

How Long Can Patients Sit Up for Before Lying Down after Combined Spinal-Epidural Anesthesia For Cesarean Delivery? A Randomized Trial

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Abstract

Objective: Sitting patients up for 5 min after spinal anesthesia decreases hypotension and ephedrine requirement. This study aimed at determining how long patients can sit up for after combined spinal-epidural (CSE) anesthesia without requiring epidural supplementation.

Methods: Ninety women booked for elective cesarean section under CSE anesthesia were randomized to sit up for 5 min (group 1), 7 min (group 2), or 9 min (group 3) after spinal anesthetic administration before lying down supine with a tilt. Sensory anesthesia level, systolic blood pressure, heart rate, ephedrine requirement, rescue epidural use, and time to achieving a modified Bromage score of two were documented by a blinded observer.

Results: The maximum height of sensory anesthesia was [T3 (1) vs. T4 (1) vs. T5 (1) for groups 1-3, respectively, $P < 0.001$]. Group 1 required more ephedrine (16.7% vs. 3.3% vs. 0%, $P = 0.024$). Changes over time in systolic blood pressure ($P = 0.117$) and heart rate ($P = 0.793$), and time to achieving a modified Bromage score of two [112 (17) vs. 110 (16) vs. 100 (28) min, $P = 0.437$] were similar amongst groups. Rescue epidural anesthesia was required in eight (26.7%) patients in group 3 compared to none in the other groups ($P < 0.001$).

Conclusion: Sitting the patient up for up to 7 min after CSE anesthesia for cesarean section reduced intraoperative ephedrine requirement without affecting the success of the spinal anesthetic. In contrast, sitting up for 9 min resulted in the need for rescue epidural anesthesia without additional benefit.

Keywords: Caesarean section; Spinal anaesthesia; Combined spinal-epidural; Ephedrine; Hypotension; Sitting position

Introduction

Combined spinal-epidural (CSE) anaesthesia is a frequently used technique for elective caesarean delivery [1] where the spinal component allows for the rapid onset of motor and sensory blockade whereas the epidural component confers the flexibility to supplement the block, if needed, intraoperatively and to extend the analgesia postoperatively. Hypotension [2], however, continues to be a challenging adverse effect of this anaesthetic technique despite routine left uterine displacement and efforts to limit the spread of local anaesthetic by reducing its dose [3,4] or changing the patient's position [5,6].

Among the non-pharmacological interventions studied to minimize the incidence of hypotension, our group and others have demonstrated that sitting patients up for 5 minutes (min) following the administration of spinal anaesthesia decreases both block height and the requirement for intravenous ephedrine without affecting the success and quality of anaesthesia [6,7]. However, it is not known if prolonged sitting for more than 5 min would further limit block height and decrease intravenous ephedrine requirement, and if it would compromise the success of the spinal anaesthetic. This particularly relevant when performing CSE anaesthesia since extra time is required to insert the epidural catheter and fix it after administering the spinal anaesthetic when using the spinal needle through the epidural needle technique. This concern has led some anaesthesiologist, when performing CSE anaesthesia, to insert the epidural catheter first and then use a different puncture site for the spinal, which inherently increases patient discomfort during the procedure. Accordingly, a randomized blinded study was undertaken to test the hypothesis that prolonged sitting for more than 5 min after CSE anaesthesia would limit block height and decrease the requirement for intravenous ephedrine

in pregnant women undergoing elective caesarean section. The aim of the study was to determine maximum length of time that patients can sit up after spinal anaesthetic administration without requiring intraoperative supplemental epidural anaesthesia.

Methods

This study was approved by our institutional Research and Ethics Committee, and was conducted at a tertiary care university hospital. Women booked for elective caesarean section under CSE anesthesia were screened for trial eligibility. They were considered "study eligible" if they were American Society of Anesthesiologists' physical class I or II, had a single viable fetus in utero, were 18-40 years of age, and had an uneventful pregnancy. Patients were not eligible for study participation if they were allergic to any of the study drugs, had chronic or pregnancy-induced hypertension, cardiac disease, diabetes mellitus, or a contraindication to neuraxial anaesthesia. Study eligible patients were invited by one of the authors (A.M.B. or S.F.A.) to participate in this randomized, single-blinded trial. A written informed consent was obtained from all patients prior to study enrollment and randomization.

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On call, ranitidine 50 mg IV and metoclopramide 10 mg IV were administered. In theatre, standard monitors were applied, 500 ml of 6% hydroxyl-ethyl starch (Voluven®, Fresenius Kabi, Bad Homburg, Germany) was infused over 30 minutes, and CSE anesthesia was performed by an anesthesiologist who did not care for the patient afterwards. After skin anesthesia with 3 ml 2% lidocaine, an 18-gauge Touhy needle (Portex®, Smiths Medical, UK) was inserted into the epidural space in the sitting position at L3-4 or L4-5 interspace using loss of-resistance to air technique. A 27-gauge (120 mm) Whitacre spinal needle (BD™, UK) was then passed through the Touhy needle into the subarachnoid space and 2 ml of 0.5% hyperbaric bupivacaine mixed with fentanyl 20 µg was injected slowly into the subarachnoid space without barbotage. The epidural catheter was then inserted leaving 5 cm of catheter length in the epidural space. The catheter was fixed in the usual fashion and no local anesthetic was injected through.

Permuted block randomization (block size of six) was performed by a research assistant using a computer-generated randomization schedule and sealed opaque, serially numbered envelopes. Patients were equally randomized to continue sitting up for either 5 minutes (group 1), 7 minutes (group 2), or 9 minutes (group3) after administration of the spinal anesthetic, and then lie down to a left-tilted (15 degrees) supine position. The timer was started immediately after the spinal needle was withdrawn and before the epidural catheter was inserted. After the patient was in the supine position, a second anesthesiologist blinded to patient's group assignment, looked after the patient and recorded the study outcomes. Oxygen 2 L min⁻¹ was administered via nasal prongs until the baby was delivered. Systolic blood pressure (SBP) and heart rate were recorded (Zeus® anesthesia workstation, Dräger Medical, Lübeck, Germany) at baseline and then every 2 minutes (for a total of 20 minutes) after the administration of the spinal component of CSE anesthesia. Using ice cubes, the blinded anesthesiologist determined the highest sensory anesthesia level achieved. A minimum of T6 sensory level was required for surgery to commence. If the block height was less than T6, 2% lidocaine 5 ml was administered epidurally and the block height was re-checked after 10 min. This dose was repeated twice at 10 min intervals if the block height was still below T6. Pain after the start of surgery was treated with 5 ml 2% lidocaine epidurally, repeated at 10 min intervals to a maximum dose of 20 ml to achieve a visual analogue scale of <2/10. Intraoperative fluid management using Ringer's lactate was not standardized and left to the discretion of the anesthesiologist. Hypotension (>20% decrease in SBP from baseline value and/or an SBP <100 mm Hg) was treated with ephedrine 5 mg IV, repeated every 2 minutes to achieve an SBP within 20% of the baseline value or an SBP >100 mmHg. Once the placenta was delivered, oxytocin 5 Unit IV was administered slowly followed by an infusion of Ringer's Lactate (with oxytocin 40 Unit L-1) at a rate of 200 ml h⁻¹. Surgery time, total amounts of intraoperative fluid and ephedrine administered, blood loss, urine output, and neonatal Apgar scores at 1 and 5 minutes were recorded. In the post-anesthesia care unit (PACU), time to motor recovery as determined by achieving a modified Bromage score of two [8] (1=unable to move feet or knees; 2=able to move feet only; 3=just able to move knees; 4=full flexion of knees; 5=no detectable weakness of hip flexion while supine; 6=able to perform partial knee bend) was documented by a blinded nurse. Adverse events such as intraoperative nausea, vomiting, itching, shortness of breath, and postoperative headache were also recorded.

Statistical Analysis

Assuming that the failure rate (patient required epidural supplement in the operating room at any time) for controls (group 1) was 1% and

for experimental subjects (groups 2 and 3) was 25%, 60 experimental subjects and 30 controls were required to be able to reject the null hypothesis that the failure rates for experimental and control subjects were equal with a two-sided < of 0.05 and power of 0.8. Fisher's exact test was used to evaluate this null hypothesis and other proportions.

Repeated measures analysis of variance was used to analyze SBP and heart rate data, and adjustment for multiple comparisons was made using Bonferroni's method. Normally distributed data were analyzed using one-way analysis of variance (ANOVA), and skewed data (intraoperative ephedrine and Apgar scores) were analyzed using Kruskal-Wallis test. All analyses were performed using the intention-to-treat principle, and all statistical procedures were conducted using IBM® SPSS® Statistics package, version 19 (IBM Corporation, Somers, NY). Data are presented as mean (SD), unless otherwise specified, and statistical significance was assumed when *P*<0.05.

Results

A hundred and ten patients were assessed for eligibility to participate in the study. Ten patients did not meet the inclusion criteria, 10 refused to participate in the study, and ninety patients gave consent, where randomized, and completed the study without protocol violation or loss to follow up. Baseline characteristics and surgery time were similar among the three study groups (Table 1). The maximum sensory block height was highest in group 1 and lowest in group 3 (Table 1, *P*<0.001) but none of the study patients required epidural supplementation before the start of surgery. However, eight (26.7%) patients in group 3 complained of pain (visual analogue scale >40/100) during surgery and required supplemental epidural anaesthesia (Table 1, *P*<0.001). On the other hand, none of the patients in group 3 received ephedrine, compared with one (3.3%) patient in group 2 and 5 (16.7%) patients in group 1 (Figure 1, *P*=0.022). There were no differences among the study groups with regard to SBP (Figure 2A, *P*=0.117) or HR (Figure 2B, *P*=0.793) changes during the study period. Also, intraoperative fluid requirements, blood loss, urine output, neonatal Apgar scores at 1 and 5 min, and time to achieving a modified Bromage score of 2 were similar amongst the study groups (Table 1). Two (6.9%) patients

	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)	P-value
Age (yr, [range])	31 (7) [21-50]	30 (5) [20-40]	30 (5) [20-42]	
Weight (kg)	79.5 (12.6)	78.1 (12.7)	79.0 (13.8)	
Height (cm)	157.7 (4.5)	157.6 (4.7)	156.9 (4.8)	
Parity (n)	1 (1)	1 (1)	1 (1)	
ASA class (I/II)	24/6	22/8	21/9	
Surgery time (min)	52 (3)	53 (4)	53 (3)	
Fasting duration (h)	9.9 (1.5)	9.9 (1.2)	9.9 (1.5)	
Intraoperative fluid (ml)	628 (307)	590 (297)	575 (283)	
Intraoperative blood loss (ml)	593 (105)	591 (101)	587 (100)	
Intraoperative urine output (ml)	100 (20)	113 (40)	104 (21)	
Apgar scores at 1 min	8 (1)	8 (1)	8 (1)	
Apgar scores at 5 min	10 (1)	10 (1)	10 (1)	
Sensory level (n)				<0.001
T1	2 (6.7%)	0	0	
T2	15 (50%)	0	0	
T3	9 (30%)	1 (3.3%)	0	
T4	3 (10%)	17 (56.7%)	2 (6.7%)	
T5	1 (3.3%)	12 (40%)	14 (46.7%)	
T6	0	0	14(46.7%)	
Epidural supplementation (n)	0	0	8 (26.7%)	<0.001
Time to Bromage score 2 (min)	112 (17)	110 (16)	105 (28)	0.437

Table 1: Baseline characteristics and patient outcomes ASA: American Society of Anesthesiologists. Data shown as mean (SD) or absolute numbers.

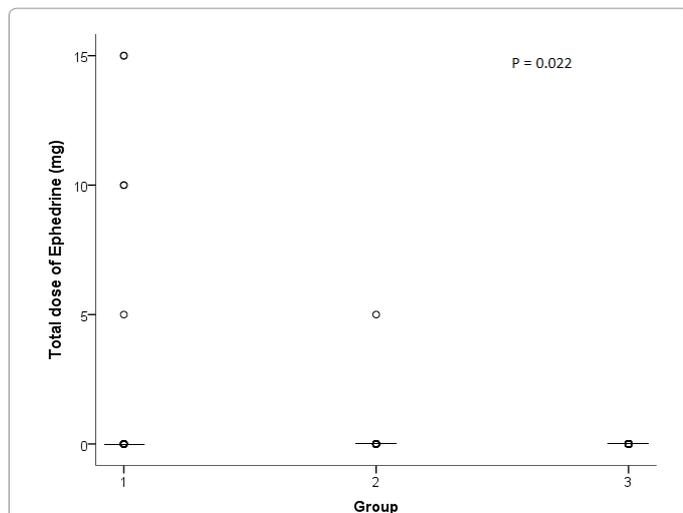


Figure 1: Total dose of ephedrine required during the study. Group 1=Sitting up for 5 minutes after spinal anaesthetic administration; Group 2=Sitting up for 7 minutes after spinal anaesthetic administration; Group 3=Sitting up for 9 minutes after spinal anaesthetic administration. The solid horizontal line (●) represents the median for all groups, and the circles (○) represent the total dose administered to either one patient or several superimposed patients.

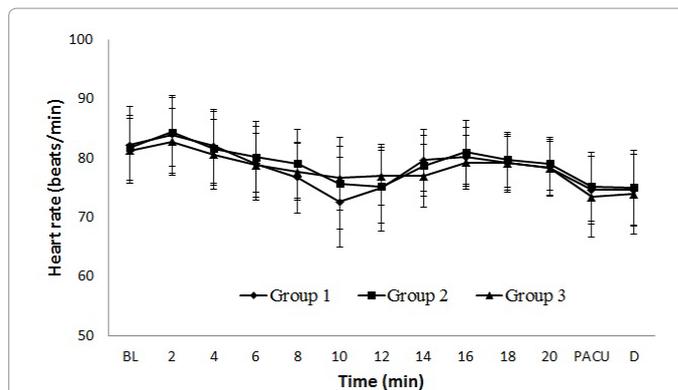


Figure 2b: Change in heart rate during the study period. Group 1=Sitting up for 5 minutes after spinal anaesthetic administration; Group 2=Sitting up for 7 minutes after spinal anaesthetic administration; Group 3=Sitting up for 9 minutes after spinal anaesthetic administration. Heart rate decreased from baseline value in all groups during the study period ($P=0.025$ for test of within-subjects effects), but there was no difference among the study groups over time ($P=0.793$ for test of between-subjects effects). Data presented as mean (SD). BL=baseline; $n=n$ minutes after administration of spinal anaesthetic; PACU=post-anesthesia care unit; D=discharge from PACU.

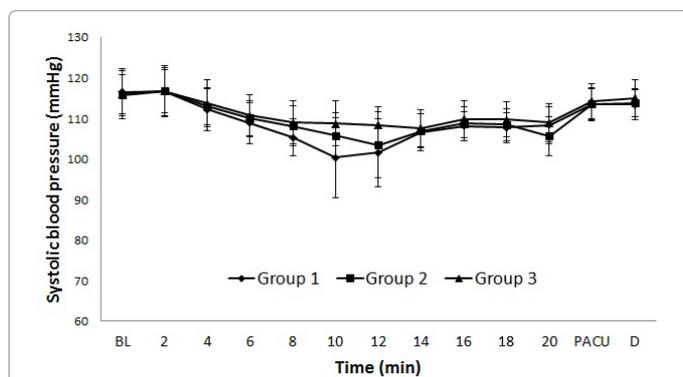


Figure 2a: Change in systolic blood pressure during the study period. Group 1=Sitting up for 5 minutes after spinal anaesthetic administration; Group 2=Sitting up for 7 minutes after spinal anaesthetic administration; Group 3=Sitting up for 9 min after spinal anaesthetic administration. Systolic blood pressure decreased from baseline value in all groups during the study period ($P<0.001$ for test of within-subjects effects), however, there was no difference among the study groups over time ($P=0.117$ for test of between-subjects effects). Data presented as mean (SD). BL=baseline; $n=n$ minutes after administration of spinal anaesthetic; PACU=post-anesthesia care unit; D=discharge from PACU.

in group 1 and one (3.3%) in group 2 complained of shortness of breath intraoperatively ($P=0.341$). Shivering occurred in 7 (24.1%) vs. 4 (13.3%), vs. 8 (26.7%) patients in groups 1-3, respectively ($P=0.409$). Itching was experienced by 6 (20.7%) patients in groups 1 and 2 each, compared with 8 (26.7%) patients in group 3 ($P=0.794$). Only one (3.3%) patient in group 1 complained of nausea intraoperatively, but none of the study patients had intraoperative vomiting or post-dural puncture headache.

Discussion

This study demonstrated that sitting patients up for up to 7 min after administering the spinal anaesthetic component of CSE anaesthesia for elective caesarean section was associated with limited

cephalic spread of the local anaesthetic and decreased requirement for ephedrine administration to treat spinal anaesthesia-associated hypotension. Furthermore, prolonged sitting for 9 min after spinal anaesthesia administration was associated with significantly decreased sensory block height and the lack of need for ephedrine administration to maintain systolic blood pressure. This, however, was achieved at the cost of increasing the requirement for supplemental epidural anaesthesia during an average length surgery in this patient population.

Several factors have been shown to affect the cephalad local anaesthetics when injected into the subarachnoid space including lumbosacral cerebrospinal fluid volume [9], local anaesthetic dose [3] and baricity [7], and patient position [3,6,10,11]. Except for the latter, none of these factors were altered in the current study, and hence, the observation that prolonged sitting progressively limited the sensory height of the subarachnoid block was attributed solely to the length of time spent in the sitting position. These findings are in keeping with those reported by others [6,10,11]. However, this is the first study that demonstrated that patients can set up for up to 7 min without compromising the success of the spinal anaesthetic. This time should be long enough to insert an epidural catheter and fix it during CSE anaesthesia, and thus should obviate the need for placing the epidural catheter first and performing the spinal block afterwards using a second puncture site, a practice which would inherently increase patient discomfort during the procedure. It should also allow for the safe transition of the patient to a tilted or wedged supine position without having to rush things up, as usually happens in current practice, to "prevent" an inadequate sensory block height.

The need for intravenous ephedrine to support blood pressure was virtually non-existent with prolonged sitting and was correlated with the height of the sensory block achieved in each study group. This is consistent with the finding that spinal anaesthesia-induced hypotension is directly related to the degree of sympathetomy caused by the cephalad spread of the local anaesthetic [12]. In contrast, Yun et al. [5] have demonstrated that sitting patients up during CSE anaesthesia is associated with more hypotension and increased need for ephedrine. This, however, could be explained by the higher dose of local anaesthetic administered (12.5 mg 0.75% hyperbaric bupivacaine)

and the higher sensory block achieved (T3-C7) in their study compared with ours. In addition, the current study used a colloid for preloading whereas a crystalloid preload was used in Yun's study [5]. Dhalgren et al. have eloquently demonstrated that patients undergoing caesarean delivery under spinal anaesthesia and receiving a crystalloid preload has a higher frequency of hypotension and a greater need for ephedrine compared with those receiving a colloid preload [2]. Despite colloid preload and treatment with ephedrine, SBP decreased within 20% of baseline values in each study group. This could be explained by the rapid onset of sympathectomy [13] and by aorto-caval compression caused by the uterus despite the tilted supine position [14]. It also supports the notion that no intervention can reliably eliminate spinal anaesthesia-induced hypotension [15]. Nonetheless, it was anticipated that there would be no difference among study groups with regard to SBP changes over time during the study period due to colloid preloading [15] and the prompt treatment of hypotension with ephedrine.

Although hyperbaric solutions have been shown to move downward when injected in the subarachnoid space due to gravity [16], postoperative motor recovery as assessed by the modified Bromage score was similar amongst the study groups. This suggests that perhaps the dose and baricity of the spinal local anaesthetic are more important in determining motor recovery than patient position during the block. Interestingly, about a quarter of group 3 patients also received supplemental epidural anaesthesia intraoperatively without affecting their motor recovery. This could be attributed in part to the lack of statistical power to detect a difference had it truly existed (this was not the study's primary end point) and in part to the use of 2% lidocaine which has a relatively short clinical duration compared with bupivacaine.

A potential limitation of the current study is the lack of patient blinding. This, however, was not possible given that the patients were awake throughout the procedure. Any potential bias should have been minimized by blinding the data collector and the anaesthesiologist who managed the patient intraoperatively after the patient assumed the tilted supine position. Another potential limitation is the lack of documentation of time to epidural supplementation among those who required it during surgery. Given that any intraoperative epidural supplement was considered a failure of the subarachnoid block regardless of the time of supplement administration, this potential limitation should not affect the results of the primary research question.

In conclusion, this study demonstrated that in patients undergoing caesarean delivery using CSE anaesthesia, the maximum "allowable" time for patients to sit up after the administration of the spinal anaesthetic was 7 minutes. Given the increased need for intraoperative supplemental epidural anaesthesia and the very limited hemodynamic benefit, sitting up for 9 min after the administration of spinal anaesthesia should be avoided.

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