Hemodynamic effects of a right lumbar–pelvic wedge during spinal anesthesia for cesarean section.

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Int J Obstet Anesth 2011;20(4):307-11.

ABSTRACT

Background

Aortocaval compression is a major cause of maternal hypotension. A randomized controlled trial was designed to determine the effectiveness of a mechanical intervention using a right lumbar-pelvic wedge in preventing hypotension after spinal anesthesia for cesarean delivery.

Methods

Eighty healthy women undergoing elective cesarean section were randomly allocated immediately after spinal blockade to either a lumbar-pelvic wedge positioned under the right posterior-superior iliac crest (Wedge group, n=40) or the complete supine position (Supine group, n=40). Hemodynamic values, vasopressor consumption and adverse effects were collected during the surgical procedure. Hypotension was defined as a reduction in systolic blood pressure of 25% from baseline. Patient allocation, management and data collection were performed by a single unblinded anesthetist.

Results

There was no difference in the incidence of hypotension between the two groups (42.5% vs. 50%, P=0.51). During the first 5 min, blood pressure decreased less in the Wedge group. There were significant differences in median [interquartile range] vasopressor requirements between the Wedge group and the Supine group (1 [0-2] vs. 3 [1-4] mg, P<0.01) and in nausea during the procedure (6 vs. 22 patients, P<0.01).

Conclusion

In our study population the use of right lumbar-pelvic wedge was not effective in reducing the incidence of hypotension during spinal anesthesia for cesarean section. Patients in whom the wedge was used had higher systolic blood pressure values during the first 5 min of anesthesia and fewer episodes of nausea. The risk of hypotension remains substantial.

Keywords

Spinal anesthesia; Cesarean section; Left lateral displacement; Right lumbar–pelvic wedge; Hypotension

INTRODUCTION

Spinal anesthesia for cesarean delivery can result in both maternal and neonatal morbidity. (1-4) Hypotension has a sudden onset and has been reported to occur with a frequency approaching 100%. (5,6) It is caused by sympathetic block and increased venous capacitance which, together with inferior vena caval compression by the gravid uterus, leads to pooling of blood in the lower extremities, preload reduction and hemodynamic compromise. (7)

Several strategies to maintain blood pressure have been studied, such as crystalloid/colloid pre- or co-loading, prophylactic use of vasopressors, low doses of spinal anesthetic and patient positioning. (1) A recent systematic review compared eight positions during the surgical procedure but failed to reach definite conclusions. (8) In our daily clinical practice, the supine position is used in almost all patients, although some anesthesiologists use saline solution bags under the right lumbar–pelvic area to promote left uterine displacement. A right lumbar–pelvic wedge was designed to simulate this approach and make it reproducible. The aim of the study was to evaluate if the use of a right lumbar–pelvic wedge during cesarean delivery under spinal anesthesia reduced the incidence of perioperative maternal hypotension.

METHODS

Ethical approval from Ethics Committee of Universidad del Cauca was granted. All patients gave written informed consent. ASA 1 or 2 patients aged between 18 and 45 years with an uncomplicated singleton pregnancy at term who were scheduled for cesarean delivery under spinal anesthesia were eligible for recruitment.

Exclusions were those with pregnancy-induced hypertension, cardiac disease, diabetes, fetal complications and those in labor. Post hoc exclusions were those in whom surgery lasted longer than 2 h, those who required perioperative sedation or conversion to general anesthesia, those in whom surgical complications arose such as intraoperative hemorrhage and those in whom protocol violation occurred.

Pre-medication was not given. Standard monitoring included non-invasive blood pressure measurements, pulse oximetry and electrocardiography. Baseline blood pressure and maternal heart rate were recorded. Oxygen was administered to all patients via nasal prongs at 3 L/min. An 18-gauge cannula was inserted in a forearm vein. All patients received co-loading with 0.9% saline 10 mL/kg. Spinal anesthesia was performed in the left lateral position at the L2–3 or L3–4 interspace with a 26-gauge Quincke spinal needle. All patients received 0.5% hyperbaric bupivacaine 9 mg and fentanyl 20 mcg (total volume 2 mL).

After intrathecal injection, patients were immediately placed in the supine position either with the right lumbar–pelvic wedge (Wedge group) or without (Supine group). Groups were assigned by an independent anesthetist using random numbers generated by EPIDAT 3.1. The wedge used was wood, 35 cm long, 20 cm wide and with 20° of inclination, and was placed at the right posterior–superior iliac crest and lumbar region. Spinal anesthesia, patient positioning, anesthetic management and data collection were performed by an unblinded anesthetist. The upper level of sensory block 15min after spinal injection was determined using loss of pinprick and cold sensation. Surgery began when the sensory block reached the T6 dermatome bilaterally.

Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and heart rate (HR) were collected minutely for the first 8 min, then every 3 min until 20 min, and every 5 min until the end of surgery. Maternal hypotension was defined as a 25% reduction of SBP from baseline, (1,9) and was treated with intravenous boluses of ethylephrine 1 mg until hypotension was corrected. Bradycardia (<40 beats/min) was treated with intravenous atropine 1 mg to a maximum dose of 3 mg. Vasopressor and atropine requirements were recorded. Any further management was at the clinical discretion of the anesthetist. The presence or absence of nausea and vomiting after spinal anesthesia were recorded.

Statistical analysis

The primary outcome was the incidence of hypotension during surgery. Secondary outcomes were vasopressor consumption and adverse effects. Power analysis revealed that 39 cases were required to show a decrease in the cumulative incidence of hypotension from 80% to 50% between groups with a level of 0.05 and b level of 0.2 using a two-tailed test. A low dropout rate was anticipated.

Continuous data were reported as mean (±SD) and categorical data were reported as numbers and percentages. SBP data are shown as bean plots, which were used to show the mean and data distributions at each measurement over time. (10) Nonparametric data were reported as median and interquartile range (IQR). Data between groups were compared using the t test, Mann–Whitney U test, X^2 test and Fisher's exact test as appropriate.

Sequential measurements of SBP were focused on the first 5 min, being the interval during which SBP showed most changes in graphical analysis. Analysis was per- formed using the area under the curve (AUC) of SBP for each patient as a summary statistic. AUC was calculated in sections using standard formulae for areas of rectangles and triangles, (11,12) and AUC results between randomization groups were compared using t test and presented as mean difference with 95% confidence intervals (95% CI).

In all cases, $P < 0.05$ was considered significant. All analyses and graphs were performed using the computer programs SPSS (version 15; Chicago, IL) and R project. (13) Data analysis was performed by an independent researcher who was blinded to the study interventions.

RESULTS

There were no protocol violations, dropouts or missing data. Eighty patients were enrolled in the study, with 40 in each group. There were no significant differences in demographic data between the groups, the extent of sensory blockade, the duration of surgery or ASA status (Table 1).

Hemodynamic baseline values did not differ between groups (Table 2). The incidence of hypotension was similar: 42.5% in Wedge group vs. 50% in Supine group (RR 0.7, 95% CI 0.3–1.7; P = 0.51). The distribution of SBP over time is presented in Fig. 1. During the first 5 min after spinal anesthesia, SBP, DBP and MAP decreased relative to baseline values in both groups. The AUC of SBP was 593 mmHg min and 540 mmHg min for the Wedge and Supine Groups, respectively (mean difference -52.97, 95% CI -85.19 to -20.75; P = 0.002). Thereafter, SBP, DBP and MAP increased slowly but did not reach baseline values in either group. There were no differences in maternal heart rate after the onset of spinal anesthesia. There were, however, significant differences in vasopressor median [IQR] requirements between the Wedge group and Supine group (1 [0–2] vs. 3 [1–4] mg, respectively; P < 0.01) and the incidence of nausea during the procedure (6 and 22 patients, respectively; P < 0.01).

Table 1. Maternal, obstetric and anesthetic data

	Wedge group (*n* = 40)	**Supine group (*n* = 40)**
Age (years)	29 (±7)	28 (±7)
Weight (kg)	70 (±8)	69 (±8)
Sensory block level	T5 [T4–T6]	T4 [T3–T6]
Duration of surgery (min)	42 [32–57]	45 [30–53]
ASA status		
I	23	25
II	17	15

Data are mean (±SD), median [range] or number; No significant differences between groups.

Table 2. Maternal hemodynamic data, vasopressor consumption and adverse effects

	Wedge group (*n* = 40)	**Supine group (*n* = 40)**	***P* value**
Baseline systolic BP (mmHg)	130 (±17)	125 (±13)	0.16
Baseline mean BP (mmHg)	91 (±14)	86 (±11)	0.08
Baseline heart rate (beats/min)	83 (±12)	81 (±11)	0.45
Cumulative incidence of hypotension	17/40 (42.5%)	20/40 (50%)	0.51
Ethylephrine consumption (mg)	1 [0–2]	3 [1–4]	0.01
Atropine consumption (mg)	0 [0–0]	0 [0–0]	0.15
Nausea	6	22	0.01
Vomiting	0	4	0.11

Data are mean (±SD), median [range] or number.

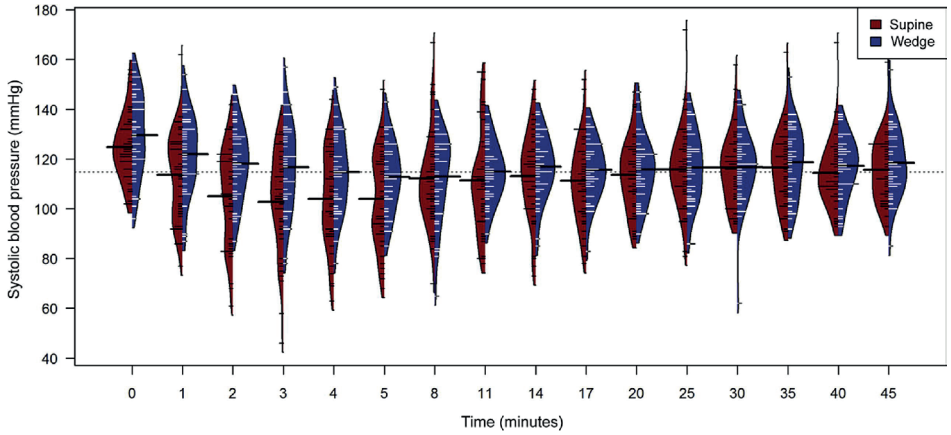

Figure 1. Systolic blood pressure distribution following spinal anesthesia. The graph represents the distribution of the values for systolic blood pressure at each time point and per intervention group. The thick black line represents the mean value for each distribution.

DISCUSSION

Several authors have studied the effect of positioning following induction of spinal or combined spinal–epidural anesthesia for cesarean section. The studies are in three main categories. The first compares the left or right tilted supine position with the full left lateral position. (14-17) The second compares lateral or tilted supine positions with the complete supine position, (18-21) and the third compares different locations of wedges or right-tilted vs. left-tilted positions. (22,23) The current study could be classified in the last of these three groups because it compared the use of a lumbar–pelvic wedge with the complete supine position. The results show that hypotension occurred frequently and that the wedge used was ineffective in reducing the incidence of maternal hypotension, but that patients with the wedge required less vasopressor and experienced fewer episodes of nausea.

Matorras et al. assessed the benefits of performing cesarean delivery under spinal or general anesthesia using lateral tilt or supine position. (20) No differences in blood pressure control, umbilical artery biochemistry or clinical condition of the newborn were shown. Comparisons with our study are limited due to the patient populations, but similar incidences of hypotension were found.

The Cardiff wedge was initially designed to perform maternal resuscitation. (24) It is a rigid wedge with an upper plane angled at 27°, the maximum tilt found to be consistent with effective external cardiac massage. Crawford et al. observed that compared to the supine position, right lateral tilt for uterine displacement improved neonatal outcome during general anesthesia for cesarean delivery, and attributed this finding to the management of inferior vena caval occlusion. They suggested that the use of a wedge or

some tilting device was advisable, although conceded that left tilt was preferable. (19) In the current study the wedge covered the lumbar and pelvic region but was shorter than the original Cardiff wedge and had only 20° of inclination. Theoretically, this position relieves aortocaval compression but it is difficult to estimate the extent of uterine displacement. (25) A recent systematic review did not show differences in maternal blood pressure between left or right lateral and complete supine positions. (21)

In the present study, prophylactic vasopressors were not used, the anesthetic technique was standardized and the upper level of anesthesia was similar in both groups. The only a_1 vasopressor available in the operating rooms of our institution is ethylephrine, which may produce tachycardia through b_1 stimulation as a secondary effect. Although the incidence of hypotension was the same in both groups, SBP in the Supine group showed a more rapid fall over the first 5 min, and differences in the AUC of the SBP between groups favored the Wedge group. Zhou et al. found higher SBP during the first min in patients using a lumbar wedge versus a pelvic wedge. (22) The clinical relevance of this finding and its relationship to nausea and vomiting are unknown.

The incidence of hypotension varies according to its definition and limits comparability of different preventive measures. (9) We used a commonly accepted definition, and the incidence was high but in agreement with other studies. (1,26) Current evidence for the prevention of hypotension during cesarean delivery with spinal anesthesia suggests that an approach employing vasopressor infusions, co-loading fluids and positioning may be the best strategy. (27,28) Other authors have concluded that, despite a high incidence of maternal hypotension during cesarean delivery, term infants tend to tolerate the physiological insult without major sequelae. (26) The tilted supine position or the use of wedges or cushions for prevention of hypotension has been widely adopted. (14,25,29-31) However, a recent systematic review assessed maternal positions during cesarean section for preventing maternal and neonatal complications in women receiving spinal anesthesia. (8) The review concluded that there is limited evidence to support or disprove the value of tilting, wedges or the use of mechanical displacers. Current evidence suggests that further studies are needed to support this recommendation.

The current study has some methodological limitations. The same anesthetist performed spinal anesthesia, positioned the patient and collected data, and may have introduced bias, limiting the clinical significance of our findings. Neonatal data, both clinical or biochemical, were not collected, and there was no quantification of aortocaval compression or uterine deviation.

In conclusion, in our study population the use of the right lumbar–pelvic wedge, when compared to the complete supine position, was not effective in reducing the incidence of hypotension in spinal anesthesia for cesarean delivery, although vasopressor requirement was significantly decreased. The risk of hypotension in both groups remains substantial.

ACKNOWLEDGEMENTS

We would like to acknowledge Dr. N. Palechor and C. Daza for their clinical and methodological advice respectively, and to the patients of the Gynecology and Obstetrics Department of Hospital Universitario San José, Popayán, Colombia for their cooperation. Our special thanks go to Dr. M. Perez and Dr. J. Cardenas for their advice on translation.

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