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ORIGINAL ARTICLE

Patient-controlled epidural analgesia: the role of epidural fentanyl in peripartum urinary retention

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Background: Urinary bladder function is impaired during labor and delivery, predisposing to urinary retention. The effect of low-dose epidural opioid on bladder function remains unclear. We tested the hypothesis that adding low-dose fentanyl to epidural ropivacaine for patient-controlled labor analgesia does not promote urinary retention.

Methods: Laboring women who requested patient-controlled epidural analgesia were randomly assigned in a double blind study to 0.2% ropivacaine (R-group, $n = 100$) or 0.2% ropivacaine with fentanyl 2 μg/mL (RF-group, $n = 98$). Urinary bladder distension was assessed clinically every hour. The post-void residual urine volume was measured by ultrasonography. Urine volume exceeding 100 mL was drained by catheterization. Bladder volume of $\geqslant 300$ mL, as determined by catheterization was considered as evidence of urinary retention.

Results: Thirty percent of the patients in each group developed urinary retention during labor. There was no statistically significant difference between the groups. There was an excellent correlation between bladder volume as estimated by ultrasonography and that by catheterization: catheterization volume = 0.93 × ultrasound volume + 25; $r^2 = 0.83$. The bias (mean error) was -1 ± 99 mL and the precision (average absolute error) between the ultrasound estimate and actual bladder volume determined by catheterization was 58 ± 79 mL.

Conclusion: Addition of fentanyl to patient-controlled epidural analgesia did not increase the risk of urinary retention. Ultrasound measurements were effective and reliable in assessing urinary bladder volumes during labor.

Keywords: Anesthesia; Obstetrics; Epidural analgesia; Patient-controlled analgesia; Urinary retention; Urinary bladder catheterization; Urinary infection

INTRODUCTION

Urinary bladder function is impaired during pregnancy and delivery, predisposing parturients to urinary retention,[1,2] need for repeated bladder catheterizations, infection[3] and even irreversible detrusor muscle damage.[4] The effect of epidural local anesthetics on bladder function during labor remains controversial. Some studies were unable to find any effect[5] while others have shown distinct impairment.[6] However, most studies reported an increased incidence of hypotonic bladder and urinary retention during labor with epidural analgesia compared to labor without labor epidural analgesia.[7–9]

Systemic meperidine administration does not promote urinary retention.[10] In contrast, intrathecal or epidural opioids are associated with a 21-53% incidence of peripartum urinary retention,[10–12] as are epidural local anesthetics.[7–9] The effect of low-dose

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epidural opioid on bladder function remains unclear because the putative adverse opioid effects may be counterbalanced by reduced local anesthetic requirement. For example, including opioids in a local anesthetic mixture for labor epidural analgesia or using opioids in a combined spinal-epidural technique reportedly does not increase the incidence of urinary retention.[13]

Clinical assessment of urinary retention in labor is difficult and there is no consensus as to the magnitude of the bladder volume required for diagnosis of peripartum urinary retention.[14] Post-micturition bladder volume has traditionally been measured by bladder catheterization, carrying the imminent risk of urinary tract infections.[3] Transabdominal ultrasonography for assessment of residual urine volume is noninvasive and well-validated in the peripartum period.[15–17] However, the technique has not yet gained common acceptance during labor when distortion of bladder anatomy by the fetus may preclude accurate ultrasound measurements. Nevertheless, its use has decreased the incidence of unnecessary bladder catheterizations during labor by 27%.[15]

We determined the effects of patient-controlled epidural analgesia (PCEA) with and without fentanyl on the incidence of peripartum (labor and post partum period) urinary retention, using clinical and ultrasound estimates of urinary bladder volume.

METHODS

The Institutional Human Investigation Committee at Wolfson Medical Center approved this study, and each participant gave written informed consent. Between February and October 2003, we prospectively enrolled 210 ASA I or II primiparous women in early labor at term with a singleton cephalic presentation and cervical dilatation <5 cm, requesting labor epidural analgesia. We excluded patients with ASA $\geqslant$ III, preeclampsia, morbid obesity (BMI > 35 kg/m^2), diabetes, a history of drug or alcohol abuse, urinary bladder pathology, hepatic or renal disease, coagulopathy or cesarean delivery, or a predicted newborn weight exceeding 4500 g.

Protocol

All women were randomized to receive labor epidural analgesia with either 0.2% ropivacaine (R-group) or 0.2% ropivacaine plus 2 μg/mL fentanyl (RF-group). Randomization was based on computer-generated codes that were maintained in sequentially numbered opaque envelopes until just before use. Investigators and patients were blinded to treatment allocation.

Before the establishment of labor epidural analgesia, 7 mL/kg of lactated Ringer's solution was infused intravenously over a 20-min period. An epidural catheter was inserted at the L3-L4 interspace using loss of resistance to saline with the patient sitting. A multi-orifice epidural catheter was threaded 2-3 cm into the epidural space. After confirming there was no aspiration of blood or cerebrospinal fluid, 1.5% lidocaine 3 mL without epinephrine was injected through the epidural catheter in both groups. The women were then immediately turned to the left lateral position. Five minutes later, if there were no signs of subarachnoid or intravascular injection, 10 mL of the designated epidural solution (ropivacaine alone or ropivacaine with fentanyl) was injected epidurally in 5-mL increments over 10 min.

Analgesia was maintained throughout labor and delivery with PCEA (PCAM syringe pump model P 500, IVAC Medical System, New Hampshire, USA) using a continuous epidural infusion with a 5-mL/h basal infusion rate and 5-mL patient-controlled boluses of plain ropivacaine 0.2% or ropivacaine 0.2% plus 2 μg/mL fentanyl, with 20-min lockout interval (20 mL/h limit). The anesthesiologists recording study measurements and the patients were blinded to the presence or absence of fentanyl in the epidural solution, as the syringes were labelled with code numbers only. Patients requesting additional analgesia received a 10-mL bolus of the study solution in 5-mL increments using the PCEA device; this bolus was included in the 20-mL/h dose limit. Patients remained in bed for the duration of the study.

Based on previous reports of 21-53% (mean 33%) incidence of urinary retention during epidural analgesia for labor and our clinical experience, this study provides 80% power to detect a 50% relative reduction (or 16.5% reduction) in the urinary retention rate for those who received ropivacaine alone compared with those who received ropivacaine with fentanyl.

Measurements

Before epidural injection, patients were instructed to void. Urinary bladder volume was assessed clinically by inspection and palpation by an anesthesiologist blinded to the study drug by bimanual palpation, as this method is a commonly accepted practice. Baseline values were not recorded as these parturients where not known to have urinary problems. When retention was suspected, patients were asked to void and the residual urine volume was estimated by ultrasonography (Toshiba SSA – 220A, Tochibi, Japan) with a 3.5-MHz abdominal curvilinear probe within 2 min of voiding. Two experienced ultrasonographers performed the ultrasound examination. The residual volume was estimated using two orthogonal diameters of the urinary bladder.[16]