Obstetrical and Pediatric Anesthesia

Body habitus does not influence spread of sensory blockade after the intrathecal injection of a hypobaric solution in term parturients

[L'habitus corporel n'influence pas l'étendue du blocage sensitif qui suit l'injection intrathécale d'une solution hypobare chez des parturientes à terme]

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Purpose: To determine if the extent of sensory blockade after the intrathecal injection of hypobaric fentanyl (25 µg) and bupivacaine (2.5 mg) in the sitting position in term parturients is influenced by body habitus.

Methods: A prospective observational study in 245 term parturients who received intrathecal fentanyl and bupivacaine plus an epidural test dose to initiate labour analgesia at an academic university hospital. The highest sensory blockade to ice and pinprick was determined at 15 and 30 min after the intrathecal injection. Correlations between sensory blockade and parturient height, weight and body mass index (BMI) were determined.

Results: There was no association between highest sensory blockade and parturients' height. Increasing weight and BMI were associated with increased cephalad sensory blockade at 15 min, but not at 30 min. The estimated difference in sensory level between women at the extremes of BMI, based on our linear regression model, was less than one dermatome.

Conclusion: Height did not influence the extent of sensory analgesia after initiation of intrathecal labour analgesia using a hypobaric solution injected with the parturient in the sitting position. Weight and BMI were associated with a non-clinically significant increase in the cephalic spread of analgesia, suggesting that dose adjustments based on body habitus in this population are not necessary.

Objectif: Déterminer si l'étendue du blocage sensitif, suivant l'injection intrathécale de fentanyl (25 µg) et de bupivacaine (2,5 mg) hypobares en position assise chez des parturientes à terme, est influencée par l'habitus corporel.

Méthode : Une étude par observation a été menée dans un centre hospitalier universitaire auprès de 245 parturientes à terme qui ont reçu du fentanyl et de la bupivacaine intrathécaux en plus d'une dose test épidurale pour amorcer l'analgesie du travail. Le blocage sensitif maximal à la glace et à la piqure d'épingle a été déterminé à 15 et 30 min après l'injection intrathécale. Les corrélations entre le blocage sensitif et la taille, le poids et l'index de masse corporelle (IMC) de la parturiente ont été déterminées.

Résultats : Aucun lien n'a été trouvé entre l'intensité du blocage sensitif et la taille de la patiente. Une hausse de poids et d'IMC a été associée à une hausse du blocage sensitif en direction céphalique à 15 min, non à 30 min. La différence estimée de niveau sensitif entre les femmes d'IMC extrêmes, fondée sur notre modèle de régression linéaire, a été de moins d'un dermatome.

Conclusion : La taille ne modifie pas l'étendue de l'analgesie sensitive qui suit l'injection intrathécale d'une solution hypobare chez les parturientes en position assise. Le poids et l'IMC sont associés à une hausse non cliniquement significative de l'extension de l'analgesie en direction céphalique, d'où la suggestion que des ajustements de la dose à l'habitus corporel ne soient pas nécessaires chez cette population.

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STUDIES have found little correlation with adult patient height, weight or body mass index (BMI) and level of sensory block after subarachnoid anesthesia with iso- or hyperbaric local anesthetic solutions injected in the lateral position, except at extremes of adult height.¹⁻³ There are reports of sensory blockade of cranial nerves after initiation of labour analgesia as part of a combined spinal-epidural (CSE) technique in the sitting position when using hypobaric local anesthetic/opioid solutions.^{4,5} This implies that some parturients may have extensive cephalad spread with standard analgesic regimens.

The effect of body habitus on the dermatome spread of sensory analgesia after the intrathecal injection of hypobaric analgesic solutions has not been studied. We hypothesized that height, weight and BMI do not influence cephalad sensory spread in parturients who receive an intrathecal injection of a hypobaric solution in the sitting position. The primary purpose of this study was to determine whether the cephalad sensory level after the intrathecal injection of a hypobaric solution of bupivacaine and fentanyl injected in the sitting position is influenced by height, weight, or BMI. A secondary objective was to determine if lateral positioning after the intrathecal injection influenced the sensory level.

Methods

Following Institutional Review Board approval, written informed consent was obtained from 255 healthy term parturients with singleton pregnancies who requested neuraxial labour analgesia. Patients with contraindications to neuraxial analgesia, diabetes mellitus, or vertebral musculoskeletal abnormalities were excluded. Parturients received a 500-mL *iv* bolus of lactated Ringer's solution prior to initiation of analgesia. CSE analgesia was initiated with the parturient in the sitting position at the L2-3 or L3-4 interspace using a needle through needle technique with a 27-gauge $\times$ 127 mm pencil-point spinal needle with the orifice directed cephalad. After observing free flow of cerebrospinal fluid (CSF), an intrathecal 1-mL bolus of fentanyl 25 μ g and bupivacaine 2.5 mg (0.5 mL of fentanyl 50 μ g·mL⁻¹ and 0.5 mL of bupivacaine 0.5%) was injected over ten seconds. An epidural catheter was threaded through the epidural needle and an epidural test dose was administered (1.5% lidocaine with epinephrine 1:200,000 – 3 mL). After securing the epidural catheter, the parturient assumed the right or left lateral position for the duration of the study. Parturients assumed the lateral position, with their head on a standard pillow, between four to six minutes after the intrathecal injection. The head of the bed

remained flat for the 30-min study period. Parturients who remained sitting for more than six minutes were excluded from the study.

Dermatome level sensory testing was performed in the left and right midclavicular line using ice and an 18-gauge needle at 15 and 30 min after the intrathecal injection. Testing started at the T12 level and progressed cephalad until the parturient first noted the sensation of cold or pinprick. If there was a difference in sensory level between the right and left sides, the higher level was used for data analysis. Maintenance epidural analgesia infusion was begun following the 30-min assessment.

The density of the fentanyl-bupivacaine solution was measured in 12 randomly selected samples. Density was determined gravimetrically using a 2-mL calibrated pycnometer and a precision balance (Mettler, Inc., Toledo, OH, USA) at 37°C. Baricity was calculated by dividing the measured density of the solution by the density of CSF of a term parturient at 37°C.⁶

The sample size calculated for this study ($n = 255$) was determined to achieve 90% power to detect a difference of -0.2 between the null hypothesis correlation of zero and the alternate hypothesis correlation of 0.2 using a two-sided hypothesis test with a significance level of 0.05. This level of association between the primary outcome variable (cephalad sensory spread) and height, weight, and BMI was similar to that observed in a study of the influence of body habitus and sensory spread after the intrathecal injection of isobaric bupivacaine.⁷ Pearson's correlations and linear regression were used to determine the association between height, weight, BMI and the cephalad sensory level. The right *vs* left sensory levels were compared using the Wilcoxon signed ranks test. The sensory level of parturients placed in the left *vs* right lateral position was compared with the Mann-Whitney U test. A $P < 0.05$ was required to reject the null hypothesis.

TABLE Parturient characteristics

Height (cm)	166 $\pm$ 7
Age (yr)	44 $\pm$ 4
Weight (kg)	78 $\pm$ 13
Body mass index (kg·m ²)	28.4 $\pm$ 4.5
Gestational age (weeks)	39 $\pm$ 1
Gravidity	2 (1-8)
Parity	1 (0-4)
Cervical dilation at intrathecal injection (cm)	4 (2-8)
Left lateral positioning after intrathecal injection (%)	54

Data presented as mean $\pm$ SD or median (range).

Results

Data were analyzed for 245 parturients. Ten parturients were excluded because of failure of CSE analgesia or because they remained sitting for greater than six minutes after the intrathecal injection. Parturient characteristics are summarized in the Table. All parturients had complete analgesia (verbal rating pain score ≤ 1) during the 30-min study period. There was no difference in sensory level to cold and pinprick between the right and left sides. In no study subject was the sensory level difference between the right and left sides more than one dermatome.

Height did not correlate with the cephalad sensory level to cold or pinprick. BMI and weight were weakly

correlated with cold and pinprick at 15-min (Figures 1 and 2). No correlations or differences were found at 30-min. There were no differences in the sensory level to ice or pinprick between parturients placed in the right or left lateral position at 15 or 30 min.

The measured density of the fentanyl-bupivacaine solution was $0.99725 \pm 0.00008 \text{ g}\cdot\text{mL}^{-1}$, less than the lower limit of density necessary for a solution to be hypobaric when injected into the CSF (density $< 1.00018 \text{ g}\cdot\text{mL}^{-1}$) of a term parturient.⁶ The calculated baricity of the fentanyl-bupivacaine solution was 0.99695.

FIGURE 1 Relationship of highest level of dermatomal sensory loss to cold (ice) stimulus 15 min after the intrathecal injection of bupivacaine 2.5 mg and fentanyl 25 µg.

FIGURE 2 Relationship of highest level of dermatomal sensory loss to pinprick stimulus 15 min after the intrathecal injection of bupivacaine 2.5 mg and fentanyl 25 µg.

Discussion

The initiation of CSE labour analgesia is often performed with the parturient in the sitting position, and therefore the influence of body habitus, as well as gravity and the time spent in the upright position, may alter the distribution of the drug(s). In previous studies of term pregnant women, no linear correlation was found between patient height, weight, or BMI and the cephalad sensory level of anesthesia with the intrathecal injection of either hyperbaric or isobaric bupivacaine in the lateral position.¹⁻³ However, the spread of neural blockade after the intrathecal injection of patients in the lateral position is less likely to be influenced by gravity/baricity than when injected with patients in the sitting position.

The important findings of this study are the lack of clinically significant association of body habitus and the cephalad sensory level after intrathecal injection of a hypobaric solution for the initiation of labour analgesia in the sitting position. Although increased weight and BMI were associated with a higher sensory level, the estimated difference in sensory level between women at the extremes of BMI, based on our linear regression model, was less than one dermatome. This difference is unlikely to be clinically significant and suggests that dose adjustments are not necessary based on BMI. Similar to the results of the current study, several studies in non-pregnant adults found increased BMI was associated with a higher cephalad sensory level when local anesthetic solutions were administered at doses necessary for surgical anesthesia.⁷⁻¹¹

There was a large variability in cephalad sensory levels following intrathecal injection of a hypobaric solution in the current study, similar to studies of isobaric and hyperbaric solutions. There have been several small series of case reports in which parturients had sensory blockade of cranial nerves after initiation of CSE analgesia.^{4,5} Only one (weight = 104 kg) of five parturients reported by Hamilton⁵ and none of the two parturients reported by Abu Abdou⁴ were obese. This supports the conclusion that height and weight are not predictors of parturients at risk for unusually high cephalad spread of sensory blockade and suggests that factors other than body habitus determine the spread of sensory analgesia. For example, Carpenter *et al.* found that lumbosacral CSF volume predicts the extent of the sensory blockade after hyperbaric lidocaine.¹² A possible mechanism for the higher spread of sensory block in parturients with increased BMI's is that increased abdominal mass causes epidural venous engorgement, leading to impingement of the dura upon the subarachnoid space, thus decreasing the lumbosacral CSF volume.¹³

A limitation of the current study is that the time spent by the parturient in the sitting position was within a two-minute range, but was not fixed. Although this difference may have influenced the cephalad spread of the hypobaric solution, this time frame mimics the clinical situation, since the epidural catheter is inserted and secured prior to placing the parturient in the lateral position. An additional limitation was the administration of an epidural test dose, since volume in the epidural space may influence spread of intrathecally-injected drugs by mechanically displacing CSF.¹⁴

In conclusion, height did not influence the extent of sensory analgesia after initiation of CSE labour analgesia using a hypobaric solution injected with the parturient in the sitting position. Weight and BMI were associated with a non-clinically significant increase in the cephalic spread of analgesia, suggesting that dose adjustments based on body habitus in this population are not necessary, and may not prevent the occasional blockade of cranial nerves.

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