

# Maintenance of the parturient in the left lateral position after spinal anesthesia with plain levobupivacaine for cesarean section reduces hypotension: a randomized study

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## Summary

**Purpose of Investigation:** Hypotension during spinal anesthesia is a main concern in cesarean delivery. The authors hypothesized that keeping parturients in a prolonged left lateral position before turning them to a supine position with left lateral tilt would reduce the incidence of hypotension without jeopardizing the quality of anesthesia. **Materials and Methods:** Randomized comparative unblinded prospective study. This randomized comparative prospective study was conducted at Gaziantep University Hospital between June and December 2011. Sixty parturients undergoing cesarean section were included. Patients were randomized to two groups: turning to the supine position with left lateral tilt immediately or 15 minutes after subarachnoid injection of 2.5 ml 0.5% plain levobupivacaine in the left lateral position. Loss of pinprick sensation to T6 was accepted as adequate for cesarean section, and surgery proceeded. Characteristics of anesthesia; incidences of hypotension, bradycardia, and other adverse events, and ephedrine use were assessed. **Results:** Compared with the supine group, parturients kept in a lateral position for 15 minutes showed marked reductions in the incidence of hypotension (33.3% vs. 83.3%,  $p < 0.001$ ) and adverse events related to hypotension, such as nausea and vomiting (16.7% vs. 57.3%,  $p < 0.001$ ). In addition, ephedrine consumption per hypotension case was significantly reduced in the lateral group ( $5.4 \pm 4.7$  vs.  $8.9 \pm 5.8$  mg;  $p < 0.001$ ). **Conclusions:** Keeping parturients in the lateral position for 15 minutes before turning them to the supine position for cesarean section can provide reliable spinal anesthesia with a lower incidence and severity of hypotension and nausea/vomiting.

**Key words:** Cesarean section; Position, plain levobupivacaine; Spinal anesthesia; Pain.

## Introduction

Spinal anesthesia is the most commonly used technique for cesarean section because of its simplicity and the rapid onset of dense anesthesia [1]. However, anesthesia up to the level of T5 is required to avoid perioperative discomfort and visceral pain [2], which raises the major concern of hypotension. Incidences of hypotension of up to 74.1% have been reported in patients undergoing cesarean section under spinal anesthesia [3].

The administration of a dose of isobaric (or clinically isobaric) local anesthetic (LA) equivalent to that given to a non-obstetric patient has been shown to result in a much more cephalad block in a parturient [4,5]. This is because the caval compression causes engorgement of the epidural venous plexus and results in the bulk movement of CSF with drugs within it, in cranial direction, regardless of baricity.

In the present authors' practice, they have observed that spinal anesthesia remains at the level of T10 when a parturient is kept in the lateral position and isobaric LA is injected intrathecally just like non-obstetrical patients.

Therefore, the authors hypothesized that keeping parturients in a prolonged left lateral position before turning them to a supine position with left lateral tilt (SLLT) would reduce the incidence of hypotension without jeopardizing the quality of anesthesia.

The present study aimed to compare the incidence of hypotension in parturients undergoing elective cesarean delivery, in which they were turned to the SLLT position either immediately or 15 minutes after subarachnoid injection of 2.5 ml 0.5% plain levobupivacaine in the left lateral decubitus position.

## Materials and Methods

This prospective, randomized, unblinded study included 60 healthy, full-term parturients scheduled for elective cesarean section between June and December 2011. Subjects were divided randomly into two groups (turning to SLLT position immediately [group S] or after 15 minutes [group L]) based on computer-generated allocations contained in sealed opaque envelopes. Patients with complicated pregnancies, such as multiple pregnancy, pregnancy-induced hypertension, severe supine hypotension, or placenta previa, and those with contraindications to spinal anesthesia

were excluded.

All parturients were monitored with electrocardiography, pulse oximetry, and non-invasive blood pressure measurement. Midazolam (1.5 mg) was administered intravenously as a pre-medication just before patients were brought to the operation table. Ringer's lactate solution (ten ml kg<sup>-1</sup>) was infused over 15 minutes before intrathecal injection and continued at a rate of ten ml kg<sup>-1</sup> h<sup>-1</sup> until the end of the surgery. Intrathecal injections were administered at the L3–4 or L2–3 interspace to patients in both groups with a 25-gauge Quincke needle while in the left lateral decubitus position. Following free flow of cerebrospinal fluid (CSF), 2.5 ml 0.5% plain levobupivacaine was administered over 20 seconds without barbotage. After the spinal needle had been withdrawn, patients in group L were kept in the left lateral decubitus position for 15 minutes before turning to the SLT position, and those in group S were placed immediately in the SLT position. When parturients were in the supine position, a wedge pillow was inserted under the right hip, providing ~15° left uterine displacement to alleviate aortocaval compression. The same two anesthetists who induced spinal anesthesia preoperatively performed all assessments, measurements, and treatments.

Two to four L min<sup>-1</sup> 100% oxygen was administered via a nasal cannula until delivery. The average of two values measured of arterial blood pressure non-invasively on the left arm in the supine position on admission to the obstetric ward was defined baseline. Then, arterial blood pressure was measured at two-minute intervals for 30 minutes after intrathecal injection and at five-minute intervals thereafter. Systolic blood pressure < 90 mmHg or 20% reduction from baseline was defined as hypotension and treated with the intravenous administration of five mg ephedrine, which was repeated after two minutes if hypotension persisted. Heart rate < 50 beats/min was defined as bradycardia and treated with the intravenous administration of 0.5–1 mg atropine.

The sensory block level to pinprick sensation was assessed with a 24-gauge short, beveled needle 15 (just before positioning in Group L) and 25 minutes after intrathecal injection, and the uppermost sensory block level was recorded. The absence of pinprick sensation up to and including T6 was considered to indicate adequate blockade for surgery. If the block level was lower 25 minutes after injection, the parturient was withdrawn from the study and alternative anesthesia was used; otherwise, the parturient was prepared for surgery and covered, and surgery was initiated immediately thereafter. Patients who experienced discomfort perioperatively despite a sensory block more than T6 level were offered sedation (0.5 mg/kg propofol and one µg/kg fentanyl administered intravenously for induction, then propofol infusion at a rate of 1–2 mg kg<sup>-1</sup> h<sup>-1</sup> and a 1-µg/kg fentanyl bolus every 30 min for maintenance).

The duration of analgesia was defined as the interval between intrathecal injection and first analgesic requirement. Postoperative analgesic requirement was determined when the patient's verbally reported pain score at the incision line was > 3 on a scale of 0–10 (0 = no pain, 10 = the worst imaginable pain). Pain scores were checked every 15 minutes until the first analgesic requirement. The degree of motor block was assessed using the Bromage scale (0 = no block, 1 = unable to raise extended legs, 2 = able to move feet only, 3 = unable to move feet or knees) at the end of the operation and then every 15 minutes until total motor recovery, and maximal scores were recorded. The duration of motor block was defined as the intervals between spinal injection and total motor recovery in the lower limbs, and these values were recorded. General anesthesia was administered if the parturient's complaints persisted. All surgeries were performed *via* a Pfannenstiel skin incision, and the uterus was ex-

Table 1. — *Characteristics of patients.*

	Group L (n=30)	Group S (n=30)
Age (years)	28 ± 6.6	32 ± 4.2
Weight (kg)	74 ± 7.4	76 ± 8.9
Height (cm)	160 ± 7.6	163 ± 9.2
Duration of surgery (min)	48 ± 13.4	51 ± 17.3

Values are mean ± SD. No significant differences between the groups ( $p > 0.05$ ).

Table 2. — *Characteristics of anesthesia.*

	Group L (n=30)	Group S (n=30)	<i>p</i>
Dermatome level (height of block) at 15. min median (range)	T10 (T9-10)	T6 (T5-7)	<0.001*
Dermatome level (height of block) at 25. min median (range)	T5 (T3-6)	T4 (T2-5)	NS
Motor block (Bromage) median (range)	3 (2-3)	3 (2-3)	NS
Abdominal muscle relaxation: good, fair, poor	27, 2, 1	29, 1, 0	NS
Duration of analgesia (min) mean ± SD	191 ± 28.4	176 ± 32.2	NS
Duration of motor block (min) mean ± SD	150 ± 30.2	132 ± 42.4	NS

\* = Significant difference, NS = non-significant ( $p > 0.05$ ).

teriorized to facilitate repair. In all patients, the same surgeons clinically assessed the relaxation of abdominal muscles as poor, fair, or good. All parturients were given five U oxytocin intravenously in a slow bolus after delivery, and oxytocin infusion (20 U oxytocin in 500 ml at ~100 ml h<sup>-1</sup>) was started thereafter. Nausea and vomiting during the operation were noted and treated with the intravenous administration of ten mg metoclopramide after hypotension had been excluded. Pediatricians assessed one- and five-minute Apgar scores in all neonates.

The primary outcome was the incidence of hypotension during the operation. A *post hoc* power analysis was performed with respect to the observed difference of 83.3%–33.3%, with the sample size of 30 patients per group. The power was calculated as 97.5% with a two-tailed ( $\alpha$ ) error of 5%. Statistical analysis was conducted with SPSS software. Student's *t*-test, Fisher's exact test, or the Mann–Whitney test was used as appropriate. A *p*-value < 0.05 was accepted as statistically significant.

## Results

Surgeries were completed successfully under spinal anesthesia in all patients in both groups. Demographic characteristics were similar between groups (Table 1). Apgar scores of neonates in both groups were similar; all neonates had one- and five-minute Apgar scores of 8 or 10.

The characteristics of anesthesia are shown in Table 2. Sensory block level, abdominal muscle relaxation, Bromage scores, and duration of motor block were similar between groups. At 15 minutes after injection (just before positioning in Group L), the anesthesia level was T9–10

Table 3. — Number of patients with side effects and ephedrine requirement.

	Group L (n=30)	Group S (n=30)	p
Hypotension (n/%)	10 (33.3%)	25 (83.3%)	<0.001*
Nausea/vomiting (n/%)	5 (16.7%)	18 (57.3%)	<0.001*
Bradycardia (n/%)	0 (0%)	1 (2.8%)	NS
Ephedrine requirement (mg) mean±SD	2.3 ± 1.2	21.7 ± 7.9	<0.001*

\* = significant difference; NS = non-significant ( $p > 0.05$ ).

in group L and T5–7 in group S ( $p < 0.001$ ). Left- and right-side anesthesia levels did not differ significantly in either group. The quality of intraoperative anesthesia was also similar in both groups. Only one parturient in group L experienced intraoperative discomfort (poor anesthesia quality) and required sedation; all other parturients completed the operation with no problem. No parturient required atropine or underwent general anesthesia. The durations of analgesia and motor block were also similar in all patients.

The incidences of side effects and ephedrine requirements are shown in Table 3. The incidence of hypotension differed significantly between groups; 25 (83.3%) parturients in group S and ten (33.3%) in group L required treatment for hypotension ( $p < 0.001$ ). All hypotension episodes in group L occurred after 15 minutes just after positioning: eight (26.7%) episodes occurred at 20–25 minutes and two (6.7%) at 25–30 minutes. In group S, 19 (63.3%) episodes were observed in the first five minutes, three (10%) at 5–10 minutes, and three (10%) at 10–15 min. No hypotension episode was observed after delivery. Eighteen (57.3%) parturients in group S and five (16.7%) in group L had nausea or vomiting ( $p < 0.001$ ). Parturients in group S required a mean total ephedrine dose of  $21.7 \pm 7.9$  mg, compared with  $2.3 \pm 1.2$  mg in group L ( $p < 0.001$ ). In addition, ephedrine consumption per parturients observed hypotension was significantly lower in group L than in group S ( $5.4 \pm 4.7$  mg vs.  $8.9 \pm 5.8$  mg;  $p < 0.001$ ). One parturient in group S had bradycardia with hypotension and nausea, which was treated with ten mg ephedrine.

## Discussion

The present study demonstrated that keeping parturients in the left lateral decubitus position for 15 minutes after spinal injection of plain (truly isobaric) [6] levobupivacaine provided an anesthesia level of about T10. This 15-minute interval before turning the patient to the supine position for cesarean section markedly reduced the incidence of hypotension and related adverse events such as nausea and vomiting, without reducing the sufficiency of anesthesia. In addition, the amount of ephedrine administered per hypotension case was significantly lower in patients who un-

derwent delayed supine positioning, indicating that this technique attenuates the severity of hypotension in addition to reducing its incidence.

In addition to the dose of the local anesthetic injected, two other major factors determining anesthesia level in the non-obstetric population are the baricity of the solution injected and subsequent patient position [7]. In contrast to hypobaric and hyperbaric solutions, the spread of isobaric solution is not changed markedly by position [8]. However, a dose of plain (slightly hypobaric, practically isobaric) bupivacaine equivalent to that given to a non-obstetric patient provides a much more cephalad block in a parturient [4, 5]. Because the gravid uterus compresses the inferior vena cava, and that causes engorgement of the epidural venous plexus, placing a parturient in the supine position may result in the bulk movement of CSF and enhance rostral spread, regardless of baricity [9–11]. Neither the parturient's position during the induction of spinal anesthesia nor the density of the solution used has reported any effect on the solution's spread within the CSF [5, 12–14]. The spread of isobaric solutions is known to be less predictable and controllable than that of hyperbaric solutions in parturients. However, the results of the present study suggest that the block level may be controllable when levobupivacaine (truly isobaric solution) injection is performed with the parturient in the left lateral decubitus position, and this position is maintained for a 15 minutes. This delayed supine positioning also delayed uterus compression and subsequent bulk movement of CSF, providing adequate time for the uptake of most LA by neural and other tissues; therefore, dense anesthesia can theoretically be obtained below T10. The present authors hypothesize that, after placement of the parturient in the supine position, reduced free LA in the CSF enhanced rostral spread *via* bulk movement, causing a slightly less dense block in the upper thoracic segments that might result in incomplete sympatholysis and a more stable cardiovascular condition.

In spinal anesthesia practice with hyperbaric drugs in non-obstetric patients, more cephalic segments can be obtained by changing position a few minutes after injection, when the anesthesia level remains in the lower segments. However, the opportunity to manage the anesthesia level by changing position is lost after a certain amount of time because most intrathecally injected LA has bound to neural and other tissues. Although marked changes in patient position up to two hours after spinal injection can rarely result in limited changes in the block level, LA spread seems to stop almost entirely by 20–25 minutes after injection in non-obstetric patients [15, 16].

The pathophysiological mechanism of hypotension during spinal anesthesia is secondarily related to the rapid onset of a dense sympathetic blockade, resulting in decreasing venous return to the right side of the heart and leading to a fall in mean arterial blood pressure. This re-

sponse may be further exacerbated by aortocaval compression by the gravid uterus. Therefore, spinal anesthesia for cesarean section is often performed with the parturient in the left lateral decubitus position, which has been shown to minimize the degree of aortocaval compression [17], thereby maximizing maternal cardiac output and uteroplacental blood flow. The present study showed that the anesthesia level remained around T10 for 15 minutes after the spinal injection of plain levobupivacaine as long as remain in left position just like nonobstetrical patients.

Although there are some studies investigated effects of positions, they either kept patients in the induction position for a short time before supine positioning, or they did not administer truly isobaric agent. Longer maintenance of the parturient in the lateral position to provide adequate time for truly LA adsorption before turning to the SLLT position has not been studied previously.

Hypotension is related to the degree and speed of LA-induced sympatholysis; therefore, greater hemodynamic stability was observed in epidural anesthesia with gradual injection of LA. Delayed blockade of upper thoracic segments contributed to slower and less dense sympatholysis and thus, a lower incidence of hypotension.

This study has some limitations. The authors speculated that less dense anesthesia contributed to the lower incidence of hypotension, but they did not assess block density. The study had to be unblinded because the parturients and the anesthetist who performed assessment in the first 15 minutes remained unblinded. The authors did not seek to determine the optimal duration of time spent in the left lateral decubitus position after spinal injection, which undoubtedly varies with dosage. Also, anesthetic onset may be delayed by the proposed technique.

In conclusion, the administration of spinal anesthesia with plain levobupivacaine with parturients in the left lateral decubitus position and the maintenance of that position for 15 minutes before turning them to a supine position for cesarean section markedly reduces the incidence and severity of hypotension and related adverse events, such as nausea and vomiting, without reducing the sufficiency of anesthesia.

## Acknowledgements

The authors would like to thank doctors of Obstetric and Gynecology Clinics for their assistance with the study.

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