

Combined spinal-epidural anaesthesia

Narinder Rawal

Purpose of review

The purpose of this review is to present the most important recent studies on the clinical use of the combined spinal-epidural technique.

Recent findings

The predominant recent literature on the combined spinal-epidural technique involves its use in obstetrics. A 2004 UK survey showed that the use of the technique is increasing. Studies are presented which show the role of intrathecal drug selection for improving the quality of the combined spinal-epidural technique for anaesthesia for Caesarean section. The pros and cons of using the method as opposed to traditional epidural for labour analgesia are still being debated; the results of a meta-analysis show that combined spinal-epidural provides faster onset of analgesia and increased maternal satisfaction but the incidence of pruritus is high. This review also looks at some technical aspects of the technique.

Summary

The use of combined spinal-epidural is widespread and increasing particularly in obstetric anaesthesia and analgesia. Recent literature provides new information about the choice of drugs and technical aspects of the technique and also about its advantages and drawbacks in obstetric and non-obstetric patients.

Keywords

Caesarean section, combined spinal epidural block, epidural block, labour analgesia, regional anaesthesia, spinal block

Curr Opin Anaesthesiol 18:518–521. © 2005 Lippincott Williams & Wilkins.

Department of Anaesthesiology and Intensive Care, Örebro University Hospital, Örebro, Sweden

Correspondence to Professor Narinder Rawal, MD, PhD, Department of Anaesthesiology and Intensive Care, Örebro University Hospital, SE-701 85 Örebro, Sweden
Tel: +46 19 6021000; fax: +46 19 127479; e-mail: n.rawal@orebroll.se

Current Opinion in Anaesthesiology 2005, 18:518–521

Abbreviations

CSE combined spinal-epidural
EVE epidural volume extension
FHR fetal heart rate
NTN needle-through-needle

© 2005 Lippincott Williams & Wilkins
0952-7907

Introduction

The combined spinal-epidural (CSE) technique has gained increasing popularity for patients undergoing major surgery below the umbilical level who require prolonged and effective postoperative analgesia. CSE anaesthesia combines the rapidity, density, and reliability of a subarachnoid anaesthetic with the flexibility of continuous epidural anaesthesia to extend the duration of analgesia [1]. The technique is particularly popular in obstetric anaesthesia and analgesia. A recent UK survey [2] showed that 65% of obstetric consultant anaesthetists used the CSE technique in their practice. In keeping with the aims of this journal the current review looks at the literature on CSE anaesthesia during the last year, in general the literature was predominantly on the use of CSE anaesthesia in obstetrics and in particular labour analgesia.

Combined spinal-epidural Caesarean section

A modification of the conventional CSE is the sequential CSE technique, in which spinal anaesthesia is induced with a small-dose intrathecal local anaesthetic and opioids to produce a limited anaesthetic that can be extended with epidural top-ups of local anaesthetic or saline. This epidural volume extension (EVE) may be due to several mechanisms including the 'volume effect' in which the dura is compressed by epidural saline, resulting in 'squeezing' of cerebrospinal fluid and more extensive spread of subarachnoidal local anaesthetic. The volume effect appears to be time-dependent, beyond 30 min or after two-segment regression has begun, any epidural top-up of saline would have no effect on block extension and may even accelerate regression of the spinal anaesthetic.

In a controlled study of 62 parturient women undergoing elective Caesarean section Lew *et al.* [3**] compared the EVE technique with single-shot spinal anaesthesia with respect to its sensory and motor block profile and haemodynamic stability. Patients in the EVE group demonstrated significantly faster motor recovery (73 ± 33 min versus 136 ± 32 min; $P < 0.05$). The study showed that CSE with EVE provided adequate anaesthesia with only 55% of the bupivacaine dose, which allowed a more rapid motor recovery of the lower limbs [3**]. This faster motor recovery by 1 h may have an impact on shortening post-anaesthesia care unit (PACU) stay.

Van de Velde *et al.* [4] performed a retrospective chart analysis of all pre-eclamptic parturient women who

underwent Caesarean section over a 4-year period at their institution. Of the 77 participants, 26 were severely pre-eclamptic and 51 had mild pre-eclampsia. Surgery was performed under epidural anaesthesia in 62 patients and under CSE in 15 patients. No differences were seen between the two groups with regard to patient characteristics and obstetric data. In the CSE group more ephedrine was used while in the epidural group more fluids were required. The authors concluded that CSE anaesthesia appeared to be a safe technique for pre-eclamptic parturient women. The limitations of the study, however, included its retrospective design and the fact that the number of patients was much larger in the epidural group [4].

Combined spinal-epidural anaesthesia for labour analgesia

Several methods have been advocated to provide neuraxial analgesia for labour. The classical labour epidural may take up to 20 min for onset of pain relief. In contrast, the CSE technique provides the advantages of a spinal anaesthetic, such as speed of onset, low drug usage and with the additional advantages of an epidural catheter. This catheter may then indefinitely prolong the analgesia or may serve for a Caesarean section in case of need. The CSE technique has also made ambulation possible due to the minimal motor block. Ambulation is also possible with epidural techniques, however, using continuous infusions of dilute local anaesthetics with opioids. Furthermore many women who receive a CSE never actually ambulate in spite of encouragement to do so [1].

A debate has been going on for several years about the pros and cons of CSE versus the plain epidural technique for labour analgesia. A prospective, blinded randomized study was undertaken involving 113 women. Analgesia was initiated with intrathecal 2.5 mg bupivacaine combined with 5 µg sufentanil in the CSE group ($n = 54$) and with bupivacaine 0.125% plus epinephrine 2.5 µg/ml plus sufentanil 7.5 µg in the epidural group ($n = 59$). In the CSE group, the onset of analgesia was faster (5 versus 15 min), the consumption of bupivacaine was lower (7.5 versus 11.3 mg/h) and there was less unilateral analgesia (14.8% versus 40.7%) than in the epidural group. The characteristics of labour were similar in both groups. In the CSE group, however, there was a higher incidence of posterior presentation (25.9% versus 10%), pruritus, hypotension, somnolence, nausea and one case of meningitis. The CSE technique provided more effective analgesia during labour than epidural analgesia alone but offered no other advantage [5].

Non-reassuring fetal heart rate (FHR) abnormalities have been reported after the administration of spinal opioids in parturient women with an arterial blood pressure that is stable and within normal limits. These FHR patterns are

believed by some to be associated with uterine hyperactivity but there is no agreement on this issue. Van de Velde *et al.* evaluated the role of the spinal sufentanil dose on FHR changes. Three hundred parturient women were randomized into three groups. In the first group, known as the EPD group, epidural analgesia was initiated with 12.5 mg of bupivacaine, 12.5 µg of epinephrine, and 7.5 µg of sufentanil. In group 2, the BSE group, initial intrathecal analgesia consisted of 2.5 mg of bupivacaine, 2.5 µg epinephrine, and 1.5 µg of sufentanil. In group 3, the SUF group, spinal analgesia consisted of 7.5 µg of sufentanil. Twenty-four percent of patients in the SUF group developed FHR abnormalities (bradycardia or late decelerations) during the first hour after initiation of analgesia compared with 12% in the BSE group and 11% in the EPD group. Uterine hyperactivity occurred in 12% of parturients in the SUF group but only 2% in the other groups. Onset of analgesia was more rapid in both CSE groups as compared with the EPD group. Of patients in the BSE group, however, 29% developed severe hypotension [6^{••}]. These data are consistent with previous recommendations of caution when performing CSE anaesthesia using a large dose (7.5 µg or more) of spinal sufentanil because of the risk of uterine hyperactivity and FHR abnormalities.

In a controlled study using the CSE technique, Lim *et al.* [7^{••}] compared the duration of labour analgesia by giving a standard dose (same dose) of three different long acting local anaesthetic drugs to 60 nulliparous parturient mothers. All patients received 2.5 mg of intrathecal bupivacaine, ropivacaine, or levobupivacaine. The duration of analgesia was the longest (76.3 ± 5.9 min) with bupivacaine but similar between ropivacaine (52.6 ± 4.0 min) and levobupivacaine (51.1 ± 3.4 min). Bupivacaine was associated with the most frequent incidence of motor block; there was no difference in motor block between patients who received ropivacaine or levobupivacaine. This study also suggested that intrathecal (as opposed to epidural) ropivacaine is less potent than bupivacaine, even at clinically relevant doses [7^{••}].

Combined spinal-epidural versus epidural for labour pain: literature review

A Cochrane review of CSE versus epidural analgesia in labour identified 14 trials ($n = 2047$), which met the inclusion criteria; 25 outcomes were analysed. The authors concluded that there was no standard CSE or epidural technique. Compared with epidural, CSE provided faster onset of effective pain relief from the time of injection, and increased the incidence of maternal satisfaction. CSE women experienced more itch, however, following injection of intrathecal opioids. There was no difference between CSE and epidural techniques with respect to the incidence of forceps delivery, maternal mobility, postdural puncture headache, Caesarean section

rates or admission of babies to the neonatal unit. It was not possible to draw any meaningful conclusions regarding rare complications such as nerve injury and meningitis [8**].

Choice of drugs and dosages for combined spinal-epidural anaesthesia in labour analgesia

In the literature, the dosages of intrathecal opioid-local anaesthetic mixtures have been arbitrarily chosen, with little knowledge of the contribution of each component to the overall effectiveness of analgesia. The local anaesthetic that has been used most extensively is bupivacaine, in doses ranging from 1 to 2.5 mg, usually combined with opioids. More recently, the chiral drugs such as ropivacaine and levobupivacaine have been administered for CSE labour analgesia [1].

Camorcia *et al.* [9*] compared the analgesic efficacies of intrathecal ropivacaine, levobupivacaine, and bupivacaine for the first stage of labour analgesia. To compare equipotent analgesia doses the authors used the up-down sequential allocation model, which allows estimation of the minimal local analgesia dose (MLAD). Ninety-seven nulliparous term parturient women requesting CSE analgesia were randomly allocated to one of three groups to receive 0.25% spinal ropivacaine, levobupivacaine, or bupivacaine. The initial dose of the local anaesthetic drug was 2.5 mg and the testing interval was set at 0.25 mg, subsequent doses were determined by the response of the previous patient. The intrathecal MLAD was 3.64 mg for ropivacaine, 2.94 mg for levobupivacaine and 2.37 mg for bupivacaine. There were significant trends for greater motor block with bupivacaine and levobupivacaine. This study [9] showed a potency of spinal bupivacaine over levobupivacaine over ropivacaine.

Various drugs have been used for the intrathecal portion of CSE, ranging from opioids alone to multiple drug combinations with local anaesthetics, opioids, epinephrine, clonidine, and neostigmine [1]. Intrathecal epinephrine doses of 25 and 200 μg were found to prolong the duration of local anaesthetic–opioid combinations given intrathecally. Gurbet *et al.* investigated the dose–response relationship for intrathecally administered epinephrine added to a local anaesthetic–opioid combination in CSE analgesia for labour. The control group received an intrathecal injection of bupivacaine 2.5 mg and fentanyl 25 μg only. The others received epinephrine 12.5, 25, 50 or 100 μg added to this intrathecal regimen. Compared to the control group, all four epinephrine groups had significantly longer duration of intrathecal analgesia, but the times were similar. The frequencies of side effects were similar in all five groups. Epinephrine doses higher than 12.5 μg produced no

additional benefits in terms of duration or quality of spinal analgesia with this drug combination [10].

Non-obstetric use of the combined spinal-epidural technique

The CSE technique has also been used for a variety of non-obstetric procedures [1]. Dobrydnjov *et al.* [11*] evaluated the perioperative effects of intrathecal and epidural clonidine combined with a local anaesthetic in 60 patients undergoing hip arthroplasty. Addition of intrathecal 15 μg of clonidine to bupivacaine during CSE anaesthesia provided a higher quality of anaesthesia and longer-lasting analgesia than bupivacaine alone. The combination of clonidine and ropivacaine administered by the epidural route was well tolerated and produced significantly improved postoperative pain relief compared with ropivacaine alone. Epidural infusion of clonidine 40 $\mu\text{g}/\text{h}$, however, also had a moderate hypotensive effect [11*].

Does the choice of combined spinal-epidural technique influence failure rates?

A retrospective analysis was performed on 19 259 deliveries during a 3-year period at one institution. The neuraxial labour analgesia rate was 75% and the overall failure rate was 12%. The incidence of overall failure, intravenous epidural catheter, wet tap, inadequate epidural analgesia and catheter replacement were lower in patients receiving CSE versus epidural analgesia [12*].

The two techniques currently in practice are the needle-through-needle (NTN) technique and the double-space technique. When two separate spaces are used, the epidural component is completed before the intrathecal injection is attempted. With the NTN technique, the intrathecal injection follows insertion of the epidural Touhy needle, which serves as an introducer. When the intrathecal injection is completed, the spinal needle is first removed, followed by the Touhy needle after epidural catheter placement, leaving the catheter to be withdrawn to the desired mark. Compared with the double space technique, the advantages of the NTN technique are a single injection site and speed of performance. One of the several new NTN kits is the Epistar (Medimex, Hamburg, Germany) which permits epidural catheter insertion prior to a spinal injection, thereby allowing catheter problems to be taken care of before rather than after the intrathecal injection of the local anaesthetic.

In a controlled study of 200 parturient women, Backe *et al.* [13] compared the performance of the Epistar NTN with the double space technique for CSE anaesthesia during Caesarean section. The success rates for blocks to T5 with the double space and NTN techniques were 80 and 54% respectively. Time to readiness for surgery was

15 min and 12.9 min for the double space and NTN techniques, respectively. The double space technique had a greater success rate than the NTN technique [13]. A 54% success rate with the NTN technique may be the lowest in the published literature. The authors recommend the double space technique, but even an 80% success rate is far lower than that reported below by Cook [14]. In the literature, large studies report a success rate in the high 90% region with the NTN technique [1].

The issue of NTN or double space CSE was also studied by Cook [14] who reported his experience in 201 parturient women. The CSE technique developed by the author involved placement of the spinal needle in the subarachnoid space followed by replacement of the spinal needle stylet after appearance of cerebrospinal fluid. The epidural catheter was then positioned separately before returning to the spinal needle and injecting the subarachnoid drug. The technique had a high technical success rate. Both needles were successfully placed in 200 (99.5%) patients. Spinal anaesthesia was successful in all cases. The epidural catheter was used in 179 cases and failure of the epidural occurred in two (1.1%) patients. Paraesthesia, inability to advance the epidural catheter and blood in the epidural catheter occurred in 31 patients (15.4%), which necessitated immediate replacement of the epidural catheter in 14 (7%) of these cases. Postoperatively, typical postdural puncture headache was reported by one patient (0.5%) and mild backache by four of them (2%). There were no neurological complications. Minor problems occurred during the procedure in 31 patients (15.4%). These consisted of paraesthesias with epidural catheter ($n = 13$) and spinal needle insertion ($n = 2$), blood in the epidural catheter ($n = 12$) and the inability to feed the epidural catheter ($n = 4$). Nevertheless, the author of this uncontrolled study concluded that the separate needle technique is superior to the NTN technique but comparative studies between the two techniques are needed to confirm or refute this [14].

Conclusion

The use of regional techniques is increasing worldwide. CSE is also gaining increasing acceptance particularly for Caesarean section and orthopaedic surgery. For labour analgesia, the role of CSE is less clear and many obstetric anaesthesiologists still prefer the traditional epidural technique. A Cochrane review comparing the two techniques showed that CSE provided faster onset of pain relief and increased maternal satisfaction, but the parturient participants experienced more itch. Recent studies have evaluated the issue of intrathecal potency differences between bupivacaine, levobupivacaine, and ropivacaine and also the role of adjuvants such as sufentanil and epinephrine. There is a new debate about the technical advantages and higher success rates of

double-space over NTN CSE techniques, but this needs to be confirmed in large studies.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

- 1 Rawal N, Holmstrom B, Crowhurst JA, Van Zundert A. The combined spinal-epidural technique. *Anesthesiol Clin North America* 2000; 18:267–295.
- 2 Blanshard HJ, Cook TM. Use of combined spinal-epidural by obstetric anaesthetists. *Anaesthesia* 2004; 59:922–923.
- 3 Lew E, Yeo SW, Thomas E. Combined spinal-epidural anaesthesia using epidural volume extension leads to faster motor recovery after elective Caesarean delivery: A prospective, randomised, double-blind study. *Anesth Analg* 2004; 98:810–814.
This excellent study demonstrated the advantage of sequential CSE and EVE in Caesarean section. Spinal local anaesthetic reduction by about 50% resulted in significantly faster motor recovery and shorter PACU stay.
- 4 Van de Velde M, Berends N, Spitz B, *et al.* Low-dose combined spinal-epidural anaesthesia vs conventional epidural anaesthesia for Caesarean section in pre-eclampsia: a retrospective analysis. *Eur J Anaesth* 2004; 21:454–459.
- 5 Vernis L, Dualé C, Storme B, *et al.* Perispinal analgesia for labour followed by patient-controlled infusion with bupivacaine and sufentanil: combined spinal-epidural vs epidural analgesia alone. *Eur J Anaesth* 2004; 21:186–192.
- 6 Van de Velde M, Teunkens A, Hanssens M, *et al.* Intrathecal sufentanil and fetal heart rate abnormalities: a double blind, double placebo-controlled trial comparing two forms of combined spinal-epidural analgesia with epidural analgesia in labor. *Anesth Analg* 2004; 98:1153–1159.
This important study addressed the debate about the role of spinal opioid-induced rapid analgesia in causing uterine hyperactivity and FHR abnormalities. The authors recommend caution when sufentanil doses larger than 7.5 μg are used.
- 7 Lim Y, Ocampo C, Sia AT. A comparison of duration of analgesia of intrathecal 2.5 mg of bupivacaine, ropivacaine, and levobupivacaine in combined spinal-epidural analgesia for patients in labor. *Anesth Analg* 2004; 98:235–239.
This important study showed that there was no difference between intrathecal ropivacaine and levobupivacaine regarding duration of analgesia or motor block.
- 8 Hughes D, Simmons SW, Brown J, Cyna AM. Combined spinal-epidural versus epidural analgesia in labour [Review]. *Cochrane Database Syst Rev* 2003; (4):CD003401.
This is an excellent review of the literature on the long-standing debate about the pros and cons of CSE versus epidural technique for labour. CSE is associated with faster onset of pain relief and better patient satisfaction but at the cost of a higher incidence of pruritus. There were no other advantages (or disadvantages) of CSE.
- 9 Camorcía M, Capogna G, Columb M. Minimum local analgesic doses of ropivacaine, levobupivacaine, and bupivacaine for intrathecal labor analgesia. *Anesthesiology* 2005; 102:646–650.
This addresses the controversial issue of potency differences between ropivacaine and the other two long acting local anaesthetic drugs. The authors demonstrated a potency of spinal bupivacaine over levobupivacaine over ropivacaine.
- 10 Gurbet A, Turker G, Kose DO, Uckunkaya N. Intrathecal epinephrine in combined spinal-epidural analgesia for labor: dose-response relationship for epinephrine added to a local anesthetic-opioid combination. *Int J Obstet Anesth* 2005; 14:121–125.
- 11 Dobrydnjov I, Axelsson K, Gupta A, *et al.* Improved analgesia with clonidine when added to local anesthetic during combined spinal-epidural anaesthesia for hip arthroplasty: a double-blind, randomized and placebo controlled study. *Acta Anaesthesiol Scand* 2005; 49:538–545.
This non-obstetric study showed a beneficial effect of intrathecal 15 μg clonidine, but epidural clonidine (40 $\mu\text{g}/\text{h}$) was associated with moderate hypotension.
- 12 Pan PH, Bogard TD, Owen MD. Incidence and characteristics of failures in obstetric neuraxial analgesia and anaesthesia: a retrospective analysis of 19,259 deliveries. *Int J Obstet Anesth* 2004; 13:227–233.
Although this was a retrospective study, it provided important information about the incidence of common problems based on data from nearly 20 000 deliveries at one institution.
- 13 Backe SK, Sheikh Z, Wilson R, Lyons GR. Combined epidural/spinal anaesthesia: needle-through-needle or separate spaces? *Eur J Anaesth* 2004; 21:854–857.
- 14 Cook TM. 201 combined spinal-epidurals for anaesthesia using a separate needle technique. *Eur J Anaesth* 2004; 21:679–683.