

After initiating neuraxial labor analgesia, there are many techniques that can be used to maintain analgesia for the duration of labor. Both continuous infusion and patient-controlled epidural analgesia (PCEA) are associated with certain undesirable effects. Programmed intermittent epidural bolus (PIEB) appears to have the advantage of greater spread within the epidural space and therefore better sensory blockade.

But we have still have some questions: What are the main advantages of PIEB compared to other techniques (e.g. continuous infusion and classical PCEA)? What are the "hints" to obtain these advantages: the optimal drug combination, appropriate pump settings (bolus amount, bolus interval, lockout time) are yet to be defined. How to organize the PIEB in high-volume centers? Last, but not least, a question which is important –not only– for the "developing" countries: is it-cost-effective? Do you have any hints to convince the health-insurance-system about its cost-effectiveness?

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Editor

Programmed Intermittent Epidural Boluses (PIEB) for Maintenance of Labor Analgesia: A Superior Technique to Continuous Epidural Infusion?

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Continuous epidural infusions (CEI) of local anesthetics with patient-controlled epidural analgesia (PCEA) is the most popular method of maintaining epidural labor analgesia in the United States (1). However, over a decade ago, evidence began to emerge showing that epidural pumps programmed to deliver intermittent epidural boluses (PIEB) of local anesthetic provide more effective analgesia than CEI (2-4). The suggested mechanism of superior epidural analgesia with PIEB compared to CEI is greater spread of anesthetic solution within the epidural space, and therefore better sensory blockade compared to CEI. These clinical observations are consistent findings of more uniform spread with large volumes and correspondingly high injectate pressures in cadavers (5), and observations of greater dye solution spread in semi-absorbent paper with boluses compared to continuously infused solution (despite the same hourly volume being administered) (6). The importance of bolus administration of epidural local anesthetics with or without opioids may also explain why PCEA compared to CEI reduces the need for manual clinician boluses for breakthrough pain, and decreased amount of local anesthetic used (7), and why PIEB regimes with larger boluses and longer lockouts (10 mL every 60 min) are more effective than smaller boluses and shorter lockouts (2.5 mL every 15 min) (8).

All studies that have compared PIEB with CEI for labor epidural maintenance have found either better or equivalent analgesic and obstetric outcomes with PIEB. Specifically, studies have shown a local anesthetic sparing effect, shorter duration of labor, and improvements in maternal satisfaction with PIEB compared to CEI (9). However, while clinical studies have clearly demonstrated superiority of PIEB over CEI, we must question how important these differences are. The local anesthetic-sparing effect with PIEB compared to CEI from meta-analysis data of pooled comparative studies was found to be 1.2 mg of bupivacaine per hour (95% CI, -2.2, -0.3) (9). That dose sparing difference is the equivalent to 1 ml of 0.125% bupivacaine per hour. While this local anesthetic difference reaches the threshold of statistical significance, is this 1 mL per hour difference clinically important? In comparison, adding opioids into the local anesthetic solution has a much greater impact on reducing local anesthetic consumption (10). The epidural delivery technique is comparatively less important for local anesthetic sparing than the concentration of local anesthetic epidural solution utilized.

An advantage of less local anesthetic use and wider spread of local anesthetic solution with PIEB is less motor block. This can result in better maternal expulsive efforts during the second stage of labor, and potentially lead to a shorter second stage and reduce the requirements for instrumental delivery. A meta-analysis of PIEB compared to CEI for labor analgesia found that on average the use of PIEB was associated with a 12 minute shorter second stage (9). The clinical significance of this difference is

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unknown. There is no consistent finding that the spontaneous vaginal delivery rates are improved, or if instrumental or cesarean delivery rates are impacted. There were no differences in cesarean delivery (odds ratio 0.87; 95% CI, 0.56-1.35) or instrumented delivery (odds ratio 0.59; 95% CI, 0.35-1.00) in the George et al. (9) meta-analysis comparing PIEB and CEI studies. Only one study by Capogna et al. (11) (that was designed to show difference in obstetric outcomes) found a significant improvement in the spontaneous vaginal delivery rate with PIEB compared to CEI. We acknowledge that decreased local anesthetic use with PIEB compared to CEI should lead to less motor block that may facilitate better expulsive effort, and reduce the chance of an assisted delivery. However, the impact of PIEB compared to CEI on instrumental delivery rates appears very small and institutional obstetric practices likely have a much bigger influence on these rates than epidural technique.

A clinically important outcome measure in studies comparing epidural techniques is maternal satisfaction. Studies consistently demonstrate that PIEB is associated with superior maternal satisfaction. The mean maternal satisfaction scores in four studies that recorded this outcome was 85 out of 100 in the CEI group and 92 out of 100 in the PIEB group (9). The difference of 7 (95% CI, 6.2-7.8) out of 100 reported is however very small and likely of modest clinical significance; although we appreciate that satisfaction scores that start out high are difficult to improve.

It remains uncertain if PIEB improves labor pain relief or reduces requirements for manual supplementary epidural boluses compared to PIEB. When we implemented PIEB into our practice, we retrospectively found that there was a modest decrease in maximal pain scores experienced by our patients, a slight decrease in unilateral blocks, and a reduction from 19% to 12% of patients requiring manual supplementary boluses of local anesthetics (by the anesthesia team for breakthrough pain not relieved by the PCEA function of the epidural pumps) (12). However, this decrease in workload is small, and at our institution would result in the need to intervene on one less patient's epidural catheter every day when using PIEB instead of CEI. The meta-analysis by George et al. did not find a difference in anesthesia interventions (odds ratio 0.56; 95% CI, 0.29-1.06) with PIEB compared to CEI (9).

Now that PIEB pumps with PCEA capabilities are commercially available, many obstetric anesthesia practices are contemplating adopting this new technology. The modest benefits of PIEB compared to CEI for maintenance of labor analgesia need to be considered against the cost and implementation logistics of adopting PIEB epidural pumps. The cost is likely negligible if your institution is already considering replacing current CEI pumps, and we would recommend that epidural pumps with PIEB and PCEA functionality should be acquired in preference to other epidural pumps. However, if CEI pumps were recently acquired, then switching to PIEB pumps is probably not justified. Additionally, the optimal settings for PIEB are not yet known, so late adopters of PIEB will benefit from the experiences of early adopters. Despite theoretical safety concerns, to date, there does not appear to

be any additional risk associated with PIEB versus CEI, however with widespread use, PIEB safety concerns may become evident. Fortunately, experience with PCEA suggest safety concerns when utilizing dilute local anesthetic solutions are unwarranted.

In conclusion, PIEB is an exciting new technique that appears to improve the maintenance of epidural labor analgesia compared to CEI. Potential advantages with PIEB include local anesthetic sparing, shorter duration of labor, and improvements in maternal satisfaction. However, the observed differences with PIEB compared to CEI are very modest and of limited clinical impact, and these potential advantages need to be considered against the cost and implementation logistics of adopting PIEB epidural pumps. The PIEB technique should only be considered an incremental improvement over CEI for the maintenance of epidural labor analgesia.

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