Incidence of Hypotension in Patients Undergoing Subarachnoid Block in Sitting versus Lateral Decubitus Position in Elective Lower Limb Surgeries

Paudel B,[1] Paudel S,[1] Gautam S,[1] Shrestha KK[2]

[1]Department of Anesthesiology and Critical Care and Pain Management

Nobel Medical College and Teaching Hospital,

Biratnagar, Nepal.

[2]Edenburgh International College,

Purbanchal University,

Nepal.

Corresponding Author

Bandana Paudel,

Department of Anesthesiology and Critical Care and Pain Management

Nobel Medical College and Teaching Hospital,

Biratnagar, Nepal.

E-mail: dr.bandana.nobel@gmail.com

Citation

Paudel B, Paudel S, Gautam S, Shrestha KK. Incidence of Hypotension in Patients Undergoing Subarachnoid Block in Sitting versus Lateral Decubitus Position in Elective Lower Limb Surgeries. *Kathmandu Univ Med J.* 2025; 92(4): 529-33.

ABSTRACT

Background

Subarachnoid block (SAB) is a widely practiced regional anesthetic for lower limb surgeries. The patient position for subarachnoid block induction, either sitting or lateral decubitus, may affect hemodynamic stability and block quality.

Objective

To compare the incidence of hypotension and the onset times of block in these two positions.

Method

In this prospective single-center observational comparative study, 108 patients, who were scheduled to undergo elective lower limb surgery, were equally assigned to subarachnoid block in sitting position (SP) and Lateral decubitus position (LP) groups. An intrathecal dose of hyperbaric Bupivacaine 0.5% (15 mg) was given. Hemodynamic variables, onset of sensory and motor block, maximum level of sensory and motor block and any complications including hypotension and bradycardia were recorded and compared. Categorical variables were analyzed using the Chi-square test, and continuous variables were compared using the unpaired Student's t-test.

Result

The incidence of hypotension was greater in sitting position group (20.41%) than in LP group (16.67%), but the difference was not statistically significant. Out of these, bradycardia was more frequent in sitting position (9.2%) as compared to lateral decubitus position (7.4%). The onset times of sensory and motor blocks in the lateral decubitus position group were significantly shorter ($p < 0.05$).

Conclusion

Lateral decubitus position results in superior early hemodynamic stability and shorter time to sensory and motor block onset as compared to sitting in subarachnoid block for elective lower limb surgeries.

KEY WORDS

Bradycardia, Hemodynamic stability, Hypotension, Subarachnoid block

INTRODUCTION

The subarachnoid block (SAB) technique is a commonly used regional anesthesia technique that has been proven to be safe and effective for procedures performed below the umbilicus. It is usually done with the patient in lateral decubitus or sitting position, the preference influenced by the type of surgery, the patient's characteristics, and the anesthetist's choice.[1,2] Complications related to spinal anaesthesia also depend on features such as the type of needle used, dosage and concentration of the anesthetic drug, patient weight and height, needle placement technique and patient position.[3,4] Bradycardia and hypotension are frequently observed as early adverse events, whereas headache constitutes the most prevalent late-onset complication.[4,5]

Subarachnoid block (SAB) may be administered in the lateral decubitus, sitting or prone position, with the lateral and sitting positions being most commonly employed. In patients receiving general anesthesia, the procedure is frequently initiated in the supine position, followed by rapid transition to the sitting posture, a maneuver that predisposes to postural hypotension.[5,6] Hypotension lasting for a long time with severe effects was found in the healthy individual in caesarean section carried out under the combination of spinal-epidural anesthesia, and SAB from the sitting position was pointed out.[7] However, a study in elderly patients comparing SAB induced in sitting versus lateral decubitus positions found that anesthesia onset was faster in the sitting position, though there were no significant differences in hemodynamic stability or motor block onset between the two positions.[8] Furthermore, only limited studies were done on such topic so this study aims to compare the incidence of hypotension in patients undergoing subarachnoid block in sitting versus lateral decubitus position in elective lower limb surgeries.

METHODS

This prospective single-center observational comparative study was conducted in the orthopedic operating theatre of Nobel Medical College Teaching Hospital from April 2024 to April 2025. Ethical clearance was obtained from the Institutional Review Committee (IRC ref.no 11/2024), and written informed consent was obtained from patients during the preanesthetic evaluation. The sample size was calculated from the results of a previous study that reported an incidence of hypotension of 50% in the lateral position (LP) and 76.3% in the sitting position (SP) during spinal anesthesia with 80% power and a 5% significance level, where the confidence interval was 95%.1 Using the formula for comparing two independent proportions,

$$n = (Z\alpha/2 + Z\beta)^2 \times [p1(1 - p1) + p2(1 - p2)] / (p1 - p2)^2$$

where p1 and p2 represent the expected proportions in the two groups, $Z\alpha/2$ is the standard normal deviate corresponding to a two-sided significance level of 5% (1.96), and $Z\beta$ is the standard normal deviate corresponding to a power of 80% (0.84). So, the minimum sample size calculated was approximately 49 patients, and 10% non-response rate was added to cover up probable attrition, so the actual sample size was 54 patients for each study group. In our study, patients of ASA III and IV, patients who refused to give consent, patients on sedatives, opioids or a depressant, and patients who had a history of hypersensitivity to spinal anesthesia were excluded from our study. A total of 108 patients were randomly divided into two groups of 54, each according to position during anesthesia injection, viz. Group SP consisted of patients who received spinal anesthesia in the sitting position, while Group LP comprised those who underwent the procedure in the lateral decubitus position.

All the patients were examined a day before surgery with a detailed preanesthetic evaluation. All the protocols and study procedures were explained thoroughly to all the patients, and written informed consent was obtained from all patients. All patients received tab. Pantoprazole 40 mg orally on the evening prior to surgery, and nil per oral for at least 8 hours before surgery was also maintained. After explaining the procedure to the patient, an 18 G intravenous cannula was inserted in the non-dominant hand of the patient, who also received 20 mL/kg of intravenous (i.v.) Ringer lactate solution 15 minutes before the administration of spinal anesthesia. Standard ASA monitors were attached, and baseline heart rate, blood pressure, oxygen saturation, and ECG were recorded. Patients were positioned by transitioning from lying flat on their back to sitting upright, keeping their legs extended straight on the operating table with knees fully straightened. For lateral position, the patients were made to lie in lateral position on the operating table with the knees and hips in flexion. The position of the table was kept horizontal. Under all aseptic precautions the Dural puncture was done at L3-L4 or L4-L5 level either in the sitting or lateral position using midline approach with 25-gauge Quincke's spinal needles. After confirming free flow of cerebrospinal fluid, 3 mL (15 mg) of 0.5% hyperbaric bupivacaine was administered at a rate of 0.5 mL per second, with the needle bevel oriented parallel to the cephalad direction. Following the injection, patients were promptly positioned supine. Following the spinal injection, patients were assessed every three minutes for the first 15 minutes and subsequently every five minutes for the next 45 minutes. Parameters recorded included maximum sensory and motor block levels, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and peripheral oxygen saturation (SpO_2). Sensory blockade was evaluated along the midaxillary line using both pinprick and alcohol swab methods. The onset of sensory block was defined as the interval from injecting spinal drug in subarachnoid space ('0' time) to the loss of sensation at the knee joint (L1). Maximum sensory block level was tested by pinprick and alcohol swab in midclavicular line every minute until the level had stabilized for two consecutive tests. The time required to attain the maximum sensory block level was recorded. Motor block onset was defined as the time interval from the intrathecal injection of the anesthetic agent (considered as time zero) to the point at which the patient could flex the knee and ankle but was unable to elevate the extended leg. This was tested every 10 seconds up to the onset. Degree of motor block was assessed using a 4-point Bromage score {0- (no motor block) full flexion of knees and feet, 1-(partial) just able to move knees and feet; hip blocked; 2-(almost complete) able to move feet only; hip and knee blocked; 3-(complete) unable to move knees and feet; hip, knee and ankle blocked.

Baseline systolic blood pressure and heart rate were recorded before administration of spinal anesthesia. Blood pressure and heart rate were then recorded at 3-minute intervals for the first 15 minutes and at 5-minute intervals for the next 45 minutes. Hypotension was defined as a decrease in systolic blood pressure > 25% from the baseline value, and bradycardia was defined as a decrease in heart rate > 25% from baseline. Any episode meeting these criteria during the intraoperative period was documented and counted indidence. All measurements were recorded by a fellow anesthesiologist or nurse present in operating room. Hypotension was managed by elevating the legs, administering an intravenous fluid bolus of 200 mL normal saline over 10 minutes, and giving 3 mg of intravenous Mephentermine, repeated every three minutes until the systolic blood pressure (SBP) dropped by less than 25% from the baseline. Bradycardia was treated by giving injection atropine 0.6 mg intravenously. Injection ondansetron 4 mg i.v. was given for nausea and vomiting.

All the data were recorded in Microsoft Excel and Data analysis was done using SPSS (Statistical packages of social science) windows version 21.0. Mean, standard deviation (SD) and percentage (%) were expressed with graphical and tubular form. The discrete and categorical variables were analyzed using Chi-square test. Continuous variables were analyzed using unpaired t-test. The p-value less than 0.05 was considered statistically significant.

RESULTS

In this study, total 108 patients (Group SP- 54 patients, Group LP- 54 patients) who came for lower limb surgeries were enrolled and analyzed. Patients of both groups were comparable according to demographic data, such as age, gender, height, weight, ASA status and mean surgery time as shown in table 1.

The mean heart rate and systolic blood pressure were comparable in both groups. There was decrease in SBP in both groups throughout the time period, but significantly lower in SP group than LP group up to initial 12 minutes (p < 0.01) (Fig. 1]. The lowest SBP was 81 mmhg in group SP and 85 mmhg in group LP. Furthermore, heart rate showed no significant difference between two groups (Fig. 2).

Table 1. Demographic data

Variable	Group SP (n=54)	Group LP (n=54)	p-value
Mean Age ± SD (Years)	58.41±8.14	56.83±8.69	0.33
Gender (Male/Female)	45/9	41/13	0.34
Mean height ± SD (cm)	159.26±6.34	158.54±7.09	0.58
Mean weight ± SD (Kg)	61.27±7.10	59.80±5.99	0.14
ASA (I/II)	16/38	12/42	0.38
Mean Surgery time in min ± SD	103.25±9.87	104.98±10.39	0.375

SD: Standard deviation; ASA: American society of anesthesiologists; chi-square test was applied; independent t-test was applied

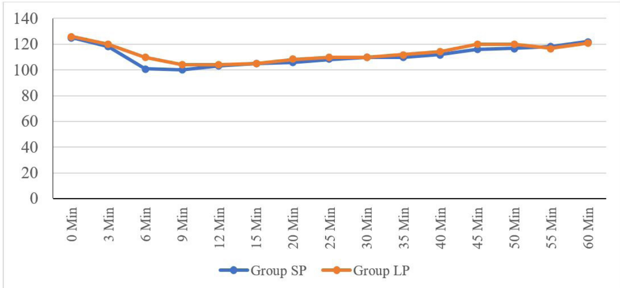

Figure 1. Comparison of mean systolic blood pressure at various intervals

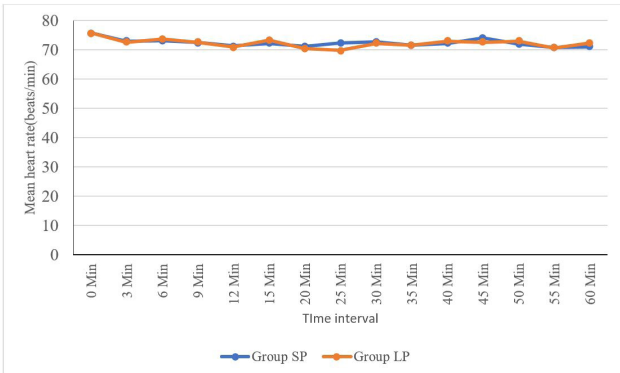

Figure 2. Comparison of mean heart rate at various intervals

In present study, Onset of sensory block after spinal anesthesia was significantly faster in group LP [1.29±0.88] than group SP [2.42±1.22] and time required to achieve maximum level of sensory block was also significantly slower in group SP [7.82±2.01] as compared to group LP [6.66±1.82] (Table 2). Furthermore, Onset of motor block after spinal anesthesia was significantly slower in group SP [3.42±1.96] than group LP [5.72±2.32]. Similarly, the time required to achieve maximum motor level was significantly higher in group SP [7.82±2.01] than group LP [6.66±1.82] (Table 2). A 4-point Bromage score was used to accessed degree of motor block and the score was three in all patients in both groups, so there was no significant difference.

Table 2. Sensory and Motor Block

Variable	Group SP (n=54)	Group LP (n=54)	p-value
Mean onset time of Sensory block in min ± SD	2.42±1.22	1.29±0.88	<0.001
Mean time required for max-imum sensory level in min ± SD	7.82±2.01	6.66±1.82	0.002
Mean onset time of motor block in min ± SD	3.42±1.96	2.42±2.32	0.017
Mean time required for max-imum motor level in min ± SD	8.82±3.22	7.25±2.32	0.0045

SD: Standard deviation; ASA: American society of anesthesiologists; unpaired t-test was applied

In this study, the incidence of hypotension and bradycardia was slightly higher in Group SP compared to Group LP. Where, 20.41% of patients had hypotension in Group SP and 16.67% in Group LP, while bradycardia was observed in 9.2% of Group SP and 7.4% of Group LP (Table 3). However, these differences were not statistically significant.

Table 3. Intraoperative side effects

Variable	Group SP (n=54)	Group LP (n=54)	p-value
Hypotension	11(20.41%)	8(16.67%)	0.620
Bradycardia	5(9.2%)	4(7.4%	0.696

Chi-square test was applied

DISCUSSIONS

Numerous factors, including age, height, the concentration and dosage of the local anesthetic agent, the patient's posture, the needle's orientation, and repeated drug injections, affect the degree of sensory and motor blockages that are caused by injecting the anesthetic agent into the CSF. One of the most frequent causes of hypotension following spinal anesthesia is a high degree of sensory block.[5]

In present study hypotension was statistically significantly higher in sitting position as compared to lateral position (20.41% vs 16.67 %) proving the fact that participants position during induction does play a pivotal role in development of hypotension. A study done at by Obasuyi et al.[9] corelates with our findings where hypotension was significantly lower in lateral position than in relation to sitting position. Furthermore, Obasuyi et al., Befkadu et al. and Simin et al. also reported lower incidence of hypotension in lateral position as compared to sitting position.[9-11] Studies have shown that in the sitting position, the hyperbaric local anesthetic spreads more caudally due to the effect of gravity, while in the lateral position it spreads more cephalad.[12,13] So, the level of block is higher in the lateral position when hyperbaric local anesthetics are used, and the likelihood of hypotension is increased.[14] Overall, bradycardia was reported higher in sitting as well in our study in compared with lateral position. Kongur et al. also observed consistent result in the study where bradycardia was most commonly reported in sitting position.[3]

In the present study, it was observed that both groups were comparable with respect to age, gender, height, weight and BMI and no statistically significant difference in their mean values. However, the mean age in our study which was 58.41 and 56.83 in two groups, differs with the findings of Sarkar et al. where mean age was above 65 in both groups.[8] This variation could be due to inclusion criteria of Sarkar's study, which focused only elderly patients.[8]

Blood pressure was affected by the position used for induction of spinal block.[18] Studies done by, Befkadu et al, Simin et al. and Manouchehrian et al. showed that mean systolic blood pressure of patients under spinal anesthesia in the sitting position were significantly lower than those of patients in the lateral position ($p < 0.05$).[10,11,15] These findings were consistent with our study, where mean systolic blood pressure was significantly lower in SP group than LP group up to initial 12 minutes ($p < 0.01$). Meanwhile, our results differs from those of out Akash et al, who found a significant increase in systolic blood pressure in SP group than LP group between 15 to 30 minutes ($p < 0.001$).[16] No significant difference was observed between the two groups for heart rate at any stage from the baseline until 20 minutes in our study. These findings were consistent with studies done by Manouchehrian et al. and Shahzad et al.[15,17]

Moreover, we also found that the onset of spinal anesthesia was slower in the sitting position compared to the lateral position, and this difference was statistically significant ($p < 0.001$). This finding agrees with Befkadu et al, who also reported a faster sensory block onset in the lateral position than sitting ($p < 0.001$).[10] However, Shahzad et al. reported the opposite, with a quicker onset in the sitting position than lateral (4.5 vs. 5.4 minutes, $p < 0.006$).[17] Additionally, in our study, the motor block started more slowly and took longer to reach its maximum level in the sitting position compared to lateral, which is consistent with Befkadu et al. results.[10]

This study had some limitations. It was carried out at a single center with a relatively small participant pool, which may restrict the generalizability of the findings to other settings and populations. We also analyzed only patients undergoing elective lower limb surgery, so these results may not be applicable to other procedures. We were only able to non-invasively assess hemodynamic changes, and did not employ advanced measurements of cardiac output as these were not available to us. Anatomical variations between the patients and difficulties in patient positioning in the lateral group might have influenced the results. Lastly, we did not evaluate anesthetist preference or experience with each position, which might influence the ease and outcomes of spinal anesthesia.

CONCLUSION

It is concluded that placing patients in the sitting position for spinal anesthesia resulted in slower onset times for both sensory and motor blocks, along with less hemodynamic stability compared to the lateral decubitus position. While there was slightly more hypotension and bradycardia in the sitting group, the differences had no clinical significance. The findings indicate that the lateral position may be preferred in spinal anesthesia for lower limb surgery in regard to early hemodynamic changes.

REFERENCES

1. Baral BK, Poudel PR, Regmi S, Karki AJ, Koirala P, Shah A, et al. Subarachnoid block in prone position for lower limb surgery. *J Nepal Health Res Counc.* 2021;18(4):801–3.
2. Gupta K, Rastogi B, Gupta PK, Rastogi A, Jain M, Singh VP. Subarachnoid block with Taylor's approach for surgery of lower half of the body and lower limbs: a clinical teaching study. *Anesth Essays Res.* 2012;6(1):38–41.
3. Kongur E, Saylan S, Eroğlu A. The effects of patient position on early complications of spinal anesthesia induction in arthroscopic knee surgery. *Acta Clin Croat.* 2021;60(1):68–74.
4. Doelakeh ES, Chandak A. Risk factors in administering spinal anesthesia: a comprehensive review. *Cureus.* 2023;15(12):e49886.
5. Kelly JD, McCoy D, Rosenbaum SH, Brull SJ. Haemodynamic changes induced by hyperbaric bupivacaine during lateral decubitus or supine spinal anaesthesia. *Eur J Anaesthesiol.* 2005;22(9):717–22.
6. Sharma HM, Khandelwal M, Beniwal S, Gurjar SS, Sharma S. Comparison of sitting versus lateral decubitus position during spinal anaesthesia on the occurrence of post-dural puncture headache. *Indian J Anaesth*. 2022;66(10):738–40.
7. Yun EM, Marx GF, Santos AC. The effects of maternal position during induction of combined spinal-epidural anesthesia for cesarean delivery. *Anesth Analg.* 1998;87(3):614–8.
8. Sarkar V, Kakodiya PS, Lemos CL, Dwivedi C, Singh M, Tamaskar A, et al. Comparative study of sitting versus lateral position for induction of spinal anesthesia in elderly patients. *Int J Life Sci Biotechnol Pharm Res.* 2024;13(11):592–6.
9. Obasuyi BI, Ogan SF, Mato CN. A comparison of the haemodynamic effects of lateral and sitting positions during induction of spinal anaesthesia for caesarean section. *Int J Obstet Anesth.* 2013;22(2):124–8.
10. Befkadu A, Timerga S, Mihretu F, Seyoum F, Alimawu AA. Sitting versus lateral position during induction of spinal anesthesia for elective cesarean delivery on block characteristics and severity of hypotension. *Int J Surg Open.* 2024;62(4):431–439.
11. Simin A, Naghipour B, Hojjat P, Farzin H, Saeede M, Pouya H. Effect of position during induction of spinal anaesthesia for caesarean section on maternal haemodynamics. *J Clin Diagn Res.* 2018;12(2):UC01–UC04.
12. Loubert C, Hallworth S, Fernando R, Columb M, Patel N, Sarang K, et al. Does the baricity of bupivacaine influence intrathecal spread in prolonged sitting position before elective cesarean delivery? *Anesth Analg*. 2011;113(4):811–7.
13. Wen C, Xiang YY, Pang QY, Liu HL. Effects of neuraxial anesthesia in sitting and lateral positions on maternal hemodynamics in cesarean section. *PLoS One*. 2024;19(5):e0303256.
14. Hwang JW, Oh AY, Song IA, Na HS, Ryu JH, Park HP, et al. Influence of a prolonged lateral position on induction of spinal anesthesia for cesarean delivery. *Minerva Anestesiol.* 2012;78(6):646–652.
15. Manouchehrian N, Moradi A, Torkashvand L. Comparative study of effect of spinal anesthesia in sitting and lateral positions on onset time of sensory block and hemodynamic condition in cesarean section. *Anesth Pain Med.* 2021;11(1):e111483.
16. Akash T, Swati D. Comparison of sitting and lateral position in spinal anesthesia during orthopaedic surgery. *Int J Novel Res Dev.* 2024;9(6):e162–e174.
17. Shahzad K, Afshan G. Induction position for spinal anaesthesia: sitting versus lateral position. *J Pak Med Assoc*. 2013;63(1):11–15.