Comparison of combined spinal-epidural and low dose epidural for labour analgesia

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Purpose: To compare the combined spinal-epidural (CSE) technique with the epidural technique with regard to time to initiate and manage, motor block, onset of analgesia and satisfaction during labour.

Methods: Upon requesting analgesia, 50 healthy term parturients were randomized in a prospective, double-blind fashion to receive either CSE analgesia or lumbar epidural analgesia in the labour floor of a university hospital at an academic medical centre. The epidural group (n=24) received bupivacaine 0.0625%-fentanyl 0.0002% with 0.05 ml in 10 ml local anesthetic sodium bicarbonate 8.4% and epinephrine 1:200, 000. The CSE group (n=26) received intrathecal 25 μg fentanyl and 2.5 mg bupivacaine. Additional analgesia was provided upon maternal request.

Results: There were no differences ($P > 0.05$) in time to perform either technique, motor blockade, or parturient satisfaction or in the number of times that the anesthesiologist was called to perform any intervention. Although the first sign of analgesia was not different between the two groups, the onset of complete analgesia was more rapid with the CSE technique (Visual Analogue Pain Score (VAPS) at five minutes < three: 26/26 *vs* 17/24, $P \pm 0.001$).

Conclusion: Although epidural analgesia with a low concentration of local anesthetic and opioid mixture takes longer to produce complete analgesia, it is a satisfactory alternative to CSE.

Objectif : Comparer l'analgésie rachidienne-péridurale combinée (RPC) à l'analgésie péridurale concernant le temps nécessaire à la réalisation de la technique et à l'induction, le blocage moteur, le délai d'installation de l'analgésie et la satisfaction de la patiente pendant le travail obstétrical.

Méthode : Au moment de la demande d'analgésie, 50 parturientes à terme réparties de façon aléatoire ont reçu soit une analgésie RPC, soit une analgésie péridurale lombaire pour participer à une étude prospective en double insu. Le groupe péridural (n=24) a reçu un mélange bupivacaïne 0,0625 %-fentanyl 0,0002 % avec un ajout de 0,05 ml (par 10 ml d'anesthésique local) de bicarbonate de sodium à 8,4 % et de l'épinéphrine 1:200 000. Le groupe RPC (n=26) a reçu une injection intrathécale de 25 μg de fentanyl et de 2,5 mg de bupivacaïne. L'analgésie supplémentaire a été administrée sur demande.

Résultats : Il n'y a eu aucune différence intergroupe ($P > 0,05$) quant au temps nécessaire à la réalisation de chacune des techniques et à l'atteinte du blocage moteur, à la satisfaction des patientes et au nombre d'interventions de l'anesthésiologiste appelé sur demande. Le premier signe d'analgésie est survenu au même temps dans les deux groupes, mais le début de l'analgésie complète est survenu plus rapidement dans le groupe RPC (Score à l'Échelle Visuelle Analogique, SEVA, à cinq minutes < trois : 26/26 *vs* 17/24, $P \pm 0,001$).

Conclusion : L'analgésie péridurale complète réalisée avec une faible concentration d'anesthésique local et un mélange d'opioïdes connaît une installation plus lente que l'analgésie RPC, mais elle en constitue une solution de remplacement satisfaisante.

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EPIDURAL analgesia has been used extensively to provide pain relief in labour and is the standard by which other methods of labour analgesia are compared. Recently, the combined spinal-epidural (CSE) technique has gained popularity as an approach to labour analgesia.[1,2] The technique was reviewed extensively by Norris *et al.*, who showed a similar safety profile between the two techniques.[3] Side effects of CSE include pruritus, postdural puncture headache, hypotension, nausea and vomiting and fetal bradycardia. The incidence of pruritus, nausea and vomiting are greater than with the epidural technique alone. Some anesthesiologists at our institution argue that the CSE technique takes longer to perform and more effort to manage (less time efficient). The suggested advantages of CSE are its rapid onset of analgesia and relative lack of motor blockade. Epidural analgesia traditionally has been associated with motor blockade. However, no studies have compared a very low dose local anesthetic and opioid mixture in the epidural space with the CSE technique, both of which produce minimal motor block. In addition, no studies have compared the time involved in performing and managing these two techniques. We hypothesized that the time to perform the technique, the amount of motor blockade and the number of physician interventions are not different between these two techniques.

Materials and methods

Following institutional review board approval, written informed consent was obtained from 50 healthy term parturients who requested labor analgesia. They were randomized to either the epidural technique alone or to the combined spinal-epidural technique. Parturients with preeclampsia, diabetes, preterm labour, bleeding problems, scoliosis, in advanced labor (>5 cm cervical dilatation) or who received previous intravenous opioid were excluded. The epidural technique was performed in the sitting position by a third year anesthesia resident. The epidural space was entered using a midline approach at the $L_{2\text{-}3}$ or $L_{3\text{-}4}$ interspace with an 18 gauge Tuohy-Weiss epidural needle with a loss of resistance to air technique. The epidural group received 16 ml bupivacaine 0.0625% (B)-fentanyl 0.0002% (F) with 0.05 ml in 10 ml local anesthetic sodium bicarbonate 8.4% (S) and epinephrine 1:200, 000 (E) in divided doses over three minutes through the epidural needle. In the CSE group, the intrathecal space was entered with a 26-gauge 127 mm Gertie Marx needle through the epidural needle, and 1 ml bupivacaine 0.25% plus 25 μg fentanyl (0.5 ml) were injected through the spinal needle. In both groups, a multiport epidural catheter was threaded five centimeters into the epidural space. Catheters of both groups were initially not dosed to avoid introducing the variability of catheter function. If, at 20 min, analgesia was inadequate in any parturient of either group (Visual Analogue Pain Score>3), 13 ml BFSE were injected in incremental doses through the epidural catheter. When additional analgesia was requested, both groups received 13 ml BFSE in incremental doses (first 3 ml as a test dose) and an infusion of BF with epinephrine 1:400, 000 was started at 10 $ml \cdot hr^{-1}$. Another anesthesiologist, blinded to the technique, was in charge of collecting the data. Maternal blood pressure, heart rate, oxyhemoglobin saturation, fetal heart rate and uterine activity were monitored throughout labour and delivery. Parturients were laying on their right side throughout labor so as to avoid aortocaval compression. Visual Analogue Pain Score (VAPS) on a scale of 0-10 (0=no pain and 10=worst possible pain) was obtained at 0, 5, 10 and 15 min after the first injection, every 15 min thereafter until 60 min and then every 30 min until delivery. Parturient satisfaction on a scale of 1-4 (1-very satisfied to 4-not satisfied) were obtained at the time of complete analgesia, at delivery and on post-partum day 1 (PP #1). Maternal Bromage scores were obtained at 15 and 30 min to assess motor block: 1= unable to move feet or knees (complete motor block), 2=able to move feet only (almost complete), 3=just able to move knees (partial), and 4=full flexion of feet and knees (none).[4] Measurements included times from skin infiltration 1) to taping of the epidural catheter, 2) to initial sensation of analgesia (a decrease in VAPS) and 3) to request for additional analgesia. Parturient interventions were defined as supplemental analgesia and treatment of pruritus, hypotension (systolic blood pressure <100 mmHg, >30% decrease from baseline), nausea, vomiting or nonreassuring fetal heart rate changes. Maternal parameters obtained included height, weight, gravity and cervical dilatation. Newborn parameters obtained included umbilical artery pH, umbilical vein pH, weight and Apgar scores at one and five minutes. Data are presented as mean ± standard deviation (SD). Parametric data were analyzed using unpaired t tests. Nonparametric data were analyzed using chi-square. A value of $P < 0.05$ was considered significant.

Results

There were no differences in maternal or neonatal demographics (Tables I, II.). It did not take longer to perform the CSE nor did it take more of the physician's time to manage the CSE technique compared with the epidural technique. In addition, the time from injection of the solution to maternal request for

TABLE I Maternal demographics

	CSE (n=26)	*Epidural (n=24)*
Height (cm)	164.3 ± 7.6	163.8 ± 8.1
Weight (kg)	83.4 ± 15.7	80.5 ± 12.4
Multiparous	14/26	13/24
Cervical Dilation (cm)	4.8 ± 1.4	4.2 ± 1.5

CSE=combined spinal-epidural, cm=centimetres, *P*., NS. Data as mean ± SD.

TABLE II Neonatal demographics

	CSE (N)	*Epidural (N)*
Apgar Score-1 min (≥7)	20/26 (26)	18/24 (24)
Apgar Score-5 min (≥7)	26/26 (26)	23/24 (24)
Umbilical Artery pH	7.33 ± 0.1 (22)	7.28 ± 0.1 (17)
Umbilical Vein pH	7.34 ± 0.1 (23)	7.32 ± 0.1 (20)
Weight (g)	3367.8 (26)	3266.2 (24)

CSE=combined spinal-epidural, min=minutes, *P*., NS. Data as mean ± SD.

TABLE III Comparison of CSE and epidural techniques

	CSE (N)	*Epidural (N)*
Infiltration-taping (min)	6.9 ± 3.5 (26)	7.2 ± 4.1 (24)
First sign of analgesia (min)	1.8 ± 1.5 (26)	2.5 ± 2.2 (24)
Additional analgesia (min)	91.1 ± 32.6(24)	81.3 ± 30.4 (22)
VAPS-0 min (<3)	0/26 (26)	0/24 (24)
VAPS-5 min (<3)	26/26 (26)	17/24 (24)*
VAPS-15 min (<3)	26/26 (26)	17/24 (24)*
VAPS-30 min (<3)	26/26	24/24
VAPS-60 min (<3)	26/26	24/24
VAPS-delivery (<3)	26/26	24/24
Interventions (<1)	22/26 (26)	21/24 (24)
Very Satis-complete Analg	26/26 (26)	21/24 (24)
Very Satis-delivery	25/26 (26)	21/24 (24)
Very Satis-PPD #1	25/26 (26)	19/24 (24)
Pruritus	24/26	21/24
N/V	3/26	2/24
Hypotension/ephedrine use	4/26	4/24
Bromage 4-15 min	24/26 (26)	23/24 (24)
Bromage 4-30 min	25/26 (26)	24/24 (24)
Intravenous fluids (ml)	852	919

CSE=combined spinal-epidural, min=minutes, VAPS=visual analogue pain score, Satis=satisfied, Analg=analgesia, PPD#1=postpartum day number one, N/V=nausea and/or vomiting * $P < 0.001$, all other not significant. Data as mean ± SD.

additional analgesia was similar between the two techniques. Although there was no difference in the initial onset of analgesia (a decrease in the VAPS), the VAPSs at 5, 10 and 15 min were lower in the CSE group, indicating a faster onset of complete analgesia in the CSE group ($P < 0.05$ by Chi-square). However, there were no differences in the VAPSs after 15 min. There were no differences between group satisfaction scores at complete analgesia, at the time of delivery or on PP#1 (Table III).

There was no difference in the degree of motor block between the two techniques (Table III). Only three subjects developed motor blockade. In the CSE group, one parturient had a Bromage score of three at 15 min (no motor block at 30 min) and another had a score of two at 15 min (Bromage of three at 30 min). Only one parturient in the epidural group had a score of three at 15 min, which was not present at 30 min.

In all cases, the CSE or epidural technique functioned well and there was no need to repeat the technique. Four women (two in each group) delivered before dissipation of the intrathecal dose or the original epidural dose. These parturients were excluded from the additional analgesia data but were included with the rest of the data. There were no accidental dural punctures in the epidural group and none of the parturients in the CSE group developed a postdural puncture headache (PDPH). The incidence of pruritus, nausea, vomiting and hypotension were similar. The amount of ephedrine used to treat hypotension was also similar (Table III).

Four parturients in the CSE group and six in the epidural group required Cesarean section. Two parturients in the CSE group and one in the epidural group required low forceps vaginal delivery. None of the above differences were significant. The reasons for the Cesarean section and low outlet forceps delivery included failure to progress, arrest of dilatation and dystocia. There were no cases of fetal bradycardia or respiratory depression in the mother or fetus. The neonates (n=50) experienced no complications and none were admitted to the neonatal intensive care unit.

Discussion

Many authors have studied epidural[5,6] and CSE techniques separately for labour analgesia[2,7,8,9] but few have compared them with each other. The few studies that have compared them, have included an epidural technique with a relatively high concentration of local anesthetic such as bupivacaine 0.25%,[10–12] or a CSE technique with morphine or with a low dose of sufentanil and bupivacaine.[13,14] Two of the above studies used 10 ml of bupivacaine 0.125 % in the epidural group.[13,14] While this is not a high concentration, it is not as dilute a mixture as some clinicians are using. The overall conclusion of the studies comparing CSE with the epidural technique is that the CSE provides faster onset of analgesia with minimal motor blockade. Pruritus, nausea and vomiting are increased in the CSE group compared with the epidural group. It is difficult

to reach a conclusion from these studies because the epidural and/or CSE drug mixtures are not the same. Also, lower concentrations of local anesthetic with opioid mixture in the epidural space have been shown to decrease the incidence of motor blockade.

In an effort to produce motor blockade similar to CSE technique, we opted for a lower concentration of local anesthetic and opioid mixture in the epidural space than in the above studies. We placed the emphasis of our study in comparing CSE with a low dose local anesthetic and opioid mixture epidural technique for labour analgesia with regard to time to perform and number of physician interventions. We chose to place greater emphasis on these two issues because time efficiency is a current economic concern and none of the previous studies had addressed this question.

These concentrations of local anesthetic and opioid for epidural analgesia were chosen (bupivacaine 0.0625%-fentanyl 0.0002%) based on our experience and on previous studies that have demonstrated good analgesia and minimal motor blockade when using this mixture for epidural infusion.[5,6] We felt it important to choose an epidural solution that would avoid motor blockade. While probably not equipotent to the CSE solution, this epidural solution achieved similar levels of analgesia as intrathecal fentanyl with bupivacaine. The 25 μg fentanyl dose in the CSE technique was chosen based upon clinical impression of efficacy and duration of analgesia. A recent study to determine the dose-response relation of intrathecal fentanyl for labor analgesia confirms this opinion.[15] While the ED50 of intrathecal fentanyl was 14 μg, additional duration of analgesia was obtained by increasing the dose to 25 μg. The authors' conclusion was that there was little benefit in increasing the dose beyond 25 μg. The addition of bupivacaine to the intrathecal fentanyl prolongs its duration with no additional motor block.[2]

Our use of high volumes of a very low concentration of local anesthetic combined with fentanyl, epinephrine and bicarbonate for the first injection in the epidural group may account for the relatively fast onset of analgesia. This may also explain the similar duration of action of both techniques. All 26 of the CSE patients had VAPS < 3 at five minutes while only 17 of 24 in the epidural group had VAPS < 3 at 15 min. Proximity of drug to nerve in the CSE approach probably accounts for the difference in pain scores. The site of action of intrathecal lipid soluble opioids is believed to be spinal as well as supraspinal.[16] Lipid soluble opioids such as fentanyl also penetrate the dura following lumbar epidural administration and, as such, may reach cerebrospinal fluid (CSF) concentrations similar to those after intrathecal injection.[17] The slower onset of action of fentanyl given by the epidural rather than the intrathecal route may be because it must penetrate the dura to reach its site of action. Even though the CSE group initially obtained greater degree of analgesia, satisfaction was equal and excellent in both sets of mothers from shortly after the initial injection to the end of the study. We believe this is because all parturients achieved a satisfactory degree of analgesia without motor blockade.

Our study may be criticized for not taking into account the total time from parturient request for pain relief to achieving satisfactory analgesia. We did not delay the initiation of epidural or CSE analgesia to prepare the solutions. While one anesthesiologist was placing the needle, another was preparing the solution. This time must be taken into consideration if a solo practitioner attempts to repeat our results. In this case, the individual must prepare the epidural solution prior to injection, which would add approximately two minutes.

Another criticism to our study is the use of high volumes of local anesthetic, opioid and epinephrine through the epidural needle. The main reason we injected all of the solution through the epidural needle was to have two groups with untested epidural catheters. The epidural solution was injected over a three minutes period and a very careful monitoring of the parturient's response and of the vital signs was taking place at that time. This fractionation may account for the longer latency to onset compared with that of the intrathecal route. We believe that if the medication had ended up in the subarachnoid space or intravenously (*iv*), it would have been recognized prior to the full amount being injected. A further question regards accidental injection of 10 mg bupivacaine and 32 μg fentanyl intrathecally (IT) or *iv*. 32 μg fentanyl is safe in either space as long as maternal respiration is monitored adequately. Bupivacaine, 10 mg *iv,* is well below the toxic dose and IT will produce a spinal block that would be recognized by an anesthesiologist. We are not advocating the injection of the entire solution through the epidural needle or the injection of high concentrations of local anesthetic. Our usual approach is to inject an initial test dose with a local anesthetic and 15 μg epinephrine through the catheter and wait three to five minutes before further injection through the catheter to avoid accidental subarachnoid block or intravenous injection.

Overall, the incidence of side effects was very similar between the two groups. We did not find a difference in the incidence of pruritus unlike earlier studies. We believe that this is because of the substantial con-

centrations of opioid used in the epidural bolus and in the infusion mixture. Overall, with the exception of a slower onset to complete analgesia, the epidural mixture produced a similar clinical profile to CSE. Is the faster onset of complete analgesia worth the extra cost of a spinal needle and the potential for an increase of side effects? Our impression is that the difference in speed of onset of CSE over epidural injection is measurable but unlikely to be of clinical importance.

Our results indicate that there is no difference between the CSE technique and an epidural technique using bupivacaine 0.0625% combined with fentanyl, epinephrine and bicarbonate in regard to time to perform the block or number of interventions by a physician. Although the epidural group took a longer time for complete analgesia, once it was achieved, it provided a similar clinical profile to the CSE.

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