Improved epidural analgesia in the parturient in the 30° tilt position

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Purpose: To compare the incidence of incomplete analgesia when epidural local anesthetic is administered with the parturient supine in a 30° leftward tilt or in the left lateral decubitus position.

Methods: After placement of a multiorifice catheter 5 cm into the epidural space, 293 women in active labour were randomly positioned either to the left lateral decubitus position (lateral group) or supine with a 30° leftward tilt (tilt group) and then received 13 mL bupivacaine 0.25%. The success of the epidural block was determined by asking the patient if she required additional medication 15 min later. The incidence of complications (fetal heart rate decelerations, hypotension, and ephedrine usage) was noted.

Results: In the lateral group, 38% required additional medication compared with 24% in the tilt group ($P = 0.006$). There were no differences between groups in the incidence of maternal hypotension or fetal heart rate decelerations, but more women (10%) received ephedrine in the lateral than in the tilt group (4%), $P = 0.035$.

Conclusions: Placing the parturient supine with a 30° leftward tilt is associated with a greater success rate of labour epidural analgesia without an increase in complications than in women in the left lateral decubitus position. This advantage should be considered when positioning the parturient after epidural catheter placement.

Objectif : Comparer l'incidence d'analgésie incomplète lorsqu'un anesthésique local épidural est administré chez une parturiente installée en décubitus dorsal, inclinée à 30° vers la gauche, ou en décubitus latéral gauche.

Méthode : Après la mise en place d'un cathéter à orifices multiples à 5 cm dans l'espace épidural, 293 femmes en travail actif ont été installées, en décubitus latéral gauche (groupe latéral), ou en décubitus dorsal avec une inclinaison de 30° vers la gauche (groupe incliné) et ont reçu 13 mL de bupivacaïne à 0,25 %. La réussite du blocage épidural a été établie en demandant aux patientes, 15 min plus tard, si l'analgésie était suffisante. L'incidence de complications (décélération de la fréquence cardiaque fœtale, hypotension et usage d'éphédrine) a été notée.

Résultats : Dans le groupe latéral, 38 % des femmes ont demandé des médicaments supplémentaires en comparaison de 24 % dans le groupe incliné ($P = 0{,}006$). Il n'y a pas eu de différence intergroupe quant à l'incidence d'hypotension maternelle ou de décélération de la fréquence cardiaque fœtale, mais davantage de femmes (10 %) ont reçu de l'éphédrine dans le groupe latéral, comparé au groupe incliné (4 %), $P = 0{,}035$.

Conclusion : L'installation d'une parturiente en décubitus dorsal, inclinée à 30° vers la gauche, comparée à la position de décubitus latéral gauche, est associée à un taux de succès plus élevé d'analgésie épidurale pendant le travail sans complications additionnelles. C'est un avantage à considérer quand on cherche une position appropriée pour une parturiente après la mise en place d'un cathéter épidural.

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EPIDURAL analgesia is widely used to alleviate labour pain. To avoid aortocaval compression with a resultant decrease in blood pressure after the placement of an epidural catheter and administration of local anesthetic, the parturient should not be positioned supine.[1] Commonly, a wedge with a 30° angle is placed under the right hip to displace the uterus from the great blood vessels.[2] Nonetheless, fetal heart rate decelerations occur when the patient is in this position. Some believe that occult aortocaval compression occurs when the parturient is in this position which can lead to fetal heart rate decelerations, and have therefore recommended that the parturient should be positioned in the left lateral decubitus position.[3]

Three studies have assessed if patient position effects the quality of analgesia in the parturient.[4-6] Two did not contain a control group[4,5] and they all included a relatively small number of patients: their results have been inconclusive. The primary purpose of this study was to determine if there is a difference in the incidence of incomplete analgesia when local anesthetic is administered into the epidural space for labor analgesia while the parturient is positioned in the left lateral decubitus position *vs* supine with left uterine displacement. Additionally, we assessed the incidence of complications (fetal heart rate decelerations, hypotension, and ephedrine usage) between the two groups.

Methods

The protocol was approved by our institutional review board and written informed consent was obtained from each patient prior to the onset of painful contractions. Women in active labour who were having contractions at least once every five minutes and who requested epidural analgesia were enrolled in this prospective randomized study. Women with spinal column disorders including scoliosis and herniated discs, and women who had undergone spine surgery, were excluded from participation.

Prior to placement of the epidural catheter the patient was asked to quantify her level of pain on a verbal 0 to 10 scale with zero representing "no pain" and 10 the "worst pain imaginable." All patients received a 500 to 1000 mL fluid bolus of a crystaloid solution *iv* as per our protocol. All epidural catheters were placed with the woman in the sitting position. Using an 18-gauge Hustead needle, the epidural space was identified via a midline approach at the L_{2-3} or L_{3-4} interspace using the loss-of-resistance-to-air technique. Then, a 20-gauge multiorifice catheter was threaded through the cranially directed tip of the epidural needle to a depth of 5 cm into the epidural space. No local anesthetic was injected through the epidural needle before epidural catheter placement.

The patient was then positioned either on her left side (lateral group) or supine with a 30° leftward tilt (tilt group) depending on group assignment. Maternal position was standardized by placing the patient completely on her left side in the lateral group and by placing the same firm foam bolster with a 30° incline under the patient's right hip in the tilt group. A computer generated random numbers program was utilized to assign patients to each group. The results of the randomization were sealed in opaque envelopes and opened sequentially by the anesthesiologist after the woman requested labor analgesia.

After positioning, attempts to aspirate blood or cerebrospinal fluid (CSF) via the catheter were made using a 3 mL syringe. If blood was aspirated the procedure was repeated at another interspace: if CSF was aspirated the study was concluded. If there was no aspirate, a 3 mL test dose of bupivacaine 0.25% without epinephrine was administered through the catheter. The presence of clinical signs of an intravascular injection were sought for the following two to three minutes by asking the woman if she felt dizzy, had tinnitus, or had a metallic taste in her mouth. Five minutes after the test dose, if there were no clinical signs of subarachnoid injection as evidenced by the woman's ability to move her legs and the absence of hypotension, an additional 10 mL bupivacaine 0.25% were administered in two divided doses five minutes apart. If there were clinical signs of an intravascular or subarachnoid catheter placement the patient was withdrawn from the study.

The adequacy of analgesia was assessed 15 min after the last dose of local anesthetic had been administered (25 min after the test dose) by asking the woman at the peak of a contraction if she required additional medication to treat pain. She was asked to indicate only if she required additional medication for pain, not pressure. If she verbalized that she needed additional medication she was asked to point to the location of the pain. The presence and location of any non-anesthetized area was confirmed by the anesthesiologist using an alcohol preparation to detect differences in cold perception. Confirmed unsatisfactory sensory blockade was classified as complete (failed epidural) if the patient had no areas of sensory blockade, and incomplete if the patient had missed segments of analgesia. All women (those who required additional medication and those who did not) were asked to rate their level of pain on the same verbal pain scale. Analgesia was considered adequate if the patient

reported that she did not require additional medication. The highest dermatomal level of analgesia was assessed in all women with an alcohol preparation on both the right and left side of the abdomen.

If the patient had a missed segment 15 min after the last dose of medication, women in the lateral group were turned supine with a 30° leftward tilt and an additional 5 mL bupivacaine 0.25% were administered and the patient was reassessed 15 min later. Women in the tilt group who had a missed segment also received an additional 5 mL bupivacaine 0.25% but their position was not changed. If the patient was still in pain after this dose, the epidural catheter was replaced and the study was concluded. Patients who needed catheter replacement were excluded from the analysis of incomplete analgesia.

Blood pressure was measured on the upper arm in all patients and was recorded every three minutes during the study period. Hypotension was defined as a greater than 20% decrease in systolic BP from baseline value during the 25 min study period. Treatment with ephedrine was at the discretion of the anesthesiologist. Fetal heart rate was monitored throughout the study, using either a Doppler ultrasound transducer or fetal scalp ECG electrode and any evidence of severe fetal heart rate decelerations, defined as a fetal heart rate < 100 beats·min^{-1}, were recorded.

Statistical analyses

A power analysis, performed before the study was initiated, revealed that enrolling 266 women would provide 80% power to detect a two-fold increase in the incidence of inadequate analgesia between the groups assuming a 15% incidence of incomplete analgesia in the tilt group and 30% in the lateral group. This was based on a two tail test at the 5% level of significance. Differences between groups were analyzed with the chi square test or Wilcoxon rank sum test, as appropriate. Differences were considered statistically significant at $P < 0.05$.

Results

We enrolled 377 patients and studied 300. Patients were not studied either because they did not request an epidural anesthetic or because they requested analgesia when the research team was unavailable. Of the 300, seven were excluded because of protocol deviations. The most common protocol deviation was administering an incorrect volume or concentration of bupivacaine. Of the 293 women who participated in the study, 149 were randomized to the lateral group and 144 to the tilt group. Three patients (all randomized to the tilt group) were not included in the analysis of incomplete analgesia, hypotension, ephedrine use, or catheter replacement because of fetal heart rate changes that mandated changing the maternal position before the 15 min evaluation, but were included in the analysis of fetal heart rate changes. No patient was excluded because the epidural catheter was threaded into the subarachnoid space, nor was any patient excluded because of the presence of clinical signs of an intravascular or subarachnoid placement following the test dose. Six patients (four in the lateral group and two in the tilt group), required catheter replacement and were not included in the analysis of incomplete analgesia. This left 145 patients in the lateral group and 139 parturients in the tilt group for the analysis of incomplete analgesia. Demographic data and initial labor characteristics of the two groups are presented in Table I.

No woman had a failed epidural. At 15 min, more women in the lateral group required additional medication (n=55, 38%) than in the tilt group (n=33, 24%), $P = 0.008$. The results remained the same after controlling for parity and cervical dilation in the analysis. Overall, the pain scores were higher in the lateral group than in the tilt group, $P = 0.003$, and the pain scores were higher in those who did not have adequate analgesia *vs* those who had adequate analgesia in both Groups. Among patients requiring more medication, the most common location of the pain was on the right side at the T_{12} or L_1 dermatome (Table II). In the lateral group, the median highest dermatome level of analgesia was T_9 and T_{10} on the right and left side, respectively, $P = 0.0001$, and in the tilt group the median highest dermatome level of analgesia was T_9 and T_8 on the right and left side, respectively, $P = 0.0359$.

Hypotension occurred in eight patients (5%) in the lateral group and in seven patients (5%) in the tilt group, but more women received ephedrine in the lateral group (n=15, 10%) than in the tilt group (n=6, 4%), $P = 0.026$. Fetal heart rate decelerations occurred six times (4%) in the lateral group and seven times (5%) in the tilt group. Catheter replacement was required in four cases (3%) in the lateral group and in two cases (1%) in the tilt group.

Discussion

We found that when women were positioned supine with a 30° left tilt they had a greater incidence of adequate analgesia 15 min after the last dose of local anesthetic is administered than when they are positioned on their left side. The incidence of inadequate analgesia and the spread of local anesthetic when a patient is positioned on the left side *vs* supine with a leftward tilt has not been satisfactorily addressed previously. In the

TABLE I Patient demographic and labor characteristics*

	Lateral group	*Tilt group*
n	149	144
Position	Left lateral decubitus	Supine with 30° tilt
Age (yr)	33 (18-41)	32 (19-43)
Height (cm)	165 (150-180)	164 (127-178)
Weight (kg)	75 (51-120)	74 (56-157)
Primiparous (%)	48	49
Pitocin use (%)	82	92
Initial pain score (0-10)	7 (3-10)	7 (3-10)
Cervical dilatation at epidural catheter placement	2 (0-7)	2 (0-6)

* Data are presented as median and range

TABLE II Success rate and location of inadequate analgesia

	Lateral Group	*Tilt Group*	*P*
n	145	139	
Position	Left lateral decubitus	Supine with 30° tilt	
Additional medication	55 (38%)	33 (24%)	0.006
Overall pain score at 15 min†	2 (0-10)	1 (0-10)	0.003
Pain score in those who required additional medication†	5 (1-10)	4 (2-10)	0.53
Pain score in those who did not require additional medication†	0.5 (0-6)	0 (0-5)	0.36
Location of pain*			
Right	30 (51%)	19 (54%)	
Middle	20 (34%)	10 (29%)	
Rectum	4 (7%)	2 (6%)	
Left	5 (8%)	4 (11%)	
Dermatomal level of pain*			
T_8 through T_9	1 (2%)	3 (9%)	
T_{10} or T_{11}	12 (22%)	6 (17%)	
T_{12} or L_1	34 (58%)	20 (57%)	
L_2 through -L_4	8 (14%)	3 (9%)	
S_2 through-S_4	3 (5%)	3 (9%)	
Replaced catheters	4 (3%)	2 (1%)	

* In patients who required additional medication

† Data are presented as median and range

non-pregnant patient presenting for surgery two separate investigators found a higher dermatomal level of analgesia on the dependent side of the abdomen.[7,8] These patients all received large volumes (15-20 mL) of concentrated local anesthetics (lidocaine 2% or bupivacaine 0.75%). The results should not be extrapolated to the parturient receiving smaller volumes of more dilute local anesthetics.

Norris *et al.*[9] found no differences in the quality or highest dermatomal level of anesthesia on the dependent side of the abdomen when the parturient was positioned on her side while receiving an epidural anesthetic for Cesarean delivery. However, they studied women undergoing Cesarean delivery, who tend to receive a greater volume of a more concentrated local anesthetic than is usually administered during labour. Rolbin *et al.*[4] and Husemeyer and White[5] found a higher dermatomal level of analgesia on the dependent side of the abdomen in the parturient who received an epidural anesthetic for labour while positioned in the lateral decubitus position. Rolbin *et al.*[4] enrolled 34 patients and used lidocaine 1.5%, and Husemeyer and White enrolled 100 women and used bupivacaine 0.25%. However, neither study[4,5] utilized a control group, and in both studies the medication was administered via the epidural needle rather than via the catheter. In addition, both investigators enrolled too few patients to make any definitive conclusions.

Shapiro *et al.*[6] did not find a difference in pain scores among women randomized to different positions dur-

ing the administration of epidural medication. One group received epidural medication while positioned supine with a 20° tilt, a second group received epidural medication while on their left side and 10 min later were turned supine with a 20° tilt, and a third group received the epidural medication while on their left side and five minutes later were turned to the right side and five minutes after that were turned supine with a 20° tilt. The study period continued after the patient was supine. A major flaw with this study is that all patients were supine during the evaluation period and any effect of patient position on the spread of local anesthetic and subsequent pain scores may have been mitigated.

Eberle *et al.*[10] noted a greater incidence of asymmetric blocks in women placed in the left lateral decubitus position than in those positioned supine with 30 tilt. However, their study was primarily designed to assess the effect of maternal position on fetal heart rate abnormalities and not incomplete analgesia, so a formal evaluation of the quality of the block, (pain scores, dermatomal levels, etc.,) was not reported.

Defining adequate analgesia in the context of the woman in labour is complex. Some parturients expect complete pain relief, whereas others prefer to experience some pain so that they can participate more fully in the labour experience. We defined adequate analgesia as one where the patient did not request additional medication at the peak of a contraction 15 min after the last dose of local anesthetic. Clinically, anesthesiologists administer more medication based on patient request and not based on the results of a pain score. However, for completeness, we also assessed a pain score at 15 min.

We found that women in the lateral group requested additional medication (38%) more often than women in the tilt group (24%). Our overall incidence of inadequate analgesia (31%) after the initiation of labour epidural analgesia, although seemingly high, is consistent with the results of previous studies that have carefully assessed the incidence of incomplete analgesia after the initiation of labour epidural analgesia.[11,12]

The etiology of unblocked dermatomes after the placement of an epidural catheter and administration of local anesthetic is unknown. Proposed theories include slow injection of small volumes of local anesthetic, presence of an epidural septum, midline adhesions, placement of the epidural catheter through an intervertebral foramen, and placement of the epidural catheter into the anterior epidural space.[13] We have also confirmed that patient position plays a role in determining the spread of local anesthetic. Women in the lateral group had incomplete analgesia more often than women in the tilt group, and in both Groups the highest dermatomal level of analgesia was significantly higher on the left side than the right.

Although we found that the initial analgesia was better when the supine position with 30° leftward tilt was utilized, administering additional medication and changing patient position corrected the problem in most women. Only four catheters in the lateral group and two in the tilt group required replacement. We excluded these six women from the analysis of incomplete analgesia because the incomplete analgesia may have been related to a technical problem with catheter placement and unrelated to patient position. Labour pain can be distressing to the parturient and it is best if the pain can be treated as quickly as possible without additional medication or catheter manipulation. It is possible that if we had waited more than 15 min after the last dose of bupivacaine, 25 min after the test dose, our success rate may have been greater. However, for ethical reasons, we did not want to expose the patient to more than 25 min of inadequate analgesia prior to ending the study protocol. Furthermore, Eisenach *et al.*[14] found that the onset of action of 10 mL bupivacaine 0.25% is 8.7 ± 0.8 min, so that 15 min should have been adequate.

We were unable to document a difference between groups in the incidence of fetal heart rate decelerations during the study period. This evaluation was performed during the study period by the anesthesiologists and we only sought obvious (fetal heart rate < 100 beats·min^{-1}) decelerations. More subtle decelerations may have been detected if the analysis had been done after delivery by an obstetrician blinded to group assignment. Our results are different from those of Preston *et al.*[3] who found a greater incidence of severe fetal heart rate decelerations when women were positioned supine with left uterine displacement (15%) than when placed in the left lateral decubitus position (0%). They enrolled only 73 patients in their study and used a one-tailed statistical test to check for difference between groups and, as they acknowledged, the possibility of a sampling error leading to a type 1 error in a small study sample should be considered.[3] Our results are consistent with those of Eberle *et al.*[10] who also did not notice a difference in fetal heart rate decelerations between those placed supine with leftward tilt and those placed on their left side.

We were unable to find a difference between groups in the incidence of hypotension (5% in both groups), but ephedrine was administered more often in the lateral group. Overall, the incidence of ephedrine use (n=21, 7%) was greater than the incidence of hypotension (5%). Clinically, anesthesiologists may treat decreases in systolic BP that are less than a 20% decline from baseline. Ephedrine use was

greater in the lateral group than in the tilt group. Since ephedrine use was not standardized or controlled, it is difficult to determine from our study design why this was the case.

Although many anesthesiologists use lower concentrations of local anesthetics with an opioid for epidural labour analgesia, bupivacaine 0.25% is still commonly used and we wanted to study the impact of patient position without the influence of opioids. The results of our study, however, are limited to the conditions of the current study, i.e., 13 mL of bupivacaine 0.25%.

In conclusion, placing the patient supine with a 30° leftward tilt for 15 min after the administrations of 13 mL bupivacaine 0.25% is associated with a greater success rate of epidural analgesia without an increase in complications as compared to those placed in the left lateral decubitus position.

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