Advances in obstetric anesthesia: ambulation during labor with combined spinal-epidural analgesia

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Abstract
Epidural analgesia is widely considered as the most effective method of providing pain relief in labor. However, epidural labor analgesia is not a generic procedure and many technical modifications have been invented over time. Continuous search for a balanced labor analgesia, which provides relief of pain of contractions while preserving motor function, has led to the development of the ambulatory labor analgesia. The combined spinal-epidural analgesia (CSEA) performed with subarachnoid opioids (with or without local anesthetics) causes minimal motor block and is particularly applicable to ambulatory labor analgesia. While there still remains some concern about dural puncture, the CSEA technique offers many advantages to the parturient, and has gained wide spread popularity in obstetric anesthesia worldwide.

The advantages of CSEA
The combined spinal-epidural labor analgesia technique (CSEA) has attained wide spread popularity in obstetric anesthesia. In many centers it has begun to replace or has replaced traditional epidural techniques. While there still remains some concern about dural puncture, the CSEA technique offers many advantages to the parturient. Several authors have reported a very low incidence of post dural puncture headache (PDPH) associated with CSEA, which may reflect the fact that the epidural needle, which must be correctly placed first, serves as the introducer for the spinal needle, which then results in a one-time very small gauge dural puncture by the spinal needle. While there still remains some concern about dural puncture, the CSEA technique offers many advantages to the parturient, and has gained wide spread popularity in obstetric anesthesia worldwide.

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The optimal length of the spinal needle in CSEA

The distance from the tip of the epidural needle to the posterior wall of the dural sac in the midline varies from 0.30-1.05 cm. Furthermore, the anteroposterior diameter of the dural sac varies considerably during flexion and extension of the spinal column. Additionally, because the dural sac is triangular with its base resting on the vertebral body and the triangle apex pointing posteriorly to the ligamentum flavum, the above measurements are valid only when the epidural is performed in the midline. The length of protrusion of the spinal needle beyond the tip of the epidural needle for a successful CSEA placement has been the subject of significant debate, and at most institutions varies from 10-16 mm. Joshi et al. reported that the length of spinal needle protrusion should be more than 13 mm. On the other hand, Vandermeersch considers a protrusion of at least 17 mm to be optimal. The type of spinal needle may also influence the success rate of the CSEA.

A great variety of special CSEA needle sets are commercially available. Interestingly, in a European survey it was reported that special CSEA needle sets were used only by 31% of anesthesiologists. The remainder used their own combination of epidural needles and extra long spinal needles. The newly introduced Escoian CSEA needle set, allows a different exit point for the passage of the epidural catheter and the spinal needle. A “back eye” at the epidural needle curve near its bevel permits the passage of the spinal needle, while the epidural catheter enters the epidural space through the “regular” needle eye. The point of dural contact by the epidural catheter is thus at some distance from the dural hole, which might reduce the risk of epidural catheter penetration through the hole in the dura made with the spinal needle.

With the needle-through-needle CSEA technique, the tip of the spinal needle may scrape against the inner wall of the Tuohy-Schliff needle, and concern has been raised about the possibility of metal particles being carried into the subarachnoid space. However, Herman et al. could not find any evidence of metal particles produced by the needle-through-needle CSEA technique.

Ambulation during labor with CSEA

CSEA performed with subarachnoid opioids (with or without local anesthetic) causes minimal or no motor block and has been referred to as the “walking epidural”. At the University of California, San Diego, CSEA with both local anesthetics and opioids combined, has become the standard practice for ambulatory labor analgesia. The initial subarachnoid dose of bupivacaine 2.5 mg, and fentanyl 5-10 µg is extremely efficacious, abolishing most severe labor pain in 2-3 minutes. Although the initial dose is usually a low-dose mixture of local anesthetic and opioid, fentanyl or sufentanil alone may also be used. Sufentanil and fentanyl have been reported to cause fetal bradycardia (with higher incidence following subarachnoid administration of sufentanil); however, recent studies suggest the median effective dose (ED50) of subarachnoid sufentanil is less than 3 µg and have failed to demonstrate any fetal problems.

Palmer et al, in a retrospective study compared the incidence of fetal heart rate abnormalities after institution of two techniques of labor analgesia (either subarachnoid fentanyl or conventional epidural labor analgesia). Both techniques were associated with a low (6%-12%) incidence of fetal heart rate, and no difference in neonatal outcome was found.

For ambulatory labor analgesia the CSEA technique offers the possibility of combining rapid onset of subarachnoid analgesia with the flexibility of continuous epidural analgesia. This approach with the application of low-dose local anesthetic and/or opioid can provide a very selective sensory block with minimal motor blockade, allowing parturients to ambulate. Traditionally in clinical practice, the degree of motor block is assessed using the Bromage/modified Bromage scale. These scales attempt to quantify the power of various muscle groups of the leg, foot and thigh. To enable ambulation in labor, all muscle group innervated by the L5-S1 nerve roots should have normal or “nearly normal” power.

Many researchers have established that proprioceptive (dorsal column) functions can be selectively preserved with low-dose CSEA. To achieve this goal however, it is necessary to omit the traditional epidural test dose with lidocaine and epinephrine.

In the author’s practice at the University of California, San Diego, following placement of CSEA, the patient is monitored for 20 minutes (maternal blood pressure and external fetal heart monitoring). If she desires, and if the obstetrician, the nurse and the anesthesiologist agree, the patient is assessed for motor strength and the ability to ambulate. If the patient is able to get out of bed without assistance, she is then asked to stand and walk several steps across the room. After attempting ambulation, a deep knee bend (could the patient do this before CSEA placement?) and/or “modified” Bromage scale (ability to raise extended leg up from bed lying supine with left uterine displacement (LUD), ability to flex knee, and flex/extend ankle) are routinely utilized. The score from 0 to 3, where 0 = no paralysis, raises extended leg, full flexion of knee and ankle (full motor strength), 1 = inability to raise extended leg, able to move knee, 2 = inability to flex knee, able to flex ankle, and 3 = inability to move lower limb, is performed (Table 1).

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>No paralysis, raises extended leg, full flexion of knee and ankle (full motor strength)</td>
</tr>
<tr>
<td>1</td>
<td>Inability to raise extended leg, able to move knee</td>
</tr>
<tr>
<td>2</td>
<td>Inability to flex knee, able to flex ankle</td>
</tr>
<tr>
<td>3</td>
<td>Inability to move lower limb</td>
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Patients who have full motor strength may ambulate with assistance of an IV pole on one side and a support person (usually her nurse or her partner) on the other. Most patients usually walk around the room or to the bathroom, where they void, spending approximately 10-15 minutes out of bed on each occasion. If the patient is receiving an oxytocin infusion ambulation in close proximity to her bed or sitting in the armchair is usually recommended. It is very important to provide a suitable, safe environment for ambulating parturients (safe floors, no cables, and the like). To avoid epidural catheter displacement the anesthesiologist needs to ensure good fixation of the epidural catheter to the skin. Suitable remote, cordless fetal monitoring is recommended to ensure fetal well-being. Epidural maintenance of labor analgesia is usually achieved with a low-dose mixture of local anesthetics and opioids (0.0625% bupivacaine mixed with fentanyl 1.9 µg/ml, at the rate of 8-12 ml/hour). Combinations of bupivacaine with fentanyl or sufentanil have been the most studied maintenance solu-
As a test dose.

concentrations of local anesthetics, regarding the entire first dose when using a multiorifice epidural catheter and dilute abandoned the routine use of a standard lidocaine-epinephrine parturients who elect this option. Many anesthesiologists have should permit ambulation in the early post block period for most test dose and using 0.125% bupivacaine for the initial bolus turients, a similar incidence to that in their control group of fentanyl with bupivacaine, 0.5% test dose, which by itself might have af- included safe ambulation. However, critics of this study pointed out that all patients participating in the study also received a 3 ml bupivacaine, 0.1%, with 2-ug/ml, fentanyl during labor, the effect of which pre-cluded safe ambulation. However, critics of this study pointed out that all patients participating in the study also received a 3 ml bupivacaine, 0.5% test dose, which by itself might have af-lected sensory and motor function. In a subsequent study using an identical epidural bolus dose, but no test dose, Parry et al. reported abnormal dorsal column function only in 7% of par-turients, a similar incidence to that in their control group of patients who received subarachnoid fentanyl with bupivacaine as part of a CSEA technique. Cohen et al. in a randomized double-blind study found that omitting a lidocaine-epinephrine test dose and using 0.125% bupivacaine for the initial bolus should permit ambulation in the early post block period for most parturients who elect this option. Many anesthesiologists have abandoned the routine use of a standard lidocaine-epinephrine test dose when using a multiorifice epidural catheter and dilute concentrations of local anesthetics, regarding the entire first dose as a test dose.

The additional argument against traditional epidural test dose is the well-documented safety of continuous infusions of low-dose local anesthetic, or low-dose mixtures of local anesthetic and opioids for labor analgesia. Most likely, intravascular injection will result in no analgesia, with minimal adverse effects on the mother and fetus (signs of CNS toxicity and cardiovascular collapse would not occur). If the administration of local anesthetic/opioids solution is subarachnoid (or subdural), it is highly likely that a gradually increasing degree of motor block, with minimal loss of sympathetic tone will occur, with respira-tory depression being very rare. The omission of the traditional epidural test dose with 45 mg of lidocaine and 15ug of epinephrine may seem like a radical departure from traditional thinking. Nevertheless, if selective sensory block with minimal sym-pathetic block is desired, and motor function is to be preserved, then the omission of a traditional test dose is necessary. Based on the author’s experience, such an omission of a traditional test dose is safe. This is further supported by similar findings by Morgan at Queen Charlotte’s Hospital in London, England.

Use of the CSEA technique without the test dose for ambu-latory labor analgesia leaves the epidural catheter untested. Al-though some have expressed concern about the unknown func-tional status of the epidural catheter following subarachnoid drug injection, it has been well established that the epidural failure rate for the CSEA technique does not exceed that of conventional epidural analgesia for labor. However, prior to using the epidural catheter with greater concentrations of local anesthetic such as may be needed with a cesarean delivery a formal test dose should be administered.

The most common complications of CSEA technique for la-bor analgesia include pruritus, maternal hypotension, and fetal heart rate changes. The etiology of hypotension after subarachnoid opioid administration is unclear. Some authors have speculated that the sudden onset of analgesia may pro-duce hypotension, whereas others attribute a decrease in ma-ternal blood pressure to rapidly decreasing catecholamine lev-els in maternal blood. The hypotension, however, is generally minimal and is easily treated with CSEA analgesia. Addition-ally, several authors have recently reported uncommon compli-cations including aphasia, dysphagia, altered level of consciousness, high sensory block, respiratory depression, and respiratory arrest, following induction of CSEA for labor pain.

Conclusion
In summary, the CSEA technique for ambulatory analgesia in labor has a good record of efficacy and safety and can be accomplished with minimal or no side effects. Appropriate ma-ternal and fetal monitoring following administration of CSEA for ambulatory labor analgesia, as true of any kind of labor an-gesia, is recommended by the American Society of Anesthesiologists (Practice Guidelines for Obstetrical Anesthesia).

Bibliography


