SCIENTIFIC ARTICLE

Combined spinal–epidural analgesia in labour: its effects on delivery outcome

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Abstract

Background and objectives: Combined spinal–epidural (CSE) has become an increasingly popular alternative to traditional labour epidural due to its rapid onset and reliable analgesia provided. This was a prospective, convenient sampling study to determine the effects of CSE analgesia on labour outcome.

Methods: One hundred and ten healthy primigravida parturients with a singleton pregnancy of ≥37 weeks gestation and in the active phase of labour were studied. They were enrolled to the CSE ($n = 55$) or Non-CSE ($n = 55$) group based on whether they consented to CSE analgesia. Non-CSE parturients were offered other methods of labour analgesia. The duration of the first and second stage of labour, rate of instrumental vaginal delivery and emergency cesarean section, and Apgar scores were compared.

Results: The mean duration of the first and second stage of labour was not significantly different between both groups. Instrumental delivery rates between the groups were not significantly different (CSE group, 11% versus Non-CSE group, 16%). The slightly higher incidence of cesarean section in the CSE group (16% versus 15% in the Non-CSE group) was not statistically significant. Neonatal outcome in terms of Apgar score of less than 7 at 1 and 5 min was similar in both groups.

Conclusion: There were no significant differences in the duration of labour, rate of instrumental vaginal delivery and emergency cesarean section, and neonatal outcome in parturients who received compared to those who did not receive CSE for labour analgesia.

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Analgesia combinada raquiperidural em trabalho de parto: seus efeitos sobre o desfecho do parto

Resumo

Justificativa e objetivos: A analgesia combinada raquiperidural (RP) tornou-se uma alternativa cada vez mais popular para o trabalho de parto tradicional devido ao seu rápido início de ação e analgesia confiável. Este foi um estudo prospectivo de amostragem conveniente para determinar os efeitos da RP sobre o desfecho do parto.

Métodos: Cento e dez parturientes primigestas saudáveis, com gestação única de $\geq$ 37 semanas de gestação e na fase ativa do trabalho de parto foram incluídas. As pacientes foram designadas para os grupos RP (n = 55) ou não-RP (n = 55) com base em seus consentimentos para a analgesia combinada RP. As parturientes do grupo não-RP receberam outros métodos de analgesia para o parto. As durações do primeiro e segundo estágio do trabalho de parto, as taxas de parto vaginal instrumental e cesariana de emergência e os escores de Apgar foram comparados.

Resultados: A média de duração do primeiro e segundo estágio do trabalho de parto não foi significativamente diferente entre os dois grupos. As taxas de parto instrumental não foram significativamente diferentes entre os grupos, grupo RP (11%) versus grupo não-RP (16%). A incidência ligeiramente maior de cesariana no grupo RP (16% versus 15% no grupo não RP) não foi estatisticamente significativa. O desfecho neonatal em termos de índice de Apgar inferior a 7.

Conclusão: Não houve diferenças significativas em relação à duração do trabalho, às taxas de parto vaginal instrumental e cesariana de emergência e ao desfecho neonatal em parturientes que receberam RP para analgesia de parto em comparação com aquelas que não receberam.

Introduction

Labour pain is one of the most distressing types of pain a person may have to endure. The American College of Obstetricians and Gynaecologists has suggested that: ''*Labour results in severe pain for many women. There is no other circumstance where it is considered acceptable for a person to experience severe pain, amenable to safe intervention, while under a physician's care*''.[1] More women nowadays are opting for pain relief methods during labour. Epidural analgesia has gained increasing popularity worldwide as a result of its ability to provide analgesia which is more superior to other methods of pain relief.

Controversy exists however, concerning its effect on the course and outcome of labour. As a result of this, considerable research has been performed and findings have led to changes in practice. Epidural analgesia has been previously implicated in prolonging labour, increasing oxytocin requirements, as well as increasing instrumental and operative delivery rates. However, there is increasing evidence which refutes some of these claims.[2]

Combined spinal–epidural (CSE) has become an increasingly popular alternative to the traditional epidural. The local anaesthetic–opioid combination administered intrathecally provides rapid-onset, potent and reliable analgesia, with minimal motor blockade during the first stage of labour, enabling maternal mobility, and resulting in greater maternal satisfaction.[3,4] A recent study comparing the CSE technique to traditional epidural analgesia showed that, although both techniques were excellent analgesic options, CSE provided significantly faster and better pain relief during the first stage of labour.[5]

Numerous studies comparing epidural and CSE or epidural and non-epidural analgesia have shown variable results, but none have compared CSE with other methods of labour analgesia.[6–8] In the Cochrane database of systematic reviews in 2011 comparing epidural versus non-epidural or no analgesia in labour, CSE was included together with epidural analgesia and not as a separate entity. In view of the above, we decided to look at the effect CSE had on labour outcome compared with alternative methods of labour analgesia. Our endpoints were duration of the active phase of the first and second stages of labour, rate of instrumental vaginal delivery and emergency cesarean section, and neonatal outcome.

Methods

This prospective, convenient sampling study was conducted after obtaining institutional ethics approval. A total of 110 parturients of American Society of Anesthesiology (ASA) I physical status was enrolled in this study after informed consent was obtained. The parturients were primigravid, aged between 20 and 40 years with a singleton pregnancy of $\geq$37 weeks gestation and in the active phase of labour with cervical dilatation of 3–4 cm. Any parturient with pregnancy related illness or contraindications to CSE analgesia was excluded from this study.

The parturients were first examined by the obstetric team in the ward. A detailed obstetric history was taken and cephalic foetal presentation confirmed by a scan. When the

parturients were confirmed by the obstetric team to be in the active phase of labour (cervical dilatation of 3–4 cm with regular contractions), they were transferred to the labour room. Those who consented to CSE analgesia were enrolled into the CSE group, whereas parturients who declined CSE analgesia were offered other forms of analgesia and enrolled into the Non-CSE group. Parturients in the Non-CSE group were offered either entonox (N_2O/O_2; 50%/50%) or intramuscular (IM) pethidine 50 mg with IM promethazine (Phenergan) 12.5 mg. The parturient's blood pressure and pulse rate were monitored at hourly intervals. Foetal heart rate and the frequency and duration of uterine contractions were assessed with continuous cardiotocographic monitoring.

In the CSE group, infusion of lactated Ringer's solution was commenced and the parturients were placed in the sitting position. The procedure was performed under aseptic precautions at L3–L4 or L4–L5 using a pre-packed set containing an 18-gauge epidural needle, 20-gauge epidural catheter and 27-gauge spinal needle (BD Durasafe[TM] Plus). The epidural space was identified using the loss of resistance to saline technique, after which the spinal needle was inserted through the epidural needle. Upon visualization of backflow of cerebrospinal fluid, an intrathecal dose of 0.5 mL of 0.2% ropivacaine with 0.5 mL of fentanyl (25 μg) was administered. The epidural catheter was then inserted 3–5 cm into the epidural space and secured. The parturient was then positioned supine with left uterine displacement and the head end of the bed elevated to 20–30°. The level of sensory blockade was checked to ensure the sensory level was $\geq$T10, after which an epidural infusion of 0.0625% ropivacaine with fentanyl 2 μg/mL was started at 8 mL/h. The parturients' hemodynamic parameters were monitored at 5 min intervals during and after the procedure for the first 15 min, then every 15 min for the first hour, then half-hourly after that. Hypotension, defined as a 20% reduction in systolic blood pressure from baseline, was treated by turning the parturient to the left lateral position and administering maternal oxygen, intravenous fluid infusion, or vasopressor (ephedrine 6 mg or phenylephrine 50 μg per bolus) as indicated.

Throughout labour, sensory level, motor block and pain score were assessed at hourly intervals. The degree of motor block was assessed using the Modified Bromage Score (MBS) where 1, complete block, unable to move feet or knee; 2, almost complete block, able to move feet only; 3, partial block, just able to move the knees; 4, detectable weakness of hip flexion while supine; 5, no detectable weakness of hip flexion while supine. Parturients with MBS $\leq$2 and/or sensory level $\geq$T6 was regarded as having an excessively dense or high epidural block respectively, and managed accordingly.

Pain was assessed using the Numeric Rating Scale (NRS) with scores ranging from 0, indicating no pain to 10, being the worst pain imaginable. Breakthrough pain was managed by administering additional epidural bolus doses and/or increasing the epidural infusion rate, depending on the NRS score. For parturients with pain scores of 3–5, the epidural infusion rate was increased incrementally to a maximum of 12 mL/h. Those with pain scores $\geq$6 were given 2–3 mL bolus doses of epidural lignocaine 2% to a maximum of 8 mL. The epidural was assumed to be ineffective if significant pain (NRS score >5) persisted despite the maximum top up dose. These parturients were offered to have the epidural

re-sited. If they were not keen to do so, an alternative means of analgesia would be administered. Parturients who required re-siting of the epidural or an alternative means of analgesia were excluded from this study. The epidural infusion was continued until delivery of the baby and ceased only after the episiotomy wound was sutured.

Obstetric management was similar in both groups. Amniotomy was performed if the foetal membranes were intact. Pelvic examination to evaluate the progress of labour was performed at regular intervals as per labour management protocol. Oxytocin augmentation was prescribed as necessary to achieve a cervical dilation rate of $\geq$1 cm/h. The decision to proceed to vaginal instrumental or operative delivery was made according to maternal or foetal indications.

Data collected included duration of the first and second stages of labour, oxytocin augmentation, labour outcome (spontaneous vaginal delivery, instrumental vaginal delivery or cesarean section) as well as 1- and 5-min Apgar scores. The indication for emergency lower segment cesarean section (EMLSCS) was also recorded. Foetal outcome was assessed based on previous studies where scores less than 7 were considered as poor Apgar scores.[4,9] In addition, any incidence of post-partum haemorrhage was recorded and for the patients in the CSE group, any side-effects experienced (e.g. nausea, vomiting, pruritus, post-dural puncture headache) were documented and managed accordingly. For patients in the Non-CSE group, reasons for declining CSE analgesia were also documented.

Statistical analysis

Sample size was calculated using the formula by Snedecor and Cochran (1989) for continuous variables. The constant value of 10.51 was based on an α-value of 0.05 and a power of 90%. Using this formula, a sample size of 45 patients for each group was obtained. Considering a dropout rate of 20%, 55 patients were required on each arm. SPSS (version 20; IBM SPSS Inc.) was used for statistical analysis. Data analysis was done using the independent t-test for parametric data and the chi-square test for non-parametric data. A p-value of less than 0.05 was considered as statistically significant.

Results

A total of 110 parturients were enrolled in this study with 55 parturients in each group. Table 1 shows parturient characteristics in both groups. There were no significant differences in terms of age, weight, height, body mass index (BMI) and gestational age of the parturients in both groups.

There was no significant difference in the duration of the first and second stages of labour between both groups as shown in Table 2. The percentage of patients who received oxytocin was 71% and 65% in the CSE and Non-CSE groups respectively, and this was not significantly different. A total of 46 patients in the CSE group and 47 patients in the Non-CSE group had delivered vaginally. The rates of spontaneous and instrumental vaginal delivery were not statistically different between the groups. Vacuum delivery was the most common mode of instrumental assisted delivery. The rate of EMLSCS did not significantly differ between the two groups.

Table 1 Parturient characteristics (values expressed as mean $\pm$ standard deviation).

	CSE group ($n=55$)	Non-CSE group ($n=55$)	p
Age	28.8 ± 3.6	28.6 ± 3.8	0.755
Weight (kg)	67.2 ± 13.6	66.2 ± 14.4	0.717
Height (m)	1.6 ± 0.1	1.6 ± 0.1	0.642
BMI (kg/m^2)	26.7 ± 5.0	26.6 ± 5.3	0.857
Gestational age (weeks)	38.6 ± 0.9	38.7 ± 0.7	0.427

The main indication for EMLSCS was foetal distress, accounting for 14.5% and 10.9% of the cases in the CSE and Non-CSE group respectively. EMLSCS was indicated for poor progress in the remaining cases of both groups.

At 1 min, three and two neonates in the CSE and Non-CSE groups respectively had Apgar scores of less than 7, but the difference was not statistically significant. None of the neonates had an Apgar score of less than 7 at 5 min.

Pruritus was by far the most common complication in the CSE group. This was present in 24 parturients (44%) but was short-lived and did not require intervention. Two parturients (3.6%) in the CSE group complained of nausea without vomiting. There were no other CSE related complications such as post-dural puncture headache and hypotension, or other complications such as post-partum haemorrhage. Parturients who declined CSE analgesia gave reasons of fear of backache, numbness or the inability to bear down during the second stage of labour.

Discussion

The effect of neuraxial analgesia in labour and obstetric outcomes has been studied extensively over the years. Among the endpoints studied were duration of first and second stages of labour, oxytocin augmentation, rate of instrumental and cesarean deliveries, maternal satisfaction and neonatal outcome.[10–13]

The present study showed that the duration of first stage of labour was not prolonged in parturients who received CSE analgesia. The slight increase in the mean duration of the active phase labour in the CSE group (352.3 min as compared to 347.2 min in the Non CSE group) did not reach statistical significance. Previous studies comparing epidural analgesia with systemic opioids have shown inconsistent results. Epidural analgesia was either implicated in prolonging or showed no effect on the first stage of labour.[13–17] Interestingly, Tsen et al. demonstrated that CSE was associated with an increased cervical dilatation rate in nulliparous patients.[18] The authors postulated that the spinal analgesia of a CSE technique allowed, at least initially and potentially during the course of labour, for a reduction in local anaesthetic dosage when compared with conventional epidural analgesia. Another postulate was that painful labour resulted in an increase in maternal adrenaline level, which may be tocolytic in itself. There is evidence to demonstrate that epidural analgesia may accelerate labour as the provision of effective analgesia reduces maternal catecholamines, and hence minimizing its inhibitory effect on uterine contractility.[19] The use of CSE analgesia with its rapid onset and similar analgesic efficacy would thus be expected to have a similar effect on the duration of labour.

Epidural analgesia has been thought to prolong the second stage of labour by removing the parturient's involuntary bearing down reflex, or by interfering with motor function.[15] Poor maternal effort at expulsion may cause foetal malposition during descent, which may lead to intervention in the form of instrumental delivery or cesarean section. However, in modern-day practice when dilute local anaesthetic solutions are used to provide epidural analgesia, the motor blockade and hence weakness of pelvic floor muscle is either minimal or absent. This was confirmed by a recently published meta-analysis on the effect of low concentrations versus high concentrations of local anaesthetics for labour analgesia on obstetric and anaesthetic outcomes.[20]

Table 2 Labour characteristics (values expressed mean $\pm$ SD, or as numbers with percentage in parentheses where appropriate).

	CSE group ($n=55$)	Non-CSE group ($n=55$)	p
Duration of first stage (h)	5.5 ± 0.9	5.4 ± 1.2	0.718
Duration of second stage (min)	22.3 ± 8.6	23.2 ± 11.5	0.675
Oxytocin augmentation	39 (71%)	36 (65%)	0.341
Mode of delivery			
Spontaneous vaginal delivery	41 (74.6)	40 (72.7)	0.917
Instrumental vaginal delivery			
Forceps	1 (1.8)	1 (1.8)	1.000
Vacuum	4 (7.2)	6 (10.9)	0.527
EMLSCS			0.808
Foetal distress	8 (14.5)	6 (10.9)	
Poor progress	1 (0.02)	2 (0.04)	

The authors found that low concentrations were associated with a reduction in the incidence of assisted vaginal delivery and a shorter second stage of labour. We used an epidural infusion with a low concentration of 0.0625% ropivacaine with fentanyl 2 μg/mL in our study as per institutional protocol. It is of no surprise that our study found no significant difference between the CSE and Non-CSE group, in the duration of the second stage of labour. This is similar to other randomized controlled trials which compared CSE with conventional epidural analgesia.[21,22]

The instrumental delivery rate is yet another important outcome measure, as the procedure increases the risk of maternal perineal trauma, and adverse neonatal outcomes in cases of difficult delivery.[13] The 2011 Cochrane review on epidural versus non-epidural or no analgesia in labour showed that epidural analgesia was associated with an increased risk of assisted vaginal birth.[8] However, we found that the incidence of instrumental delivery was not significantly different (CSE, 9.0% versus Non-CSE, 12.7%). This was in contrast to earlier studies which reported higher rates of instrumental delivery in epidural compared to parenteral opioids or entonox.[9,12] Studies which compared CSE with epidural have reported no differences in the mode of delivery.[21,22] It must be noted that results are often affected by multiple confounding factors, such as the neuraxial analgesic technique, method of epidural analgesia maintenance, local anaesthetic concentration, degree of analgesia during second stage of labour and obstetric factors.[13]

Considerable data support the notion that neuraxial labour analgesia does not increase the risk of cesarean delivery compared with systemic analgesia.[13] In this study, we found no significant increase in the rates of cesarean delivery in parturients who received CSE analgesia. The Cochrane review on epidural versus non-epidural or no analgesia in labour showed that there was no evidence of a significant difference in the risk of cesarean section overall even though there was an increased risk of cesarean section for foetal distress.[8] Similarly, Halpern et al. reported that the risk of cesarean delivery was no different between women who received systemic opioids versus neuraxial analgesia.[17] It must also be emphasised that many factors other than labour progress may contribute to cesarean delivery, such as cephalo-pelvic disproportion, a macrosomic baby, maternal infection and parity.[13] The results of these studies, including our own, imply that neuraxial analgesia per se is unlikely to affect the chances of a normal delivery.

Neonatal outcome assessed by Apgar scores, was similar in both groups. All five neonates in both groups with Apgar scores less than 7 at 1 min recovered at 5 min. This is in accordance with other studies which showed no difference in Apgar scores or cord pH in patients receiving epidural or CSE analgesia.[6,9,12,23]

The most common side effect in parturients who received CSE analgesia was pruritus, which occurred in 44% of our parturients. This was transient and tolerable, requiring no treatment. Feedback from patients have revealed pruritus as the most common side effect of intrathecal opioids.[24] Miro et al. in their study concluded that although CSE analgesia was more commonly associated with pruritus and back pain, nevertheless it afforded analgesia of superior quality.[23]

There were some limitations in this study. Blinding of clinicians was difficult since parturients were easily differentiated between the CSE and Non-CSE group. Even though this may lower the threshold for instrumental delivery in the CSE group, this was reduced by strict adherence to institutional obstetric management protocols. Secondly, as this study included only ASA I parturients, its results cannot be extrapolated to patients with significant medical or pregnancy related illness. These co-morbidities may influence obstetric management, thus affecting the rate of instrumental or cesarean delivery and possibly neonatal outcome. Thirdly, the subjective assessment of cervical dilatation may vary among doctors of differing experience, thus affecting the actual assessment of duration of labour. Oxytocin augmentation E poses another confounding factor to labour duration. As it was part of our institutional obstetric protocol, most of our parturients received oxytocin but we did not keep record whether it was administered before or after commencement of labour analgesia. Oxytocin per se may accelerate labour progression. On the other hand, the provision of effective labour analgesia could be partly responsible for hastening the process of labour. However there may have been some parturients who despite being given labour analgesia, had no alleviation of pain. Suboptimal pain relief may retard labour progression thus prompting administration of oxytocin. Finally, with regards neonatal outcome, we only compared the Apgar scores between the two groups. Other indices for neonatal wellbeing, such as umbilical cord pH, the need for naloxone, mechanical ventilation or admission to Neonatal Intensive Care Unit, were not investigated in our study.

Overall, this study supports other studies which found that CSE analgesia did not adversely affect the outcome of labour.[17,18] Labouring women can be reassured that, in addition to obtaining superior analgesia with CSE, they would be able to experience a safe and normal vaginal delivery. In conclusion, the present study demonstrated that there was no significant difference in the duration of labour, rate of instrumental vaginal delivery and emergency cesarean section, and neonatal outcome in parturients who received, compared to those who did not receive CSE for labour analgesia.

Conflicts of interest

The authors declare no conflicts of interest.

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