations in epidural anatomy (16), although a transforaminal or anterior catheter positioning is a more likely explanation (2,7,17). Suboptimal positioning of the epidural catheter is common. Using radiography, Sanchez et al. (18) and Bridenbaugh et al. (19) showed that the intended catheter placement was often not achieved. Lim et al. (20) found that the catheter tip could be advanced without coiling for 4 cm or less in only 13% of cases. Hogan (21) found that lateral catheter deviation is a more common cause of asymmetric block than anatomic barriers to the spread of the local anesthetic solution. When epidural anesthesia is incomplete, additional injections or catheter manipulation may provide reliable surgical anesthesia, suggesting suboptimal positioning of the catheter.

Both the type of catheter (22) and its optimal depth of insertion (3,23) have been questioned. We used a multi-port epidural catheter inserted only 3 cm in the epidural space; these catheters give better anesthesia and require less manipulation than uniport ones (22), and insertion to no more than 3–4 cm into the epidural space minimizes complications and the incidence of

inadequate anesthesia, even in obstetric patients (17). Our single-injection dose via epidural needle before catheter placement led to fewer cases of catheter replacement and inadequate anesthesia. Although no imaging method was used in this study, in view of the possibility of the suboptimal positioning and the malfunction of the epidural catheter, as mentioned above, injection through the epidural needle resulted in a more even distribution of local anesthetic solution and a more adequate anesthetic action.

Thus, this single-injection administration before catheter insertion offers the advantages of a single injection technique plus the flexibility of epidural catheterization. The requirement of relatively large volumes of local anesthetic as priming solution in the single-injection/catheter technique may be a disadvantage, and the direct catheter technique is preferable if it is essential to restrict dose and level block in special patients.

In summary, we report that the administration of local anesthetics through the epidural needle before epidural catheter placement improves the quality of epidural anesthesia and decreases the risk of catheter-related complications.

References

1. Cousins JC, Veering BT. Epidural neural blockade. In: Cousins MJ, Bridenbaugh PO, eds. Neural blockade in clinic anesthesia and management of pain. 3rd ed. Philadelphia: Lippincott-Raven, 1998:243–321.
2. Doughty A. A precise method of cannulating the lumbar epidural space. Anaesthesia 1974;29:63–5.
3. Asato F, Goto F. Radiographic findings of unilateral epidural block. Anesth Analg 1996;83:519–22.
4. Mannion D, Walker R, Clayton K. Extradural vein puncture: an avoidable complication. Anaesthesia 1991;46:585–7.
5. Tseng CH, Li AH, Kuo-Sheng H, et al. Prior epidural injection of 10 ml normal saline reduces the incidence of inadvertent venous puncture in epidural catheterization. Acta Anaesthesiol Sin 1995;33:27–30.
6. Gadalla F, Lee SH, Choi KC, et al. Injecting saline through the epidural needle decreases the IV epidural catheter placement rate during combined spinal-epidural labour analgesia. Can J Anaesth 2003;50:382–5.
7. Rolbin SH, Halpern SH, Braude BM. Fluid through the epidural needle does not reduce complications of epidural catheter insertion. Can J Anaesth 1990;37:337–40.
8. Scott DA, Beilby DS. Epidural catheter insertion: the effect of saline prior to threading in non-obstetric patients. Anaesth Intensive Care 1993;21:284–7.
9. Portnoy D, Vadhera R. Mechanisms and management of an incomplete epidural block for cesarean section. Anesthesiol Clin North America 2003;21:39–57.
10. Sarna MC, Smith I, James JM. Paraesthesia with lumbar epidural catheters: a comparison of air and saline in a loss-of-resistance technique. Anaesthesia 1990;45:1077–9.
11. Richardson MG, Lee AC, Wissler RN. High spinal anesthesia after epidural test dose administration in five obstetric patients. Reg Anesth 1996;21:119–23.
12. Carr MF, Hehre FW. Inadvertent lumbar puncture. Anesth Analg 1962;41:349–53.
13. Gerancher JC, Liu SS. Complications of neuraxial (spinal/epidural/caudal) anesthesia. In: Benumof JL, Saidmen LJ, eds. Anesthesia & perioperative complications. 2nd ed. Philadelphia: Mosby, 1999:50–65.
14. Brown DL. Spinal, epidural and caudal anesthesia. In: Miller RD, ed. Anesthesia. 5th ed. Philadelphia: Churchill Livingstone, 2000:1491–519.
15. Verniquet AJW. Vessel puncture with epidural catheters. Anaesthesia 1980;35:660–2.
16. Usubiaga JE, Dos Reis A, Usubiaga LE. Epidural misplacement of catheters and mechanisms of unilateral blockade. Anesthesiology 1970;32:158–61.
17. Beilin Y, Bernstein HH, Zucker-Pinchoff B. The optimal distance that a multiorifice epidural catheter should be threaded into the epidural space. Anesth Analg 1995;81:301–4.
18. Sanchez R, Acuna L, Rocha F. An analysis of the radiological visualization of the catheters placed in the epidural space. Br J Anaesth 1967;39:485–9.
19. Bridenbaugh LD, Moore DC, Bagdi P, Bridenbaugh PO. The position of plastic tubing in continuous-block techniques: an x-ray study of 552 patients. Anesthesiology 1967;29:1047–9.
20. Lim YJ, Bahk JH, Ahn WS, Lee SC. Coiling of lumbar epidural catheters. Acta Anaesthesiol Scand 2002;46:603–6.
21. Hogan Q. Epidural catheter tip position and distribution of injectate evaluated by computed tomography. Anesthesiology 1999;90:964–70.
22. Michael S, Richmond MN, Birks RJS. A comparison between open-end (single hole) and closed-end (three lateral holes) epidural catheters. Anaesthesia 1989;44:578–80.
23. D'Angelo R, Berkebile BL, Gerancher JC. Prospective examination of epidural catheter insertion. Anesthesiology 1996;84:88–93.