

## Combined spinal epidural analgesia for labor

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*Labor pain is described as excruciating and a significant contributor to stress and anxiety by many patients. Several techniques have been developed to alleviate this pain while minimizing effects on the mother, the fetus, and the progression of labor. The absence of motor blockade and excellent sensory analgesia, together with the rapid onset and the ability to extend the level and duration of analgesia, make the combined spinal-epidural (CSE) technique increasingly popular. The technique of blockade, the mechanism of action, the side effects, and the advantages-disadvantages as compared to conventional epidural analgesia are reviewed.*

**Keywords:** *Combined spinal epidural analgesia, CSE, Epidural analgesia, Labor.*

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**Objective:**

1. To explain the concept of the most effective technique to relief labor pain.
2. To describe the technique of blockade, the mechanism and the side effects of combined spinal epidural analgesia in labor.
3. To compare the advantages and disadvantages of combined spinal epidural analgesia for labor.

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**พรสวรรค์ งามประเสริฐวงศ์. การใช้เทคนิคร่วม spinal epidural สำหรับระงับปวดระหว่าง  
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ความปวดระหว่างการเจ็บครรภ์คลอดบุตรเป็นความปวดที่รุนแรงมาก แม้วิธีการระงับปวดจะมีหลายวิธีแต่วิธีที่ได้รับการยอมรับว่าดีที่สุดคือ การใช้ยาระงับปวดเฉพาะส่วน ซึ่งมีหลายเทคนิค และได้มีการปรับปรุงให้ระงับปวดได้ดี มีผลข้างเคียงน้อยที่สุดต่อทั้งมารดาและทารก รวมถึงกระบวนการคลอด เทคนิค spinal epidural เป็นเทคนิคที่ได้รับการพัฒนาให้ระงับปวดได้เร็ว มีผลลดการทำงานของกล้ามเนื้อน้อย ทำให้มารดาสามารถเบ่งและคลอดได้ ในบทความนี้ผู้เขียนได้รวบรวมข้อมูลของเทคนิคกลไกการออกฤทธิ์ ผลข้างเคียงของการระงับปวดขณะเจ็บครรภ์คลอดโดยใช้เทคนิค spinal epidural รวมทั้งเปรียบเทียบกับเทคนิค epidural เดิมซึ่งใช้อยู่ทั่วไปในประเทศไทยปัจจุบัน

**คำสำคัญ :** ระงับปวด, การเจ็บครรภ์คลอด

The pain and anxiety of labor and delivery is a common phenomenon and may lead to the release of significant quantities of epinephrine and norepinephrine, decreasing uterine blood flow secondary to uterine vasoconstriction.<sup>(1)</sup> Skillful use of analgesia and anesthesia coupled with reassurance and emotional support for the parturient may make childbirth less stressful, not only for the mother but for the fetus as well.<sup>(2)</sup>

The ideal analgesic drug or technique for use in labor should be simple and safe to administer with no adverse effect on the mother or fetus, and no effect on the progress of labor. Most importantly, it should decrease or eliminate the pain of labor without affecting other sensations, such as the desire to push.<sup>(3)</sup>

Several techniques have been used towards this goal in an attempt to produce selective nociceptive block. Of these, the absence of motor blockade and the decreased cardiovascular disturbance in the presence of excellent sensory analgesia make the combined spinal-epidural (CSE) technique increasingly popular. The combination of spinal opioids with subsequent epidural analgesia has been suggested in several studies to provide the best of both techniques: rapid onset of analgesia with a minimal drug, dose, followed by the ability to extend the level and duration of analgesia.<sup>(4)</sup>

### **Pain pathways**

Pain during childbirth is carried by different peripheral nerves depending upon the stage of labor.<sup>(5)</sup> Pain in the first stage results primarily from uterine contraction and dilatation of the cervix and is mediated via visceral afferent fibers that accompany the sympathetic nerves to T10 - L1 segments. Pain in the second stage results from the distention of the pelvic floor, vagina and perineum and is carried by the S2, S3 and S4 spinal segments (the Pudendal nerve).

### **CSE techniques**

CSE can be performed on either single or double spinal segments.<sup>(6)</sup> However the single segment needle through needle CSE is safer, more time efficient, less traumatic and more acceptable for the patient.<sup>(7)</sup> Referring to Figure 1, the needle through needle technique most commonly involves insertion of an epidural needle into the lumbar epidural space using the 'loss of resistance' technique. The spinal needle is then inserted into the subarachnoid space, either by directing it through the lumen of the epidural needle or through a side lumen, until clear cerebrospinal fluid is observed.<sup>(8)</sup> Intrathecal opioid is injected, then the spinal needle is withdrawn. Finally, an epidural catheter, 3-4 cm. in length, is inserted into the epidural space through the epidural needle. Local anesthetics will be given via this catheter and the analgesic effect will be achieved before the spinal analgesia wears off.



**Figure 1.** Needle through needle CSE technique

Unlike the single injection spinal technique, this CSE technique involves a large conduit inside the epidural space, thereby removing the normal negative pressure of the epidural space. As a result, the dura will be easily deformed inward with the pressure from the blunt, pencil-point spinal needle. The spinal needle must be long enough to extend 1 cm beyond the tip of the epidural needle to puncture the dura reliably.<sup>(4)</sup> A number 27G or smaller spinal needle is typically used to ensure that the hole produced by the spinal needle is small enough to prevent migration of the 18G epidural catheter into the intrathecal space and to prevent the unexpected cephalad spreading of subsequently administered epidural local anesthetics or opioids.<sup>(4,9)</sup>

### Spinal drug and dosage

The site and mechanism of action of opioids and local anesthetics are different.<sup>(5)</sup> The opioid receptors in the substantia gelatinosa of the dorsal horn of the spinal cord have been suggested as the major site of action for spinal opiates. Whereas blockade of the axonal membrane of the spinal nerve roots, as well as the anterior and posterior horn cells, is the mechanism of action for local anesthetics. Mixtures of opiate and local anesthetic are associated with several advantages: one can reduce the doses of both local anesthetics and narcotics and, consequently, minimize side effects. The use of low concentrations of local anesthetic is associated with minimal motor blockade, which is suitable for the parturient.

Initially, opioids without local anesthetic are administered through the spinal injection of CSE.<sup>(10)</sup> Spinal injection of sufentanil or fentanyl results in

rapid (5 min) and nearly complete pain relief in the first stage of labor and lasts approximately 90 minutes. Sufentanil is approximately five times more potent than fentanyl for spinal or epidural analgesia. The most commonly used doses are 5-10 mcg sufentanil or 25 mcg fentanyl which can reduce sensation up to T6.<sup>(11)</sup> There is no benefit in increasing the dose of intrathecal fentanyl beyond 25 mcg.<sup>(12)</sup> Pain relief from these doses of sufentanil and fentanyl is complete or nearly complete in more than 90 % of women in early first stage labor and lasts for 90 minutes.<sup>(4)</sup> In the case of complete cervical dilatation, however, the failure rate, as defined by inadequate pain relief, typically increases to 25-30 % and the duration decreases to 60 min or less.

The addition of bupivacaine, in a dose of 2.5 mg, prolongs the duration of opioid analgesia by 30 min and decreases the failure rate in women in late labor.<sup>(5,13,14)</sup> Halving the dose of bupivacaine may reduce side effects without compromising the quality of analgesia.<sup>(15,16)</sup> The main advantages of initial subarachnoid administration of an anesthetic mixture are the speed of the onset of analgesia and increased maternal satisfaction. This initial dose reduces subsequent requirements for local anesthetics and therefore preserves the patient's ability to walk in late labor.

### The test dose

The location of the epidural catheter cannot be tested by injecting the usual volume of local anesthetic, as the presence of a high spinal block could cause total spinal anesthesia if the catheter is placed spinally. For epidural block alone, 3 mL of 2 % lidocaine can identify intrathecal misplacement

of the epidural catheter by the presence of motor block within six minutes after injection.<sup>(17)</sup> Three mL of 0.25% bupivacaine has also been used.<sup>(18)</sup>

In CSE, a possible procedure might consist of epidural injection of 1.5 mL of 2 % isobaric lidocaine when the spinal block extends below T11.<sup>(6)</sup> With a correctly inserted epidural catheter, the block height will increase by only approximately two segments. If the catheter has entered the spinal canal, the resulting block will not extend to a level causing diaphragmatic paralysis. However, the test dose may cause incremental blockade or impair balance and thus affect the patient's ability to walk safely in the early period after block placement. A test dose that includes 15 mcg of epinephrine causes a transient increase in heart rate during the first minute after intravenous injection. Cyclic changes in maternal heart rate during labor complicate this interpretation so the test dose should be given immediately after a contraction. Many anesthesiologists, however, have abandoned the routine use of the epinephrine test for position checking of the catheter. The use of multiple-orifice catheters, repeated aspiration and incremental drug injection decreases the risks of intravenously positioned local anesthetics.<sup>(19)</sup>

### **Extradural drug and dosage**

Maintenance of extradural analgesia may be accomplished using 0.125 % or 0.0625 % of bupivacaine with 2 mcg/mL of fentanyl boluses 10-15 mL, continuous infusion 8-10 mL/hr, or patient controlled extradural analgesia (PCEA). Other opioids such as sufentanil and alfentanil have also been used. The use of ropivacaine and L- bupivacaine, which have less effect on motor blockade, are currently being

studied.<sup>(3)</sup>

Continuous infusion of local anesthetics in the epidural space provides a more stable depth of analgesia, with the possibility of lowering the blood concentrations of local anaesthetic and lowering the incidence of hypotension compared with an intermittent top-up regimen.<sup>(20)</sup> It also reduced the risk of total spinal block in the presence of an inadvertent subarachnoid injection of local anaesthetic and produces lower blood concentration of local anesthetic if the catheter is accidentally placed in a vein. However, the continuous infusion technique is associated with a high incidence of motor block in late labor because administration of local anesthetic may be greater than the patient's requirements. Therefore, the technique of PCEA, for which the administration of the agent depends on the patient's demand, is advantageous. Significant advantages of PCEA are increased maternal satisfaction, feelings of self control, and a dose sparing effect compared with continuous extradural infusion. These advantages potentially enable the goal of safe ambulation during labor. However, some authors have found that PCEA pumps are unreliable in a walking population.<sup>(3)</sup>

The requirements of safe walking with regional block include normal muscle power, intact proprioception, intact visual and vestibular processes and a subjective feeling of the ability to walk. However criteria for safe ambulation remain controversial.<sup>(21)</sup> Most studies suggests that a modified Bromage, a test of proprioception such as Romberg's sign and a supervised trial walk should be the minimal test requirements. In any event, women should be supervised at all times and their walking should be supported by an appropriate adult in case

of unsteadiness.

### **CSE versus standard epidural analgesia**

There are ongoing debates on the advantages and disadvantages of CSE and on the benefits, costs, and risks of CSE versus standard epidural analgesia. Combined spinal-epidural analgesia is a more invasive technique than the epidural. The side effects are comparable with epidural technique, except for a higher incidence of pruritus and rare cases of respiratory depression in the case of CSE. As compared with continuous lumbar epidural analgesia, CSE is not associated with an overall decrease in the incidence of cesarean delivery.<sup>(22)</sup> Debate persists, however, because of the higher cost of CSE, while the labor progress and outcomes are similar.<sup>(23,24)</sup>

### **Advantages**

#### **Success rate:**

Epidural catheters inserted when using a CSE technique have a higher success rate than those inserted after an epidural.<sup>(25-27)</sup> However, the failure rate of the technique in experienced hands is minimally different from that for epidural analgesia.

#### **Speed of onset:**

The analgesic effect with CSE is more rapid in onset compared to epidural.<sup>(27)</sup> Although this is true from the time of injection, this difference is small. Nickells *et al*, found that the onset time to the first pain free contraction was not statistically different (10 minutes for the CSE vs. 12.1 minutes for the epidural).<sup>(28)</sup> This time difference generally represents only one or, at the most, two contractions in labor where the contractions are 3-4 times in ten minutes

and is further reduced if more preparation time is required. A meta-analysis of all available data may finally answer the question of speed of onset.

#### **Reliability:**

CSE is more reliable. Certainly it is more difficult to obtain a unilateral effect with a spinal injection compared to an epidural technique.

#### **Late, rapidly moving labor:**

CSE is effective in late, rapidly moving labor. If delivery occurs within 20 minutes of preparing the back for an injection, success with a spinal injection of opioid plus local anesthetic is more likely to be achieved than with an epidural technique.

#### **Safe ambulation:**

CSE produces minimal motor block and allows ambulation in early labor. Although in practice, many women lose interest in prolonged walking after pain relief, they can walk to the bathroom to attempt to void and avoid catheterization. There are also feelings of self control and satisfaction with the labor experience.<sup>(29)</sup> CSE is associated with more rapid cervical dilatation compared to epidural analgesia.<sup>(30)</sup> However, the effect of ambulation on labor is unclear; various reports have suggested an association between an upright position and shorter labor.<sup>(31)</sup> The safety and potential benefits of CSE compared with those of conventional epidural regimen have not been reported.<sup>(22,23,29,32)</sup>

### **Disadvantages**

#### **Complexity:**

CSE is a more invasive and complex a

technique than epidural alone.<sup>(7)</sup> Routine dural puncture with the spinal component of CSE may produce an increased incidence of post dural puncture headache (PDPH) but the pencil point needles used are associated with a relatively low rate of headache. There also be a relatively high incidence of failure to puncture the dura with the spinal needle, this occurs in approximately 5-10 % of cases using the "needle through needle" CSE technique, despite correct placement of the Tuohy needle in the extradural space.

#### **Cost:**

The cost of equipment for the CSE technique is greater as, at a minimum, an extra needle is required.<sup>(27)</sup>

#### **Untested epidural catheter:**

Using an untested epidural catheter in CSE may delay the identification of a poorly functioning epidural catheter, which might require replacement. Many avoid the CSE technique when they want to determine the efficacy of the epidural catheter rapidly such as in case of an emergent Cesarean section.<sup>(14)</sup>

#### **Side effects**

##### **Hypotension:**

Hypotension after CSE analgesia is evident within 15 min of injection. The reported incidence of hypotension is 0-32 % from spinal sufentanil alone and requires ephedrine treatment in 0-12 % of patients.<sup>(33,34)</sup> The mechanism of hypotension after spinal opioid is unclear. Pain relief and some degree of sympatholysis may be an explanation. However, the incidence and severity of hypotension with CSE

is comparable to that of epidural analgesia.<sup>(14,35)</sup>

##### **Fetal bradycardia:**

This phenomenon is always rapid in onset (occurring within 15 min of injection), transient (persisting less than 30 min), and accompanied by an increased frequency or intensity of contractions. A number of studies found no differences between the use of epidural (9 %) and CSE techniques (13 %) on the effect of FHR.<sup>(11,35)</sup> Several authors report fetal heart rate changes associated with this reduction in blood pressure. The mechanism is not known, but possible factors may be related to either a decrease in maternal cardiac output in the absence of hypotension or the abrupt reduction of maternal epinephrine because of quick pain relief with the continued presence of norepinephrine, causing substantial increased in uterine contractility, particularly during oxytocin augmentation which decreases uteroplacental blood flow.

The other mechanism of fetal bradycardia is the direct vagotonic effects of sufentanil on the fetal heart. Intravenous ephedrine is the first line of treatment, this may increase maternal cardiac output and catecholamine concentrations, and in few cases, terbutaline might be necessary. The fetal heart rate should always be monitored after CSE injection.<sup>(4)</sup>

##### **Respiratory depression:**

Respiratory depression associated with spinal injection of sufentanil or fentanyl occurs rapidly, within 20 minutes of injection with a 0.01 % to 0.1 % incidence and can be life threatening.<sup>(4)</sup> This risk may be greater when combined with small doses of bupivacaine or preceded by intravenous opioid.<sup>(36)</sup>

The rapid onset is due to the rapid spread of fentanyl and sufentanil in CSF to high cervical levels. The adequacy of respiration must be assessed for 20-30 minutes after spinal injection.<sup>(37)</sup>

### **Meningitis:**

There have been reported cases of meningitis associated with CSE.<sup>(38,39)</sup> Apparent risk factors include chemical contamination of equipment with sterilizing fluid and multiple extradural and dural punctures. However, it is not clear whether there is a genuinely increased risk of this complication with CSE compared with a single-shot spinal or whether it is an artifact of report.<sup>(7)</sup>

### **Insertion of extradural catheter into the CSF:**

A cadaveric study using Quincke-tipped needles showed that this was virtually impossible to force an 18-G portex epidural catheter through the dural hole made by 26-27G spinal needle<sup>(9)</sup>. Such cases are more likely to have occurred through inadvertent dural puncture with the Tuohy needle and therefore the risk of subarachnoid catheter insertion is the same whether CSE or extradural alone is used.

### **Headache:**

Davis *et al.* found no difference between epidural analgesia and CSE in the incidence of headache or postural headache.<sup>(40)</sup> The risk of postdural puncture headache from small size pencil-point needle is very low (under 1 %) and must be balanced against the risk from accidental puncture by an epidural needle (70-90 % with 16G Tuohy needle).<sup>(7)</sup> There may also be a protective effect against further loss of cerebrospinal fluid from the

injection of local anesthetic into the epidural space.<sup>(41)</sup>

### **Pruritus:**

Most patients suffer from pruritus after narcotic injection for CSE.<sup>(42)</sup> Higher incidence of pruritus was found in CSE (47 %) than in 7 % in epidural technique.<sup>(43)</sup>

### **Conclusions**

Regional analgesia, either conventional epidural analgesia or CSE, effectively relieves labor pain. However the absence of motor blockade and excellent sensory analgesia provided by CSE enables safe ambulation during labor, potentially increasing patient satisfaction. The rapid onset of analgesia with minimal intrathecal drug dosage and the ability to extend the level and duration of analgesia through the epidural catheter make CSE a reliable and effective method of labor pain relief. As a result, CSE may be more suitable than conventional epidural technique to eliminate the severe pain associated with late, rapidly moving labor. The side effects of CSE are comparable with epidural technique, except for a higher incidence of pruritus. The major disadvantages of the CSE is its high cost and 5-10 % incidence of failure to puncture the dura with the spinal needle in the "needle through needle" CSE technique.

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## กิจกรรมการศึกษาต่อเนื่องสำหรับแพทย์

ท่านสามารถได้รับการรับรองอย่างเป็นทางการสำหรับกิจกรรมการศึกษาต่อเนื่องสำหรับแพทย์  
กลุ่มที่ 3 ประเภทที่ 23 (ศึกษาด้วยตนเอง) โดยศูนย์การศึกษาต่อเนื่องของแพทย์ จุฬาลงกรณ์มหาวิทยาลัย  
ตามเกณฑ์ของศูนย์การศึกษาต่อเนื่องของแพทย์แห่งแพทยสภา (ศนพ.) จากการอ่านบทความเรื่อง  
"การใช้เทคนิคร่วม spinal epidural สำหรับระงับปวดระหว่างเจ็บครรภ์คลอด" โดยตอบคำถามข้างล่างนี้  
ที่ท่านคิดว่าถูกต้องโดยใช้แบบฟอร์มคำตอบท้ายคำถาม โดยสามารถตรวจจำนวนเครดิตได้จาก  
<http://www.ccme.or.th>

### คำถาม - คำตอบ

1. Which of the following is true regarding pain pathways during labor ?
  - a. During the second stage of labor, pain is secondary to dilatation of the cervix.
  - b. During the first stage of labor, pain is secondary to uterine contractions.
  - c. Pain from the cervix travels via the pudendal nerves.
  - d. Pain from the cervix enters the neuraxis at S2-S3 segments.
2. Which of the following is the most common side effect of combined spinal epidural analgesia for labor pain?
  - a. Hypotension
  - b. Pruritus
  - c. Fetal bradycardia
  - d. Headache
3. The ideal analgesic technique for labor pain is characterized by all of the following except.
  - a. Easy to perform
  - b. Abolish all of the pain
  - c. No effect on progress of labor
  - d. Adequate motor blockade

✂

คำตอบ สำหรับบทความเรื่อง "การใช้เทคนิคร่วม spinal epidural สำหรับระงับปวดระหว่างเจ็บครรภ์คลอด"

จุฬาลงกรณ์เวชสาร ปีที่ 48 ฉบับที่ 1 เดือนมกราคม พ.ศ. 2547

รหัสสื่อการศึกษาต่อเนื่อง 3-23-201-9010/0401-(1001)

ชื่อ - นามสกุลผู้ขอ CME credit..... เลขที่ใบประกอบวิชาชีพเวชกรรม.....

ที่อยู่.....

1. (a) (b) (c) (d)

4. (a) (b) (c) (d)

2. (a) (b) (c) (d)

5. (a) (b) (c) (d)

3. (a) (b) (c) (d)

4. All are the advantages of combined spinal epidural analgesia technique except:
- Rapid onset
  - Complete and reliable analgesia
  - Minimal motor blockade
  - Decrease incidence of cesarean delivery
5. Which of the following is the unreliable method to confirm the proper position of epidural catheter during labor?
- Loss of resistance technique
  - 3 ml of 2 % lidocaine
  - 15 mcg of epinephrine
  - Aspiration via multiple orifice epidural catheter.

**เฉลย** สำหรับบทความ รหัสสื่อการศึกษาต่อเนื่อง 3-15-201-2003/0312-(1046)

1. ค 2. ก 3. จ 4. จ 5. ค

สำหรับบทความ รหัสสื่อการศึกษาต่อเนื่อง 3-15-201-2003/0312-(1047)

1. ง 2. ง 3. ก 4. ค 5. จ

**ท่านที่ประสงค์จะได้รับเครดิตการศึกษาต่อเนื่อง (CME credit)  
กรุณาส่งคำตอบพร้อมรายละเอียดของท่านตามแบบฟอร์มด้านหน้า**

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