Original Research Article

A COMPARATIVE STUDY OF THE EFFECT OF 10 DEGREE REVERSE TRENDELENBERG POSITION VERSUS SUPINE POSITION ON SUBARACHNOID BLOCK IN ELECTIVE LOWER LIMB SURGERIES

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ABSTRACT

Background: Patient positioning following spinal anaesthesia influences the intrathecal spread of hyperbaric local anaesthetics and may affect block characteristics, haemodynamic stability, and postoperative analgesia. Limited evidence exists regarding the effect of a precisely measured 10° Reverse Trendelenburg position following administration of 0.75% hyperbaric ropivacaine. The aim is to compare the effects of a 10° Reverse Trendelenburg position with the conventional supine position following subarachnoid block on sensory and motor block characteristics, haemodynamic parameters, and duration of analgesia in patients undergoing elective lower limb surgeries.

Materials and Methods: This prospective, randomized comparative study included 60 ASA I–II patients aged 18–60 years undergoing elective lower limb surgeries under spinal anaesthesia. Patients were randomly allocated into two groups: Group T (10° Reverse Trendelenburg; n=30) and Group S (supine position; n=30). All patients received 2.5 mL of 0.75% hyperbaric ropivacaine intrathecally. Sensory and motor block characteristics, haemodynamic variables, oxygen saturation, and duration of analgesia were assessed. Statistical analysis was performed using the Independent Student's t-test, Mann–Whitney U test, and Chi-square test, with $p<0.05$ considered statistically significant.

Results: Baseline demographic characteristics were comparable between the groups. Group T demonstrated a significantly lower maximum sensory block level (predominantly T10 vs. higher thoracic levels in Group S; p=0.04), prolonged two-segment regression time (98.60±18.55 vs. 84.93±14.22 min; p=0.002), longer motor block duration (112.33±21.44 vs. 89.67±12.77 min; p=0.002), and significantly prolonged postoperative analgesia (246.10±26.03 vs. 202.77±20.35 min; p<0.0001). Although the onset of sensory and motor blockade was slightly slower in Group T, patients maintained significantly higher systolic blood pressure and mean arterial pressure throughout most of the intraoperative period.

Conclusion: A goniometrically measured 10° Reverse Trendelenburg position following spinal anaesthesia with 0.75% hyperbaric ropivacaine effectively restricts cephalad spread, prolongs sensory and motor blockade, extends postoperative analgesia, and improves haemodynamic stability without compromising oxygenation.

Keywords: Spinal anaesthesia, Reverse Trendelenburg position, Hyperbaric ropivacaine, Subarachnoid block, Haemodynamic stability, Sensory block, Motor block, Postoperative analgesia, Lower limb surgery.

INTRODUCTION

Spinal anaesthesia is the preferred technique for elective lower limb surgeries because it provides reliable sensory and motor blockade with rapid onset and favourable postoperative recovery. Achieving an adequate block while minimizing haemodynamic disturbances remains a key objective of successful spinal anaesthesia. The extent and duration of intrathecal local anaesthetic action are influenced by several factors, among which patient positioning immediately after drug administration plays a crucial role in determining cephalad spread and block characteristics.[1–5]

The intrathecal distribution of hyperbaric local anaesthetics affects both the level and duration of sensory blockade. Greater cephalad spread exposes a larger meningeal surface area to the drug, resulting in faster vascular absorption, accelerated block regression, and shorter analgesia. In contrast, restricting spread to the lower lumbar and sacral segments promotes sacral pooling, reduces systemic absorption, and may prolong the duration of spinal anaesthesia without increasing the drug dose.[6]

A 10° Reverse Trendelenburg position immediately after intrathecal injection has been proposed as a simple method to enhance sacral pooling of hyperbaric local anaesthetics and limit cephalad spread. However, evidence evaluating this positioning strategy with 0.75% hyperbaric ropivacaine is limited.[7-8]

Therefore, the present study was undertaken to compare the effects of a goniometrically measured 10° Reverse Trendelenburg position with the conventional supine position on the sensory block profile, duration of analgesia, and haemodynamic stability in patients undergoing elective lower limb surgeries under spinal anaesthesia.

MATERIALS AND METHODS

This prospective, randomized comparative study was conducted over 18 months in the Department of Anaesthesiology, Kempegowda Institute of Medical Sciences Hospital and Research Centre, Bengaluru, after obtaining Institutional Ethics Committee approval. Sixty patients aged 18–60 years, of either sex, with American Society of Anesthesiologists (ASA) physical status I–II, weighing 50–80 kg, height >150 cm, and scheduled for elective lower limb surgeries under subarachnoid block were enrolled. Patients with contraindications to spinal anaesthesia, pregnancy or lactation, or hypersensitivity to local anaesthetics were excluded. Sample size was calculated using data from a previous study, with 80% power and a 5% significance level, requiring 30 patients in each group.

Patients were randomized by computer-generated sequence using sealed opaque envelopes into two groups: Group T (n = 30) received a 10° Reverse Trendelenburg position immediately after spinal anaesthesia, while Group S (n = 30) remained in the conventional supine position.

All patients received oral alprazolam 0.5 mg the night before surgery. Following standard monitoring and intravenous preloading with 500 mL of crystalloid, subarachnoid block was performed under aseptic precautions at the L3–L4 or L4–L5 interspace using a 26-G Quincke spinal needle. After confirmation of free cerebrospinal fluid flow, 2.5 mL of 0.75% hyperbaric ropivacaine was injected intrathecally at a rate of 0.2 mL/s. Patients in Group T were positioned in a goniometrically confirmed 10° Reverse Trendelenburg position, whereas Group S remained supine.

Sensory blockade was assessed by bilateral pinprick testing to determine onset time, maximum sensory block height, and time to two-segment regression. Motor blockade was evaluated using the Modified Bromage Scale, recording onset and duration of motor block. Haemodynamic parameters, including heart rate, mean arterial pressure, and peripheral oxygen saturation, were recorded every 5 minutes for the first 30 minutes and every 15 minutes thereafter until completion of surgery. Duration of analgesia was defined as the interval from onset of sensory block to the first request for rescue analgesia.

Hypotension (mean arterial pressure decrease >20% from baseline) was treated with intravenous ephedrine 6 mg, while bradycardia (heart rate <50 beats/min) was managed with intravenous atropine 0.6 mg.

Data were analysed using SPSS version 22.0. Continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. Between-group comparisons were performed using the Independent Student's t-test or Mann–Whitney U test for continuous variables and the Chi-square test for categorical variables. A p value <0.05 was considered statistically significant.

RESULTS

Table 1: Baseline demographic and clinical characteristics of the study population

Variable	Group T (n=30)	Group S (n=30)	*p*-value
Age (years), Mean ± SD	43.77 ± 12.43	42.33 ± 13.59	0.68
Weight (kg), Mean ± SD	68.80 ± 9.68	66.33 ± 10.61	0.35
Male, n (%)	26 (86.7)	21 (70.0)	0.12
Female, n (%)	4 (13.3)	9 (30.0)	
ASA I, n (%)	18 (60.0)	22 (73.3)	0.27

ASA II, n (%)	12 (40.0)	8 (26.7)	

Baseline demographic characteristics, body weight, sex distribution, and ASA physical status were comparable between the two groups (p>0.05), confirming homogeneity of the study population.

Table 2: Comparison of sensory block characteristics

Parameter	Group T	Group S	*p*-value
Onset of sensory block (sec), Mean ± SD	220.50 ± 47.80	252.17 ± 55.81	0.02*
Two-segment regression (min), Mean ± SD	98.60 ± 18.55	84.93 ± 14.22	0.002*

Maximum sensory block level

Level	Group T n (%)	Group S n (%)	*p*-value
T6	2 (6.7)	8 (26.7)	
T8	12 (40.0)	13 (43.3)	0.04*
T10	16 (53.3)	9 (30.0)	

Group T demonstrated a significantly slower onset of sensory block but achieved significantly prolonged two-segment regression. The highest sensory block was significantly lower in Group T, with most patients attaining T10, whereas Group S more frequently reached T6, indicating restricted cephalad spread in the Reverse Trendelenburg group.

Table 3: Distribution of sensory block during follow-up

Time interval	Significant difference
0–75 min	Yes (*p*=0.01–0.04)
90–180 min	No (*p*>0.05)

During the first 75 minutes, Group T consistently maintained lower thoracic sensory levels than Group S, demonstrating restricted cephalad spread. During block regression (90–180 minutes), sensory levels became comparable between groups, indicating similar regression patterns.

Table 4: Motor block characteristics

Parameter	Group T	Group S	*p*-value
Onset of motor block (sec)	360.73 ± 63.50	406.50 ± 73.08	0.01*
Duration of motor block (min)	112.33 ± 21.44	89.67 ± 12.77	0.002*

The Reverse Trendelenburg group demonstrated a significantly slower onset but a significantly longer duration of motor blockade compared with the supine group.

Table 5: Comparison of haemodynamic parameters

Parameter	Findings
Pulse rate	Comparable throughout study (*p*>0.05)
Systolic blood pressure	Significantly higher in Group T from 20–180 min (except 120 min)
Diastolic blood pressure	Comparable initially; significantly higher in Group T at 90, 120, 135 and 180 min
Mean arterial pressure	Significantly higher in Group T from 20–180 min (except 150 min)
SpO_2	Comparable throughout study (*p*>0.05)

Pulse rate and oxygen saturation remained stable and comparable in both groups. However, patients positioned in 10° Reverse Trendelenburg maintained significantly higher systolic blood pressure, diastolic blood pressure (during later intraoperative periods), and mean arterial pressure, indicating superior haemodynamic stability compared with the supine group.

Table 6: Duration of postoperative analgesia

Parameter	Group T	Group S	*p*-value
Duration of analgesia (min), Mean ± SD	246.10 ± 26.03	202.77 ± 20.35	<0.0001*

Duration of postoperative analgesia was significantly prolonged in the Reverse Trendelenburg group by approximately 43 minutes compared with the supine group (p<0.0001).

DISCUSSION

The present prospective randomized study evaluated the effect of a 10° Reverse Trendelenburg position following subarachnoid block with 0.75% hyperbaric ropivacaine in patients undergoing elective lower limb surgeries. Baseline demographic characteristics, including age, gender, weight, and ASA physical status, were comparable between the two groups, ensuring that the observed differences were attributable to the positioning intervention rather than patient-related confounders. These findings are consistent with those of Mahesh Kumar et al., who also reported similar baseline characteristics between study groups.[9]

The Reverse Trendelenburg position significantly influenced the characteristics of spinal block. Although the onset of sensory and motor blockade was slightly delayed compared with the supine position, the maximum sensory block was significantly restricted, with most patients achieving a T10 level rather than the higher thoracic levels observed in the supine group. These findings support the gravity-dependent distribution of hyperbaric local anaesthetic and agree with previous studies by Loke et al,[10] which demonstrated reduced cephalad spread with head-up positioning. The restriction of block height was most evident during the first 75 minutes and diminished during block regression, indicating that the positional effect is greatest during the early phase of intrathecal drug distribution.

A major finding of the present study was the significant prolongation of spinal blockade in the Reverse Trendelenburg group. Both two-segment regression time and motor block duration were significantly longer, accompanied by a 43-minute increase in postoperative analgesia. These observations support Greene's pharmacokinetic hypothesis that limiting cephalad spread reduces meningeal surface area available for vascular absorption, thereby slowing elimination of the local anaesthetic. Similar prolongation of spinal anaesthesia has been reported by Infante et al. and Chauhan et al., confirming the reproducibility of this positional effect across different patient populations and study designs.[11,12]

Haemodynamic stability represented one of the most important clinical advantages of the Reverse Trendelenburg position. While pulse rate and oxygen saturation remained comparable between the groups throughout the study, patients positioned in Reverse Trendelenburg maintained significantly higher systolic blood pressure and mean arterial pressure from 20 minutes onward, with improved preservation of diastolic blood pressure during the later intraoperative period. These findings suggest attenuation of cephalad sympathetic blockade, resulting in better preservation of vascular tone and venous return. Similar improvements in haemodynamic stability and reduced incidence of hypotension have been reported by Mahesh Kumar et al,[9] Loke et al,[10] and Lee et al., supporting the clinical utility of head-up positioning during spinal anaesthesia.[13]

Overall, the findings demonstrate that a 10° Reverse Trendelenburg position immediately after administration of 0.75% hyperbaric ropivacaine effectively restricts cephalad spread, prolongs sensory and motor blockade, extends postoperative analgesia, and improves haemodynamic stability without compromising oxygenation. This simple, inexpensive, and reproducible positioning strategy may therefore serve as a valuable adjunct during spinal anaesthesia for elective lower limb surgeries, particularly in patients where maintaining cardiovascular stability is desirable.

CONCLUSION

The present study demonstrates that placing patients in a 10° Reverse Trendelenburg position immediately after subarachnoid block with 0.75% hyperbaric ropivacaine effectively modifies the characteristics of spinal anaesthesia by restricting cephalad spread, prolonging sensory and motor blockade, and significantly extending the duration of postoperative analgesia compared with the conventional supine position. Although the onset of sensory and motor block was slightly delayed, the Reverse Trendelenburg position provided superior haemodynamic stability by maintaining higher systolic, diastolic, and mean arterial pressures without adversely affecting pulse rate or oxygen saturation. These findings indicate that a simple, goniometrically measured 10° Reverse Trendelenburg position is a safe, cost-effective, and reproducible adjunct that enhances the efficacy of spinal anaesthesia while improving cardiovascular stability, making it particularly beneficial for elective lower limb surgeries where controlled block height and prolonged postoperative analgesia are desired.

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