The Effect of Reverse Trendelenburg Position on Incidence of Hypotension after Spinal Anesthesia for Cesarean Section

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Objective: *To prove if 10-degree head-up tilt position during conduction of spinal anesthesia and continue through the operation will reduce the incidence of hypotension comparing to horizontal position in elective cesarean section parturient.*
Material and Method: *In this randomized double-blind controlled trial. Forty-four parturient were equally allocated into 10-degree head-up tilt and horizontal position during conduction of spinal anesthesia and continue during the operation. Blood pressure, heart rate, incidence of hypotension, ephedrine consumption, and anesthesia level were compared.*
Results: *Incidence of hypotension and percentage of parturient that required ephedrine were comparable in control and study groups (72.73% vs. 45.45%, p = 0.066) but lower before cord clamping in the study group (68.18% vs. 36.36%, p = 0.03). The sensory block levels were identical but more parturient in the study group required reposition in order to gain the required anesthetic level.*
Conclusion: *Ten-degree head-up tilt position during conduction and maintenance of spinal anesthesia for cesarean section reduced incidence of hypotension and ephedrine consumption without any adverse effect in both parturient and newly-born babies.*

Keywords: *Spinal anesthesia, Cesarean section, Position, Head-up tilt, Hypotension*

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Spinal anesthesia offers many advantages for cesarean section. It has quick onset and provides dense sensory block. It is easier to perform and less liable to cause fatal side effects such as total spinal block comparing to epidural anesthesia. Spinal anesthesia reduces the onset time before the operation by 7.9 minutes comparing to epidural[1]. Comparing to general anesthesia, less blood loss was found in spinal anesthesia even though there is no difference in maternal and fetal outcomes[2,3]. A recent survey of hospitals in UK with 37,000 births per year revealed that the rate of regional anesthesia for cesarean section was 94.9%, and the majority (86.6%) was with spinal anesthesia[4]. In the Department of Anesthesiology at Ramathibodi Hospital, approximately 80% of cesarean section was done under spinal anesthesia. However, the advantages have complications. Hypotension is one of major complications associated with decrease placental blood flow and may lead to fetal acidosis[4-6]. Incidence of hypotension during spinal anesthesia for caesarean section varies between 50 and 60%[7]. There are many techniques to reduce the incidence of hypotension such as intravenous fluid prehydration[8], sympathomimetic drugs[9], and leg bindings or positioning[10].

Patient positioning is one of interventions that may decrease the incidence of hypotension. Spinal anesthesia is often induced in lateral position. In full term pregnancy, pelvic diameter is usually wider than shoulder span, resulting in slightly head down position in parturient woman who lies on lateral side on a leveled operating table. This might lead to higher spread of hyperbaric bupivacaine than required.

Loke et al compared the effect of 10-degree head-up during induction period of spinal anesthesia exclusively and found that reduction in incidence of hypotension was not statistically significant[11]. There are many studies showing that free-flowing local anesthetic drug in cerebrospinal fluid (CSF) can remain for longer than 20 minutes. Therefore, lowering head of the parturient after induction of spinal anesthesia could cause further spread of local anesthetic drug[11-13].

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The authors hypothesize that maintaining a 10-degree head-up position during a spinal block and throughout the entire operation can reduce incidence of hypotension in parturient woman undergoing cesarean section.

Material and Method

After getting the Ramathibodi Hospital Ethic Committee approval, the authors recruited 44 termed parturient with ASA physical status I-II who underwent elective cesarean section. After obtaining their informed consent, the parturient were randomly allocated by computer generated table into the study and control groups, 22 in each group. Parturient with complicated pregnancy such as fetal distress, abruptio placenta, twin pregnancy, and pregnancy-induced hypertension were excluded from the study. Sample size was calculated to detect 40% reduction in the incidence of hypotension for the head-up tilt group (type I error = 0.05 and type II error = 0.2).

The 44 parturients received 1 liter of acetated Ringer's solution intravenously and elastic bandages were applied on both legs and thighs. Then spinal anesthesia was induced in right lateral position at L3-4 interspace using 0.5% hyperbaric bupivacaine 2 ml over 10 to 20 seconds. Intrathecal opioids were not given.

In the study group, spinal anesthesia was induced on 10-degree head-up tilted (reverse Trendelenburg position) operating table as measured by a protractor. Then, the parturient was turned to supine position with left uterine displaced. The operating table remained in 10-degree head-up tilt and continued until the operation was over. In control group, spinal anesthesia was induced on horizontal operating table (parallel to the floor) during induction and throughout the entire operation.

Dermatome level of anesthesia was assessed by pinprick sensation every five minutes after the block. If blocked level was not adequate, the operating table was repositioned to 10 degrees head down for a maximum of five minutes. If the parturient still had pinprick sensation below T6 dermatome level when the operating table was in 10 degrees head down for five minutes, the technique of anesthesia was converted to general anesthesia with endotracheal tube and the parturient would be included as intention-to-treat.

Systolic, mean, and diastolic arterial blood pressures were measured at right arm at 1-minute intervals with by an automated oscillometric technique (Philips®, IntelliVue MP50 Patient Monitor) until umbilical cord was clamped then 5-minute intervals afterward. Hypotension was defined as a systolic blood pressure below 90 mmHg or 20% lower than baseline systolic blood pressure, depending on the prior event. Intravenous ephedrine 6 mg was given to correct hypotension. Nausea and vomiting, pain score, patient satisfaction score, and APGAR score of the newly-born baby were also recorded.

Recording patients' data and management of hypotension were done by anesthesia personnel who was not involved in the present study.

Statistical analysis was performed using SPSS for Window version 20.0. Age, weight, height, BMI, gestational age, and total ephedrine requirement were tested by independent sample t-test or Mann-Whitney U test. Chi-square or Fisher's exact test (or Montecarlo simulation) were used for proportions or incidence of hypotension and satisfaction score. The *p*-value of lower than 0.05 was considered significant. Two-way ANOVA (between subjects and within subjects variables) was used for repeated blood pressure measurement before and after umbilical cord clamping and also APGAR scores.

Results

The demographic characteristics in two groups were comparable (Table 1). Incidence of hypotension presented as percentage of parturient that required ephedrine and total ephedrine consumption were shown in Table 2.

The incidence of hypotension was comparable in both group (72.73% in control group vs. 45.45% in study group, *p*-value = 0.06). When analyzed in detailed, the incidence of hypotension, and ephedrine consumption were lower in 10-degree head-up group after induction of spinal anesthesia until the surgeon clamped umbilical cord (8/22 parturient (36.36%) vs.

Table 1. Patient demographic data (n = 44) presented as mean (SD) unless otherwise stated

	Control (n = 22)	Head-up 10° (n = 22)	*p*-value
Age (year)	30.18 (7.08)	30.23 (5.71)	0.981
Weight (kg)	70.61 (9.84)	70.45 (7.38)	0.951
Height (cm)	160.00 (5.55)	157.00 (6.75)	0.115
BMI (kg/m^2)	27.59 (3.86)	28.66 (3.45)	0.337
GA (week)	38.23 (1.51)	37.68 (2.17)	0.338
ASA II/IIE, n	7/15	11/11	0.220

BMI = body mass index; GA = gestational age; ASA = American Society of Anesthesiologists physical status

15/22 parturient (68.18%), *p*-value = 0.035; and 4.36±8.11 mg vs. 9.95±12.19 mg, *p*-value = 0.035). Regarding blood pressure, systolic, mean, and diastolic blood pressure were not significantly different between the two groups (Table 3). The sensory level to loss of pinprick sensation was not significantly different. Median level was at T4 in both groups, *p*-value = 0.256. Number of parturient who required head lowering due to inadequate level of anesthesia is higher but not statistically significant in the study group compared to control group (6 parturient vs. 1 parturient, *p*-value = 0.095) as shown in Table 4. None of the participant required changing anesthetic technique from spinal to general anesthesia. APGAR score, nausea, vomiting, pain developed during surgery and maternal satisfaction score were not significantly different between the two groups (Table 5).

Discussion

The presented study had demonstrated that 10-degree head-up tilt with the parturient in lateral position during induction of spinal anesthesia and to remain head-up position in supine position with left side tilted throughout the cesarean section operation reduces incidence of hypotension and ephedrine consumption before surgeon clamped umbilical cord which is the crucial moment for fetal well-being.

Head-up position under spinal anesthesia may cause venous blood pooling in the lower part of the body, resulting in increased incidence of hypotension, especially after sympathetic block. Therefore, the authors applied elastic bandages on both legs to counteract this phenomenon[14,15]. However, hypotension still occurred even when this maneuver was applied. It is essential to achieve the appropriate level of anesthesia without compromising its quality. Our result indicates that such goal is achievable. We found that sensory anesthetic levels in both groups were not different, and the head-up group had lower incidence of hypotension. This implies that autonomic block, which is normally four to six level higher than sensory block level, is less in head-up group.

Table 2. Incidence of hypotension which is presented as percentage of patients who required ephedrine, presented as mean (SD) unless otherwise stated

	Number of patients required ephedrine, n (%)			Doses (mg)		
	Control (n = 22)	Head-up (n = 22)	*p*-value	Control (n = 22)	Head-up (n = 22)	*p*-value
Total	16 (72.73)	10 (45.45)	0.066	13.42 (13.72)	10.00 (11.93)	0.43
Before cord clamping	15 (68.18)	8 (36.36)	0.035*	9.95 (12.19)	4.36 (8.11)	0.035*
After cord clamping	4 (18.18)	5 (22.73)	>0.999	1.64 (4.22)	2.45 (4.78)	0.629

Table 3. Hemodynamic profile presented as mean (SD) (T0 is the time from induction of spinal anesthesia)

	Control (n = 22)	Head-up 10° (n = 22)	*p*-value
SBP baseline	122.82 (18.71)	118.59 (11.57)	0.372
SBP from T0	108.53 (12.97)	109.71 (9.48)	0.730
SBP after clamping	116.50 (13.94)	112.57 (10.97)	0.305
DBP baseline	74.50 (12.98)	73.27 (7.82)	0.706
DBP from T0	56.84 (10.41)	59.60 (9.49)	0.363
DBP after clamping	59.83 (14.36)	56.67 (6.53)	0.356
MAP baseline	-	-	-
MAP from T0	82.63 (11.30)	84.66 (9.03)	0.515
MAP after clamping	88.22 (13.01)	84.62 (7.95)	0.275
HR baseline	83.59 (13.39)	83.73 (11.61)	0.971
HR from T0	87.97 (14.14)	83.69 (13.31)	0.307
HR after clamping	92.01 (11.40)	86.20 (11.76)	0.104

SBP = systolic blood pressure; DBP = diastolic blood pressure; MAP = mean arterial pressure; HR = heart rate

Table 4. Level of spinal block and requirement of position changing

	Control (n = 22)	Head-up 10° (n = 22)	*p*-value
Max height of sensory block, median (range)	T4 (T4 to T6)	T4 (T4 to T8)	0.256
Number of patients required position changed, n (%)	1 (4.55)	6 (27.27)	0.095

Table 5. APGAR score, nausea vomiting score, number of parturient who had pain, satisfaction score presented as median (min to max) unless otherwise stated

	Control (n = 22)	Head-up 10° (n = 22)	*p*-value
APGAR 1 minute	8.5 (8 to 9)	8.0 (7 to 9)	0.110
APGAR 5 minutes	9.0 (9 to 10)	9.0 (8 to 10)	0.872
NV, n (%)			0.058
0	8 (36.36)	14 (63.64)	
1	8 (36.36)	7 (31.82)	
2	6 (27.27)	1 (4.55)	
Pain, n (%)	1 (4.55)	2 (9.09)	>0.999
Satisfaction score, n (%)			0.473
Score 3	1 (4.55)	0 (0.00)	
Score 4	4 (18.18)	5 (22.73)	
Score 5	17 (77.27)	17 (77.27)	

NV score 0 = no nausea and vomiting, 1 = nausea, 2 = vomiting
Satisfaction score 0 = not satisfied, 5 = highly satisfied

The authors are well aware that the present study was not blinded. According to nature of study, it was impossible to blind investigators to which group each parturient was allocated. We decreased the chance of bias by using another anesthetic team who was not involve in the study to record blood pressure and manage hypotension.

In the present study, there were six patients in the study group vs. one in the control group that required lowering head of operating table due to inadequate level (T4). No parturient in either group required converting from spinal to general anesthesia. This result showed that local anesthetic drug dose might be too low in this study. Recommended dose of 0.5% hyperbaric bupivacaine used in caesarean section operation varies from 2.0 to 2.6 ml[16-18]. To decrease the number of patients who required head lowering, higher dose (2.2 to 2.5 ml) is suggested for a future study.

To date, the effects of head-up tilt on spinal anesthesia in cesarean section focusing on incidence of hypotension have been investigated in very few studies. Loke et al[11] demonstrated that the use of 10-degree head-up during induction of spinal anesthesia with 0.5% hyperbaric bupivacaine 2 ml and morphine 0.1 mg could not reduce incidence of hypotension but mean systolic blood pressure in the first five minutes was higher in the tilt group. Ruppen et al[14] showed that bupivacaine concentrations in CSF varied among patients and could cause higher cephalic spread even at 30 minutes after block onset. Moreover, there are many studies demonstrated that changing position after induction of anesthesia even more than 30 minutes could affect level of anesthesia and hemodynamic profiles[12,13]. Therefore, turning parturient to neutral supine position after spinal anesthesia can cause higher spread of free local anesthetic drug and leads to hypotension.

Other maternal positions that affect incidence of hypotension in cesarean section have been investigated in numbers of studies. Rucklidge et al[19] demonstrated that the modified lateral position (Oxford's position) was not invariably associated with improved hemodynamic stability. Køhler et al[20] studied on effect of delayed supine position (remain in sitting position for three minutes) and found that it did not influence the incidence of maternal hypotension. This can be explained by the same mechanism.

Effect of maternal hypotension, especially before the surgeon clamps the umbilical cord, associates with decrease uteroplacental blood flow. It can result in fetal bradycardia and acidosis. In the present study, we demonstrated that 10-degree head-up could lower incidence of hypotension before the surgeon clamped umbilical cord. After clamping there are many factors such as oxytocin[21] and blood loss that can interfere with blood pressure.

The benefit of lower ephedrine consumption in 10-degree head-up group may be controversial. Wright et al[22] had demonstrated that ephedrine administration was associated with fetal heart rate and beat-to-beat variability, but not with fetal acidosis. In 2002, Cooper et al[23] had shown that ephedrine administration was associated with more fetal acidosis compared to phenylephrine. The increased incidence of fetal acidosis could have been caused by reduced

uteroplacental perfusion from ephedrine-induced uteroplacental vasoconstriction, or by direct fetal effect of ephedrine.

In conclusion, the study results indicated that spinal anesthesia induced at 10-degree head-up position and keeping head-up during the entire operation period reduced incidence of maternal hypotension in cesarean section operation without compromising the quality of the spinal anesthesia.

What is already known on this topic?

Incidence of post-spinal hypotension in cesarean section is high. It can cause fetal acidosis and effect fetal outcome after cesarean delivery. There are many methods to prevent post-spinal hypotension including fluid loading, vasopressures, and physical method such as legs binding or positioning.

What this study adds?

From the present study, reverse Trendelenburg position can lower incidence of hypotension before surgeon clamps umbilical cord in cesarean section. This method is easy and does not affect quality of spinal anesthesia or maternal satisfaction.

Potential conflicts of interest

None.

References

1. Ng K, Parsons J, Cyna AM, Middleton P. Spinal versus epidural anaesthesia for caesarean section. Cochrane Database Syst Rev 2004; (2): CD003765.
2. Riley ET, Cohen SE, Macario A, Desai JB, Ratner EF. Spinal versus epidural anesthesia for cesarean section: a comparison of time efficiency, costs, charges, and complications. Anesth Analg 1995; 80: 709-12.
3. Afolabi BB, Lesi FE. Regional versus general anaesthesia for caesarean section. Cochrane Database Syst Rev 2012; 10: CD004350.
4. Jenkins JG, Khan MM. Anaesthesia for caesarean section: a survey in a UK region from 1992 to 2002. Anaesthesia 2003; 58: 1114-8.
5. Ratcliffe FM, Evans JM. Neonatal wellbeing after elective caesarean delivery with general, spinal, and epidural anaesthesia. Eur J Anaesthesiol 1993; 10: 175-81.
6. Mueller MD, Brühwiler H, Schüpfer GK, Lüscher KP. Higher rate of fetal acidemia after regional anesthesia for elective cesarean delivery. Obstet Gynecol 1997; 90: 131-4.
7. Rout CC, Rocke DA. Prevention of hypotension following spinal anesthesia for cesarean section. Int Anesthesiol Clin 1994; 32: 117-35.
8. Wollman SB, Marx GF. Acute hydration for prevention of hypotension of spinal anesthesia in parturients. Anesthesiology 1968; 29: 374-80.
9. Kang YG, Abouleish E, Caritis S. Prophylactic intravenous ephedrine infusion during spinal anesthesia for cesarean section. Anesth Analg 1982; 61: 839-42.
10. Emmett RS, Cyna AM, Andrew M, Simmons SW. Techniques for preventing hypotension during spinal anaesthesia for caesarean section. Cochrane Database Syst Rev 2002; (3): CD002251.
11. Loke GP, Chan EH, Sia AT. The effect of 10 degrees head-up tilt in the right lateral position on the systemic blood pressure after subarachnoid block for Caesarean section. Anaesthesia 2002; 57: 169-72.
12. Rafaniello C, Ianniello B, De Vizia M, Mercogliano A, Lettieri B, Rinaldi B, et al. Cardiorespiratory effects of change in posture after spinal anesthesia with hyperbaric bupivacaine. Minerva Med 2011; 102: 501-4.
13. Niemi L, Tuominen M, Pitkanen M, Rosenberg PH. Effect of late posture change on the level of spinal anaesthesia with plain bupivacaine. Br J Anaesth 1993; 71: 807-9.
14. Ruppen W, Steiner LA, Drewe J, Hauenstein L, Brugger S, Seeberger MD. Bupivacaine concentrations in the lumbar cerebrospinal fluid of patients during spinal anaesthesia. Br J Anaesth 2009; 102: 832-8.
15. van Bogaert LJ. Prevention of post-spinal hypotension at elective cesarean section by wrapping of the lower limbs. Int J Gynaecol Obstet 1998; 61: 233-8.
16. Rout CC, Rocke DA, Gouws E. Leg elevation and wrapping in the prevention of hypotension following spinal anaesthesia for elective caesarean section. Anaesthesia 1993; 48: 304-8.
17. Russell I. Regional anaesthesia for operative delivery. In: Reynolds F, editor. Regional analgesia in obstetrics. A millennium update. London: Springer; 2000: 255-69.
18. Vercauteren MP, Coppejans HC, Hoffmann VL, Saldien V, Adriaensen HA. Small-dose hyperbaric versus plain bupivacaine during spinal anesthesia for cesarean section. Anesth Analg 1998; 86: 989-93.
19. Rucklidge MW, Paech MJ, Yentis SM. A comparison of the lateral, Oxford and sitting

positions for performing combined spinal-epidural anaesthesia for elective Caesarean section. Anaesthesia 2005; 60: 535-40.
20. Køhler F, Sørensen JF, Helbo-Hansen HS. Effect of delayed supine positioning after induction of spinal anaesthesia for caesarean section. Acta Anaesthesiol Scand 2002; 46: 441-6.
21. Thomas JS, Koh SH, Cooper GM. Haemodynamic effects of oxytocin given as i.v. bolus or infusion on women undergoing Caesarean section. Br J Anaesth 2007; 98: 116-9.
22. Wright RG, Shnider SM, Levinson G, Rolbin SH, Parer JT. The effect of maternal administration of ephedrine on fetal heart rate and variability. Obstet Gynecol 1981; 57: 734-8.
23. Cooper DW, Carpenter M, Mowbray P, Desira WR, Ryall DM, Kokri MS. Fetal and maternal effects of phenylephrine and ephedrine during spinal anesthesia for cesarean delivery. Anesthesiology 2002; 97: 1582-90.

ผลการจัดท่า Trendelenburg กลับด้านต่ออุบัติการณ์ความดันเลือดต่ำในการระงับความรู้สึกโดยฉีดยาเข้าช่องน้ำไขสันหลังสำหรับการผ่าตัดคลอด

ชูทิศ กี่สกุล, ปริศนา แซ่โง้ว, ปัณฑ์ธีรา เอื้อรักษ์สกุล, เชิดเกียรติ กาญจนรชตะ

วัตถุประสงค์: *เพื่อพิสูจน์ว่าในผู้ป่วยที่มาทำผ่าตัดผ่าท้องคลอด การจัดท่าผู้ป่วยศีรษะสูง 10 องศา ขณะฉีดยาชาเฉพาะที่เข้าช่องน้ำไขสันหลัง และคงท่านี้ต่อเนื่องในระหว่างผ่าตัดคลอด สามารถลดอุบัติการณ์ความดันเลือดต่ำเมื่อเทียบกับท่านอนราบ*

วัสดุและวิธีการ: *ผู้ป่วยที่จะได้รับการระงับความรู้สึกโดยการฉีดยาชาเฉพาะที่เข้าช่องน้ำไขสันหลังเพื่อการผ่าตัดคลอด ถูกแบ่งเป็นสองกลุ่มโดยการสุ่ม กลุ่มศึกษาผู้ป่วยอยู่ในท่านอนศีรษะสูง 10 องศา ตั้งแต่ช่วงเวลาทำการฉีดยาชาเฉพาะที่จนกระทั่งผ่าตัดเสร็จ ส่วนกลุ่มควบคุมนอนราบเตียงระนาบกับพื้น บันทึกความดันเลือด อุบัติการณ์ความดันเลือดต่ำ ความต้องการยาเอฟีดรีนเพื่อเพิ่มความดันเลือด และระดับการชา เพื่อวิเคราะห์เปรียบเทียบ*

ผลการศึกษา: *พบว่าอุบัติการณ์ความดันเลือดต่ำและปริมาณยาเอฟีดรีนที่ต้องใช้เพื่อคงความดันเลือดในกลุ่มศึกษาน้อยกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ (ร้อยละ 36.36 ต่อ 68.18, p = 0.034 และ 4.36 มก. ต่อ 9.95 มก., p = 0.035 ตามลำดับ) ระดับการชาไม่ต่างกันแต่จำนวนผู้ร่วมการศึกษาในกลุ่มศีรษะสูงต้องถูกปรับระดับศีรษะเพื่อให้ได้ระดับชาเพียงพอมากกว่ากลุ่มนอนราบ*

สรุป: *การจัดท่าผู้ป่วยศีรษะสูง 10 องศา ขณะฉีดยาชาเฉพาะที่เข้าช่องน้ำไขสันหลังและคงท่านี้ต่อเนื่องในระหว่างผ่าตัดคลอด สามารถลดอุบัติการณ์ความดันเลือดต่ำและการใช้ยาเอฟฟีดรีนน้อยกว่าเมื่อเทียบกับท่านอนราบ และไม่มีผลเสียต่อมารดาและทารก*