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ORIGINAL ARTICLE

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The effect of bupivacaine with fentanyl temperature on initiation and maintenance of labor epidural analgesia: a randomized controlled study

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ABSTRACT
Background: Labor epidural analgesia is highly effective, but can be limited by slow onset and incomplete blockade. The administration of warmed, compared to room temperature, bupivacaine has resulted in more rapid onset epidural anesthesia. We hypothesized that the administration of bupivacaine with fentanyl at 37°C versus 20°C would result in improved initial and ongoing labor epidural analgesia.
Methods: In this prospective, randomized, doubled blinded study, 54 nulliparous, laboring women were randomized to receive epidural bupivacaine 0.125% with fentanyl 2 μg/mL (20 mL initial and 6 mL hourly boluses) at either 37°C or 20°C. Pain verbal rating scores (VRS), sensory level, oral temperature, and side effects were assessed after epidural loading (time 0), at 5, 10, 15, 20, 30, 60 min, and at hourly intervals. The primary outcome was the time to achieve initial satisfactory analgesia (VRS $\leqslant$3). Secondary outcomes included ongoing quality of sensory blockade, body temperature and shivering.
Results: There were no differences between groups in patient demographics, initial pain scores, cervical dilatation, body temperature or mode of delivery. Epidural bupivacaine at 37°C resulted in shorter mean (±SD) analgesic onset time (9.2 ± 4.7 vs. 16.0 ± 10.5 min, $P = 0.005$) and improved analgesia for the first 15 min after initial bolus ($P = 0.001$–0.03). Although patient temperature increased during the study ($P < 0.01$), there were no differences between the groups ($P = 0.09$). Six (24%) and 10 (40%) patients experienced shivering in the 37°C and 20°C groups, respectively ($P = 0.23$).
Conclusions: The administration of epidural 0.125% bupivacaine with fentanyl 2 μg/mL at 37°C versus 20°C resulted in more rapid onset and improved labor analgesia for the first 15 min. There was no evidence of improved ongoing labor analgesia or differences in side effects between groups.

Keywords: Epidural; Labor analgesia; Bupivacaine; Fentanyl; Temperature; Obstetric

Introduction

The epidural technique is considered among the most effective forms of labor analgesia; however, the initial onset can be 15–25 min, and ongoing analgesia may be associated with breakthrough pain and shivering.[1–3] The combined spinal–epidural (CSE) and dural-puncture epidural techniques can provide more rapid onset and reliable analgesia than the epidural technique,[4] but require dural puncture and the CSE technique has been associated with fetal bradycardia, greater analgesic requirements after initial dosing[5,6] and higher rates of neurological sequelae.[7]

Epidural administration of warmed, compared to room temperature, bupivacaine results in a surgical anesthetic blockade that has more rapid onset with more adequate anesthesia.[8,9] We hypothesized that administration of initial and hourly boluses of body (37°C) versus room (20°C) temperature 0.125% bupivacaine with fentanyl 2 μg/mL would improve initial and ongoing epidural labor analgesia. We also sought to determine if the incidence of shivering and the elevation in maternal temperature associated with epidural labor analgesia would be altered.

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Methods

The Brigham and Women's Hospital (BWH) Human Research Committee/Institutional Review Board approved the study. Healthy, nulliparous women with a single, vertex presentation fetus at term (38–42 weeks) and intact fetal membranes or ruptured membranes for $\leqslant$6 h were eligible to participate. Exclusion criteria included the presence of systemic disease (e.g. pre-eclampsia, hypertension, diabetes mellitus), contraindications to an epidural technique, an allergy or idiosyncratic reaction to local anesthetic or opioid medications, an increased risk of cesarean delivery (e.g. trial of labor after cesarean delivery, history of uterine rupture), evidence of anticipated fetal anomalies, clinical signs or symptoms of infection, a baseline temperature >37.6°C, and last cervical dilation assessment of >5 cm at time of epidural request.

Subject recruitment was performed upon patient admission to the labor and delivery unit by one of the study investigators (HS, LT, SY). Following written informed consent, patients were randomized by a computer-generated random numbers table, with assignments placed into opaque sealed envelopes, to receive epidural 0.125% bupivacaine with fentanyl 2 μg/mL at either body (37°C) or room (20°C) temperature. An 18L Thermo Scientific Heratherm compact Microbiological Incubator (50-125-590H, No.:50125590; temperature stability ±0.2°C, Thermo Scientific, Waltham, MA, USA) was placed on a cart at the patient's bedside. An anesthesia provider not involved in patient assessment set the incubator to 37°C or 20°C based on the randomization schema and taped an opaque card over the digital thermometer readout. Syringes (20 mL) of our pharmacy-prepared labor analgesia solution and vials of 0.25% bupivacaine 10 mL, 1.5% lidocaine 10 mL and 0.9% saline 10 mL were placed inside the incubator. Medication syringes were kept in the incubator at the randomized temperature for at least one hour before administration to ensure that the desired solution temperature was achieved and were not removed until immediately before administration.

Upon request for analgesia, a 19-gauge epidural catheter with a single, open-end hole (Arrow FlexTip Plus®, Arrow International, Reading, PA, USA) was placed 5 cm into the epidural space through a 17-gauge Tuohy–Weiss needle via loss-of-resistance to saline (<2 mL at room temperature) at the L3-4 or L4-5 interspace with the patient in the sitting position. An intravenous fluid bolus (lactated Ringers solution 250 mL at room temperature) was given simultaneously with the initiation of the epidural technique. After securing the epidural catheter, patients were moved to the left lateral decubitus position.

Patients received an initial 20 mL epidural bolus in fractionated doses over 5 min by an anesthesia provider not involved in patient assessment, followed by manual administration of 6 mL boluses of the same solution every hour for continuing analgesia. Patients were assessed by a blinded study investigator (who did not set the incubator or administer the epidural bolus) for sensory and motor block, pain, and other effects (i.e., shivering, sweating, nausea, pruritus) immediately after completion of the initial 20 mL epidural dose (time 0), at 5, 10, 15, 20, 30, 60 min and at hourly intervals thereafter before the hourly bolus. Sensory block was evaluated by a patient verbal rating scale (VRS) for pain ranging from 0 to 10 (0 = no pain and 10 = worst pain imaginable) and with the use of a non-traumatic pinprick stimulus starting caudad and moving cephalad in the mid-clavicular line until patient reported feeling "sharp". Motor blockade was assessed with the modified Bromage scale (0 = no motor block, 1 = partial flexion of knees and full flexion of ankles, 2 = inability to flex knees, 3 = inability to flex knees and ankles). Shivering (0 = none, 1 = intermittent mild tremor, 2 = continuous intense tremor), sweating (0 = none, 1 = forehead moisture detected, 2 = visible beads of sweat), nausea (0 = none, 1 = mild, 2 = moderate/severe), and pruritus (0 = none, 1 = mild, 2 = moderate/severe) were assessed. Hypotension was defined as a decrease in systolic BP to <90 mmHg or a symptomatic decrease (e.g. light-headedness) from baseline and treated with intravenous ephedrine 10 mg or phenylephrine 80 μg at the discretion of the anesthesiologist. Oral temperature was recorded at time 0, 15, 30 min and at every hour thereafter with thermometers affixed to the labor room wall (SureTemp®Plus, Welch Allyn, Skaneateles Falls, NY, USA). Fever was defined as a temperature >38°C.

Analgesia onset was defined as the time to achieve a VRS $\leqslant$3: inadequate analgesia was defined as a VRS >3. Inadequate analgesia occurring after 30 min from epidural initiation was treated with an additional 6 mL bolus of the labor analgesia solution, followed by 6 mL of 0.25% bupivacaine if the VRS was >3 after 15 min; persistent inadequate analgesia was treated with 6 mL of 0.25% bupivacaine or 1.5% lidocaine, or replacement of the epidural catheter. The study endpoint was vaginal delivery or decision to undergo cesarean delivery. All patients were evaluated on the first post-delivery day for headache, backache, persistent block, or paresthesia.

Statistical analysis

The primary outcome was the time to achieve initial satisfactory analgesia. The number of subjects needed to show a 20% reduction in analgesia onset time was based on a study by Mehta et al.,[8] which observed a reduction in mean time to reach a T10 sensory block (100°F, 11.2 ± 2.0 min vs. 70–72°F, 15.2 ± 2.2 min, $P < 0.0001$) with the administration