

Obstetric Anesthesia CME Program

Module 1

CSA is offering a new CME program in obstetric anesthesia that will consist of four modules. The first module is offered in this issue of the *Bulletin* with the next three modules appearing in the next three issues.

Mark Rosen, M.D., is the editor and chair of this program. Dr. Rosen is professor and vice chair and director of the residency training program at the University of California San Francisco. He is also professor of obstetrics, gynecology and reproductive sciences, and director of obstetric anesthesia at UCSF.

Registration: The registration page and test questions for this module are at the end of this article. The 10 questions must be answered and submitted to the CSA in order to receive the CME credit. Your CME certificate will be mailed from the CSA office.

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Fees: This is a free service for CSA members. Nonmembers will be charged \$25 per CME credit hour.

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Availability: This module is available from March 31, 2007, until March 31, 2010.

Target Audience: This program is intended for all licensed physicians, including anesthesiologists, obstetricians, neonatologists, perinatologists, and residents.

Faculty and Disclosures for Module 1:

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For this program, Dr. Carvalho has no disclosures to make regarding any real or apparent conflicts of interest.

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Objectives: Upon completion of this activity, participants will be able to:

- Recognize potential benefits and limitations of PCEA for labor analgesia
- Apply PCEA settings to optimize labor analgesia
- Discuss local anesthesia options
- Understand future developments with labor epidural analgesia

Resources: These materials, including questions, are offered on the CSA Web Site at www.csahq.org. Instructions for the *Bulletin* version are on the registration page.

Patient-Controlled Epidural Analgesia for Labor

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Introduction

Patient-Controlled Epidural Analgesia (PCEA) for labor analgesia was first described by Gambling in 1988.¹ This approach offers many advantages over continuous epidural infusions (CEI) and intermittent bolus techniques.^{2,3} However, widespread adoption of PCEA into modern obstetric practice has been slower than expected and it is estimated that only 25 percent of obstetric practices in California utilize labor PCEA.⁴

The following topics will be reviewed:

1. Potential benefits and limitations of PCEA for labor analgesia
2. PCEA settings to optimize labor analgesia
3. Local anesthetic options
4. Future developments

1. Potential benefits and limitations of PCEA technique for labor analgesia

a. *Potential Advantage*

Local Anesthetic Consumption: Compared to CEI, studies have shown that PCEA decreases local anesthetic consumption during labor by 25 percent to 45 percent.⁵⁻⁷ This reduces lower extremity motor block, *may* improve expulsive forces during the second stage and possibly reduce the need for assisted vaginal delivery. However, these benefits are unproven.

Analgesia and Parturient Satisfaction: PCEA techniques are often associated with improved labor analgesia and maternal satisfaction.^{1,8} Improved maternal satisfaction is probably the result of better analgesia, greater patient autonomy and control over labor analgesia as well as less motor block.

Physician Interventions: **PCEA for labor analgesia reduces physician interventions by about 27 percent compared to CEI.**⁵ CEI requires the anesthesia care provider to alter or discontinue the infusion rate or administer additional local anesthetic boluses if maternal analgesia is suboptimal. With PCEA, women reduce the healthcare provider's workload by self-administering additional medication. The anesthesia provider is called if the parturient-administered boluses fail to provide effective analgesia. In our institution this occurs in less than 15 percent of laboring women.⁹ However, frequent anesthesia provider assessments are essential for any epidural technique.

b. Potential Disadvantages

For optimal success, it is important that women, obstetric nurses and midwives have a basic understanding of the self-administration PCEA technique. A detailed explanation of the technique must be provided after the initiation of epidural analgesia. For best results, patients must want to control their labor analgesia and desire the degree of autonomy that PCEA offers.

A potential disadvantage is excessive self-administration leading to local anesthetic overdose. This could potentially occur with repeated bolus demands due to the patient's poor understanding of the PCEA mechanism and its inherent delayed onset of analgesia (e.g., women with poor language skills or reduced mental capacity) or from a family member or nursing staff trying to be helpful and using the on-demand PCEA button instead of the laboring woman. However, use of dilute local anesthetic solutions and use of safety measures such as hourly volume limits and adequate lockout periods reduce the risk of local anesthetic overdose. The potential of local anesthetic toxicity also exists with CEI and intermittent techniques. Epidural pump malfunction is a potential risk with any epidural technique. However, the literature and clinical experience suggest that PCEA is extremely safe and well tolerated.

Cost and need to acquire specialized equipment cause some reluctance by clinicians and hospital management to adopt this technique. PCEA devices and disposables are made by a number of manufacturers with variable pricing. Reductions in initial equipment and disposable component costs often can be negotiated if epidural rates are high. Overall, the cost of PCEA is minimal compared to the total cost of childbirth. Furthermore, there are indirect cost savings from reduced physician and nursing workload. If links between local anesthetic consumption and the prolongation of labor and/or an increase in assisted deliveries were to prove true, then reducing local anesthetic use with PCEA may offer additional indirect cost savings.

2. PCEA Settings to Optimize Labor Analgesia

Laboring women are the best judges of their own analgesic requirements. PCEA allows each parturient to self-administer only the amount of local anesthetic ± opioid she requires for effective analgesia. In contrast to CEI techniques with pre-set infusion rates, PCEA allows each woman to titrate to her specific needs and pain threshold. PCEA minimizes medical personnel's interpretation of the parturient's analgesic requirements and decreases the possibility of relative under or overdosing when pain is interpreted through a third party.^{10,11}

a. The “Ideal” PCEA Settings

Many PCEA benefits depend on type and concentration of the drugs utilized, bolus dose, lockout time intervals, hourly dose limits and use of a continuous background infusion. There is a wide range of PCEA settings in clinical practice.⁴ Evidence-based recommendations for an “ideal” PCEA setting is very difficult, given that published studies investigating PCEA for labor analgesia have wide variations in settings, study design and clinical endpoints.⁵

Bernard et al.¹² found that increasing the bolus size improved parturient satisfaction even with use of the same total amount of local anesthetic. Similarly, we found a trend towards improved analgesia with larger (12 mL) volume PCEA boluses compared to smaller (6 mL) boluses.⁹ However, Gambling et al.¹³ did *not* find significant differences in pain control, satisfaction or analgesic supplementation with increasing PCEA bolus sizes. Other investigators report that shorter lockout times may be more efficient and reduce the need for rescue boluses.¹⁴

In summary, there is no “ideal” PCEA setting and a number of various regimens produce good labor analgesia (see some recommended settings below). Despite the uncertainty of the “ideal” PCEA setting, there is strong evidence that the PCEA technique offers many advantages over CEI or intermittent bolus techniques.⁵

b. Background Infusion

The use of a continuous background (basal) infusion with PCEA is controversial. Background infusions may reduce physician interventions and workload, improve labor analgesia and maternal satisfaction.¹⁵⁻¹⁸ Adding a basal infusion to the PCEA increases local anesthetic consumption,^{15,19-21} however the increase is clinically insignificant with dilute local anesthetic solutions.

A number of randomized studies have compared PCEA with or without basal infusions. To date, four studies¹⁵⁻¹⁸ show a benefit, and three studies¹⁹⁻²¹ show no advantage to adding a background infusion to a PCEA. Campbell et al.¹⁶ showed, in a cohort of 300 patients, that PCEA + CIEA utilizing 0.08% ropivacaine + 2 mcg/ml fentanyl, provides more effective labor analgesia with significantly fewer anesthesia care provider-administered supplemental “top ups” and greater maternal satisfaction with labor analgesia compared to PCEA alone. Missant et al.¹⁷ showed a similar decreased need for physician supplementary boluses with basal infusions. In contrast, Boselli et al.²¹ found that background infusions conferred no benefit in analgesia or side effects despite increasing local anesthetic consumption during labor. Different settings and local anesthetic concentrations make comparisons among studies difficult.

PCEA for Labor (cont'd)

In our experience, omitting or reducing the basal infusion results in an unacceptable number of inadequately managed labor analgesia and frequent calls for physician supplementary boluses. In addition, the background infusion during prolonged labor allows patients to sleep without interruption from severe pain and the need to bolus. If a basal infusion is used with a PCEA, Ferrante et al.¹⁵ recommend using 33 percent of the maximum hourly demand dose as a continuous background infusion.

c. *Suggested Settings*

- At Lucile Packard Children's Hospital, Stanford, California, we initiate the epidural analgesia with 15 mL 0.125% bupivacaine + 10 mcg sufentanil and use a maintenance solution of 0.0625% bupivacaine + 0.3-0.4 mcg/mL sufentanil. Our PCEA settings are as follows: a continuous basal infusion of 10-15 mL/h, a 10-12 mL PCEA on-demand bolus and a 12-15 min lockout period with 3-4 boluses permitted per hour.
- Mark Rosen (UCSF, California) initiates epidural analgesia with a test dose (3 mL 1.5% lidocaine with 15 mcg epinephrine) followed by 8 mL 0.08% bupivacaine + 100 mcg fentanyl, then uses a maintenance solution of 0.08% bupivacaine + 2 mcg/mL fentanyl. PCEA settings: basal infusion = 8 mL/h, on-demand bolus = 8 mL with an 8 min lockout period. Maximum volume/h is set at 32 mL.
- Robert D'Angelo (Wake Forest University Hospital, North Carolina) uses a maintenance solution of bupivacaine 0.125% + fentanyl 2 mcg/mL. PCEA settings are as follows: 5-10 mL/h basal infusion, a 5 mL PCEA on-demand bolus with a 10 min lockout period.

When designing a PCEA scheme for your clinical practice, it is important to consider your parturient population (education, cultural considerations) and their expectations for labor analgesia. PCEA settings also should be tailored to each institution's need and anesthetic care providers' practices.

3. Local Anesthetic Options

a. *Type of Local Anesthetic*

Studies comparing PCEA bupivacaine and ropivacaine suggest that ropivacaine may reduce the incidence of motor block, particularly when labor is prolonged.²²⁻²⁴ However, the relative potencies of bupivacaine and ropivacaine were not always considered (ropivacaine is 40 percent less potent than bupivacaine²⁵) and less motor block was often associated with decreased analgesic efficacy, especially during the second stage of labor.^{22, 24} When relative potencies of ropivacaine and bupivacaine are considered, differences in motor

block are minimal and selection of ropivacaine based on selective motor sparing is questionable.²⁶ Studies comparing PCEA ropivacaine and bupivacaine for labor analgesia show no differences in clinically important endpoints including operative delivery or neonatal outcome.^{22-24,27-29} Although the risk of cardiovascular local anesthetic toxicity is theoretically reduced with newer local anesthetics (e.g., ropivacaine and levobupivacaine), local anesthetic toxicity in the obstetric setting is exceedingly rare in modern obstetric practice with use of dilute local anesthetic solutions and careful epidural bolus titration. Only one study described the use of levobupivacaine for labor PCEA. This small study reported similar analgesic efficacy and no significant differences between 0.1% levobupivacaine with 2 mcg/mL fentanyl and 0.1% ropivacaine with 2 mcg/mL fentanyl.³⁰

In light of the greater cost associated with ropivacaine and questionable benefit with motor block and toxicity,²⁶ most clinicians choose not to use ropivacaine as their standard local anesthetic. In a recent survey we conducted, less than 10 percent of obstetric anesthesia practices in California utilize ropivacaine.⁴

b. Local Anesthetic Concentration

Dilute local anesthetic solutions offer advantages over more concentrated ($\geq 0.25\%$ bupivacaine) infusions. In particular, motor block and the risk of instrumental vaginal delivery may be reduced.³¹⁻³³ The COMET study found that more dilute solutions used in CEI were more labor intensive and were associated with increased anesthetic call back.³¹ However, no study using PCEA in labor has shown any difference in the need for physician supplementary boluses with dilute compared to higher concentration of local anesthetic solutions. The majority of obstetric anesthesia practices in California utilize bupivacaine at 0.125% concentration as their preferred PCEA or CEI solution.⁴ The use of epidural opioid, e.g., fentanyl or sufentanil, facilitates significant local anesthetic dose reduction without compromising analgesia.

“Ultra-light,” such as $\leq 0.125\%$ bupivacaine solutions (e.g., bupivacaine 0.0625%), may have additional benefits.³³ Although some clinicians feel that “ultra-light” local anesthetic concentration may be less effective and slower in relieving pain after a patient on-demand bolus, studies suggest that this is not true. Boselli et al.³⁴ found no differences in pain scores and maternal satisfaction with 0.1% ropivacaine with sufentanil compared to 0.15% ropivacaine with sufentanil, despite 30 percent more local anesthetic consumption in the 0.15% ropivacaine group. Similarly, Weineger et al.³⁵ found equal analgesia and greater satisfaction, despite less drug use, when comparing PCEA deploying 0.0625% bupivacaine with opioid versus 0.25% bupivacaine alone. Bernard et

al.³⁶ similarly showed that dilute concentrations are as effective as high local anesthetic concentrations, even as labor progresses.

Larger volumes of more dilute local anesthetic appear to be more effective for labor epidural analgesia than smaller volumes of higher concentration.^{37,38} However, Bernard et al.³⁶ suggest that the effectiveness of PCEA is dependent on drug mass rather than the volume or concentration. At Stanford University, we utilize large volume “ultra-light” local anesthetic solutions with our PCEA technique. This technique provided excellent analgesia with minimal physician workload and a high incidence (approximately 78 percent) of spontaneous delivery.⁹

4. Future developments

Computer integrated-PCEA: Computer integrated-PCEA is a novel drug delivery system that automatically titrates the background infusion rate based on the individual woman's need (recently developed by KK Women's and Children's Hospital, Singapore).^{39,40} Their computer integrated-PCEA titrates the background infusion to 5, 10 or 15 mL/h if the patient required one, two or three demand boluses, respectively, in the previous hour and decreases the background infusion by 5 mL/h if there were no bolus demands in the previous hour. A system that responds automatically to patients' needs may prove beneficial and their initial studies show potentially less breakthrough pain and higher maternal satisfaction.^{39,40}

Programmed Intermittent Epidural Bolus: Wong et al. showed that PCEA techniques using programmed intermittent epidural bolus resulted in greater maternal satisfaction, less need for physician rescue bolus administration and less bupivacaine use compared to PCEA with a continuous background infusion.⁴¹ Programmed intermittent epidural bolus has also been shown to be more effective than CEI for labor analgesia.⁴² A mechanism proposed for the bupivacaine-sparing effect of programmed intermittent boluses compared to CEI is a more uniform epidural spread of local anesthetics when large volumes of local anesthetic with correspondingly high injectate pressures are delivered.⁴³

Conclusion

In conclusion, PCEA offers many advantages over CEI or intermittent bolus techniques for the maintenance of labor analgesia. Dilute local anesthetic solutions with opioids reduce motor block without compromising analgesia. There are no “ideal” PCEA settings and a number of various regimens produce good labor analgesia. PCEA reduces physician workload and can facilitate the provision of effective labor analgesia in busy obstetric units.

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PCEA for Labor (cont'd)

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Questions

1. The use of patient-controlled epidural analgesia (PCEA) for labor analgesia was first described in:
 - a. 1970
 - b. 1983
 - c. 1988
 - d. 2003
2. Current availability of labor PCEA in California obstetric practices is estimated to be approximately:
 - a. 10 percent
 - b. 25 percent
 - c. 50 percent
 - d. 75 percent
3. Compared to continuous epidural infusions (CEI) for labor analgesia, PCEA is associated with all of the following EXCEPT:
 - a. Decreased local anesthetic use
 - b. Greater maternal satisfaction
 - c. Increased physician workload
 - d. Improved labor analgesia
4. Compared to CEI, use of PCEA can decrease local anesthetic use during labor up to 45 percent.
 - a. True
 - b. False
5. Background infusions with labor PCEA:
 - a. Decreases local anesthetic consumption
 - b. Decreases anesthesia provider supplemental epidural boluses
 - c. Increases breakthrough pain
 - d. Is not recommended
6. Concentrated local anesthetic solutions (e.g., greater than 0.25% bupivacaine) with or without opioid are necessary to maintain adequate labor analgesia.
 - a. True
 - b. False

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In this issue of the *Bulletin*, Module 1 of the new Obstetric Anesthesia CME Program is available. Modules 1 through 4 will be available on the CSA Web Site www.csaHQ.org. The online module is a self-assessment so you can complete the test and evaluation, and then print your CME certificate right then. You also may contact the CSA office at 800-345-3691, and we will send you the materials by fax or mail.

PCEA for Labor (cont'd)

7. Compared to local anesthetic epidural infusions (e.g., greater than 0.25% bupivacaine), advantages of infusions with opioid and more dilute solutions (e.g., less than or equal to 0.125% bupivacaine) include:
 - a. Decreased local anesthetic use
 - b. Decreased motor block
 - c. Comparable analgesia
 - d. All of the above
8. Physicians and nurses are better at assessing laboring women's analgesic requirements than the woman herself.
 - a. True
 - b. False
9. Compared to CEI, potential limitations of PCEA for labor analgesia include:
 - a. Greater equipment and supply cost
 - b. Requirement for women to take control of their labor analgesia
 - c. Requirement for more detailed explanation at initiation
 - d. All of the above
10. PCEA offers many advantages over both CEI and intermittent bolus techniques for the maintenance of labor analgesia.
 - a. True
 - b. False

Evaluation of Module 1

As part of the CSA Educational Programs Division's ongoing efforts to offer continuing medical education, the following evaluation of this program is requested. This is a useful tool for the EPD in preparing future CME programs.

1. How well were the learning objectives of this program met?

Very Well	5	Above Average	4
Average	3	Below Average	2
Not Well at All	1		
2. How relevant was the information in this program to your clinical practice?

Very Relevant	5	Above Average	4
Average	3	Below Average	2
Not Relevant	1		
3. How would you rate this program overall?

Excellent	5	Above Average	4
Average	3	Below Average	2
Poor	1		
4. Did you detect any commercial bias in this module?

Yes		No	
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