

Obstetrical and Pediatric Anesthesia

Injecting saline through the epidural needle decreases the *iv* epidural catheter placement rate during combined spinal-epidural labour analgesia

*[L'injection de solution saline par l'aiguille péridurale diminue le taux de canulation *iv* du cathéter péridural pendant l'analgésie rachidienne péridurale combinée pour le travail obstétrical]*

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Purpose: To determine if injecting 10 mL saline before epidural catheter threading (pre-cannulation epidural fluid injection) can decrease the incidence of *iv* epidural catheter placement during combined spinal-epidural (CSE) labour analgesia.

Methods: One hundred healthy women requesting CSE labour analgesia with either fentanyl 20 µg or sufentanil 10 µg were prospectively randomized to receive either no epidural injection (dry group, $n = 50$) or epidural 10 mL saline injection (saline group, $n = 50$) before epidural catheter placement. A nylon multiport catheter was then threaded 3–5 cm into the epidural space and the needle was removed. We diagnosed *iv* catheter placement if blood was freely aspirated, if the mother became tachycardic after injection of epinephrine 15 µg, or if intracardiac air was heard (using ultrasound) after injection of air 1.5 mL.

Results: Intravenous epidural catheter placement occurred in one saline and ten dry group patients ($P < 0.01$). No complications of excessive cephalad intrathecal opioid spread (i.e., difficulty swallowing, hypoxemia, or respiratory arrest) occurred.

Conclusions: Injecting 10 mL of saline through the epidural needle after intrathecal opioid injection and before threading the catheter significantly decreased accidental venous catheter placement without any apparent increase in complications from excessive cephalad intrathecal opioid spread.

Objectif: Vérifier si l'injection de 10 mL de solution saline avant d'enfiler le cathéter péridural (injection de liquide pré-insertion) peut réduire l'incidence de canulation *iv* du cathéter péridural pendant l'analgésie rachidienne péridurale combinée (RPC) pour le travail.

Méthode : Cent femmes en bonne santé voulant une analgésie RPC, soit avec 20 µg de fentanyl, soit 10 µg de sufentanil, ont été réparties prospectivement au hasard. Il n'y a pas eu d'injection péridurale dans le groupe témoin ($n = 50$) mais l'injection péridurale de 10 mL de solution saline dans le groupe salin ($n = 50$) avant la mise en place du cathéter péridural. Un cathéter de nylon à ouvertures multiples a été ensuite poussé de 3-5 cm à l'intérieur de l'espace péridural et l'aiguille a été retirée. L'aspiration libre de sang, la tachycardie de la mère suivant l'injection de 15 µg d'épinéphrine ou la présence d'air intracardiaque, décelée par ultrasons après l'injection de 1,5 mL d'air, indiquaient la canulation *iv* du cathéter.

Résultats : La canulation intraveineuse du cathéter péridural est survenue chez une patiente du groupe salin et dix patientes témoins ($P < 0,01$). Aucune complication causée par la diffusion marquée de l'opioïde intrathécal en direction céphalique (comme la déglutition difficile, l'hypoxémie ou l'arrêt respiratoire) n'a été notée.

Conclusion : L'injection, par l'aiguille péridurale, de 10 mL de solution saline après l'injection intrathécale d'opioïde et avant l'insertion du cathéter a fait diminuer significativement la canulation place veineuse accidentelle du cathéter, sans augmentation apparente de complications causées par la diffusion marquée d'opioïde intrathécal en direction céphalique.

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INTRAVENOUS epidural catheter placement during needle-through-needle combined spinal-epidural (CSE) anesthesia in parturients is an under appreciated problem. During epidural anesthesia in labouring women, up to 16% of epidural catheters are inserted into veins.¹⁻³ A large, prospective series that included both CSE and epidural labour analgesia (LEA) found an incidence of venous cannulation similar to that reported in studies of LEA alone.⁴

Injection of a sufficiently large volume of epidural fluid before catheter threading decreases the incidence of accidental venous catheter placement during epidural anesthesia. The accidental *iv* epidural catheter placement rate decreases significantly after injection of 10 mL of 0.5% bupivacaine (9% *vs* 3%, $P = 0.05$) or saline (16% *vs* 0%, $P < 0.01$) through the epidural needle but not after injection of saline 3 mL (13% *vs* 16%, $P = \text{NS}$).¹⁻³ Saline 5 mL produced a decrease in the *iv* epidural catheter incidence that was significant in one of two studies (16% *vs* 9%, $P < 0.05$; 12% *vs* 6%, $P = \text{NS}$).^{5,A}

It is not known whether injecting fluid through the epidural needle [pre-cannulation epidural fluid injection (PEFI)] is safe or effective during CSE anesthesia. During surgical anesthesia, injection of 5–10 mL saline through an epidural catheter five to 20 min after spinal hyperbaric bupivacaine injection increases the sensory anesthetic level by 1–4 dermatomes.⁶⁻⁹ Even without epidural saline injection, intrathecal fentanyl or sufentanil labour analgesia can produce difficulty swallowing or respiratory arrest.^{10,11} Therefore, in this study, in addition to determining whether injecting saline through the epidural needle would decrease the incidence of intravascular epidural catheter placement, we assessed each case for symptoms of excessive cephalad intrathecal opioid spread.

Methods

The Institutional Review Board of Weill Medical College of Cornell University approved this research study. We then obtained written informed consent from 100 labouring women requesting CSE analgesia. All participants were healthy and carried healthy, vertex, singleton fetuses. All blocks were placed by experienced anesthesiologists (attending anesthesiologists or residents who had placed 20 or more epidurals). Patients were assigned to the dry group or the saline group using a computer-generated randomization list.

Each CSE was done with the patient in the sitting position after receiving 1 L lactated Ringer's solution intravenously. We recorded pulse oximetry continuously and blood pressure intermittently during and 30 min following CSE placement. We identified the mid-line epidural space by loss of resistance to air at the L2-3 or L3-4 interspace with a 17-gauge, 9 cm Hustead epidural needle. If the dura was punctured with the epidural needle, no further study procedures were performed. A 12.5 cm Whitacre spinal needle was inserted through the epidural needle, fentanyl 20 μg ($n = 97$) or sufentanil 10 μg ($n = 3$) were injected intrathecally, and the Whitacre needle was removed. In the dry group, a 20-gauge closed-tip, nylon, multiport epidural catheter (Sims Portex, Inc., Keene, NH, USA) was inserted 3–5 cm into the epidural space without prior fluid injection. In the saline group, 10 mL preservative-free normal saline was rapidly, in less than ten seconds, injected through the epidural needle before the epidural catheter was inserted 3–5 cm into the epidural space. The epidural needle was then removed and the catheter taped to the patient's back.

All catheters were observed for spontaneous fluid return and aspirated with a 3-mL syringe. If clear fluid could be freely aspirated, we assumed that the fluid was cerebrospinal fluid (CSF), ended the study, and treated the patient as clinically appropriate. We obtained no wet taps and no profound motor block. If freely flowing blood appeared, *iv* catheter placement was diagnosed. If no blood or CSF were aspirated, we injected 3 mL lidocaine 2% plus epinephrine 15 μg and observed the pulse oximeter for a tachycardic response to epinephrine (either a 25 $\text{beats}\cdot\text{min}^{-1}$ maternal heart rate increase or a 10 $\text{beats}\cdot\text{min}^{-1}$ increase in the maximum maternal heart rate during a contraction).¹² If the aspiration and epinephrine test results were negative, we injected 1.5 mL air while listening for a mill-wheel murmur using a Doppler external fetal heart rate probe placed over the maternal precordium.¹³ Aspiration for blood was attempted again if initial aspiration was negative and either the epinephrine or air tests indicated *iv* catheter location. If any of these tests were positive, these catheters were removed and replaced. Intrathecal catheter location was diagnosed and no further data were collected if the patient developed profound motor block three to five minutes after the lidocaine-epinephrine injection.

We recorded maternal demographics, the amount of air injected during identification of the epidural space, the catheter insertion depth, the ease of catheter threading, the time interval from saline injection to catheter insertion, and any spontaneous maternal complaints of difficulty swallowing. We monitored

A *Abm NN, Ung DA, DeFay S, et al.* Blood vessel puncture with epidural catheters. *Anesthesiology* 1989; 71: A916.

maternal oxygen saturation continuously for 30 min after CSE initiation and recorded any instances of oxygen saturation < 95%. We recorded whether or not *iv* or intrathecal catheter migration was subsequently diagnosed by blood or CSF aspiration.

Statistics

In order to calculate sample size, we assumed an incidence of *iv* cannulation of 15% in the dry group and 0.1% in the saline group. At a significance level of 0.05 and power of 0.8, the estimated sample size was 49 patients per group.

Data were analyzed using Student's *t* test, Fisher's exact test, or the Mann Whitney test, where applicable. $P < 0.05$ indicated statistical significance.

Results

There were no differences between the groups in demographics, the amount of air used to identify the epidural space, or the depth of catheter insertion (Table). All catheters were easily inserted. In the saline group, catheter insertion took place 18 ± 8 sec after saline injection. We identified *iv* catheter placement in 1/50 saline group and 10/50 dry group patients (2% *vs* 20%, $P < 0.01$). Intravenous catheter placement was identified by initial blood aspiration (one saline, four dry group patients), epinephrine injection (one dry group patient), or by the air test (five dry group patients). Blood was subsequently aspirated from four of the five *iv* catheters identified by the air test. No anesthetic complications occurred, including hypoxemia, patient complaint of difficulty swallowing, intrathecal catheter placement, respiratory arrest, or subsequent *iv* or intrathecal catheter migration.

Discussion

We found that injecting saline 10 mL through the epidural needle immediately before threading a nylon multiport epidural catheter (PEFI) lowered the incidence of intravenously placed catheters from 20% to 2% during CSE labour analgesia. There were no cases of difficulty swallowing, hypoxemia, or respiratory arrest.

The fact that we encountered no untoward side effects in this study suggests but does not prove the safety of injecting saline through the epidural needle in the context of CSE for labour. With no events in a 50-patient series, one can say with 95% confidence that the true event incidence is $\leq 6\%$.¹⁴ Our safety results should be verified in a larger case series.

The rapid onset of spinally administered drugs in parturients makes swift, accurate epidural catheter threading essential during CSE labour analgesia. Respiratory arrest has been reported four minutes

TABLE Patient demographic characteristics

	Saline group (n = 50)	Dry group (n = 50)
Age (yr)	30 \pm 6	30 \pm 7
Gravidity	2 (1-6)	2 (1-5)
Parity	0 (0-5)	0 (0-2)
Gestational age (weeks)	40 \pm 1	39 \pm 1
Height (cm)	165 \pm 6	165 \pm 9
Weight (kg)	77 \pm 10	74 \pm 13
Air injected (mL)	0.9 \pm 0.7	0.8 \pm 0.3
Catheter insertion depth (cm)	4.5 \pm 0.8	4.6 \pm 0.8

Gravidity and parity are reported as median (range); all other values are reported as mean \pm SD. There were no significant differences between the groups.

after intrathecal sufentanil injection in a parturient.¹⁰ Intravenous catheter threading forces the anesthesiologist either to replace the epidural catheter quickly or to postpone or abandon epidural catheterization. Thus CSE placement techniques should minimize *iv* threading of epidural catheters.

Test doses and aspiration cannot reliably detect intravenously located multiport epidural catheters. Injected test doses lack sensitivity with partially *iv* multiport catheters, for injectates preferentially exit the proximal hole while the distal hole is the one most likely to be located intravenously.¹⁵ Aspiration-negative but intravenously-located multiport epidural catheters have been reported.^{4,13} The problems of testing epidural catheter location re-emphasize the need to avoid venous cannulation.

Accidental intrathecal catheter threading, in the absence of dural puncture by the epidural needle, occurs so rarely during CSE labour analgesia (0.13%–0.4% incidence) that it is unlikely that PEFI will affect this potential complication.^{11,16} Cadaveric and *in vitro* studies have shown that it is very difficult to force an 18- or 20-gauge epidural catheter through dura punctured by a 25-gauge spinal needle.^{17,18}

Using an Arrow Flex-Tip (Arrow International, Reading, PA, USA) epidural catheter is an alternative way to minimize the incidence of venous cannulation. In parturients, the incidence of venous cannulation is lower with the softer, uniport Flex-Tip Arrow® than with the harder, multiport Portex® (Sims Portex Inc., Keene, NH, USA) epidural catheter (1.1% *vs* 5.7%, $P < 0.001$).¹⁶ However, the primary advantage of multiport catheters, the low incidence of one-sided and patchy epidural blocks, could be lost by using uniport epidural catheters.¹⁹

One limitation of our study is the high incidence of venous cannulation in the dry group. Other centres,

using different epidural needles, catheters, or placement techniques, may have a lower baseline incidence of venous cannulation. In addition, the anesthesiologist who tested the catheter for *iv* placement knew the patient's group assignment. We attempted to compensate for this logistically necessary design flaw by establishing strict criteria for the diagnosis of *iv* catheter placement.

Our study does not address the safety or efficacy of PEFI during CSE anesthesia for Cesarean delivery. Intrathecal bupivacaine injection creates a situation similar to that of the non-obstetric studies in which epidural fluid injection increased the spinal sensory anesthetic level 1–4 dermatomes.^{6–9} Since large bupivacaine doses are commonly used for Cesarean delivery, PEFI might lead to unacceptably high levels of spinal anesthesia.

In conclusion, injecting saline 10 mL through the epidural needle after intrathecal opioid injection and before threading of the nylon, multiport, epidural catheter greatly decreased the venous catheter placement rate. We postulate that this is due to widening the space and pushing blood vessels away from the epidural needle tip. In this series of 100 labouring women requesting CSE, no evidence of excess intrathecal opioid effect (respiratory depression, hypoxemia, or dysphagia) was seen. Given our sample size and the low incidence of these complications, however, this study does not establish the safety of this technique. PEFI may be a useful way to decrease the incidence of *iv* epidural catheter placement during CSE labour analgesia.

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