

Effect Of Trendelenburg And Horizontal Positions On The Height Of Sensory Block In Patients Undergoing Lower Abdominal Surgeries Under Spinal Anesthesia With Hyperbaric Ropivacaine.

Author

Abstract

Background. The aim of this study was to compare the clinical effects of trendelenburg (20 degrees) and horizontal positions on the height of sensory block after giving hyperbaric ropivacaine and also the need of vasopressors in the two groups.

Methods. Seventy ASA grade I-II patients undergoing elective lower abdominal surgery under spinal anaesthesia with 22.5 mg of hyperbaric ropivacaine were randomized to two groups (T and H). Group T were placed in 20° trendelenburg position for 40 seconds and group H were kept in horizontal position after neuraxial blockade. Height of sensory block was assessed at 30 sec, 60 sec, 3 min, 5 min and thereafter every 5 min interval until two consecutive readings were same and that was taken as maximum sensory block height. The MAP and HR were recorded at baseline and there after every 3 mins after giving SA for 30 mins. Hypotension was treated with inj. Mephentermine.

Results. At 3 minutes, more patients in Group T reached T10 (91.4% vs. 62.8%; $p = 0.022$), with higher levels (T8, T6) more frequent by 5 minutes ($p = 0.004$). Cephalad spread remained greater in Group T at 10–25 minutes, with more patients reaching T4 and fewer at lower levels ($p < 0.0001$). Mean arterial pressure was lower in Group T at several intervals, but not significantly. Heart rate changes were comparable. Mephentermine use was similar between groups (14.3% vs. 8.6%; $p = 0.71$).

Conclusion. Trendelenburg position can be used to achieve a higher sensory level of block as compared to horizontal position after neuraxial blockade with Hyperbaric ropivacaine. The recovery and safety profile of ropivacaine may be useful where prompt mobilization is required

Keywords: Spinal Anesthesia, posture, ropivacaine, hemodynamics

Date of Submission: 27-02-2026

Date of Acceptance: 07-03-2026

I. Introduction

Elective lower abdominal surgery can be performed under general anaesthesia (GA) and spinal anaesthesia (SA). Several physiological benefits of neuraxial blockade like less stress response, better hemodynamic stability and reduced cost provide rationale to improve outcome by preferring this technique and avoiding GA¹.

Factors affecting sensory block height of spinal anaesthesia are baricity of anaesthetic solution, position of the patient during injection and immediately after injection, drug dosage, site of injection. Other factors are age, curvature of the spine, drug volume, intra abdominal pressure, needle direction, patient height and Pregnancy³. Among them, dominant factors are the baricity of the solution injected and the subsequent posture of the patient^{3,4}

Hyperbaric ropivacaine produces shorter duration of sensory and motor blockade, reduced degree of motor blockade and significantly lesser time to mobilization and micturition compared to hyperbaric bupivacaine^{11,12}. Also intrathecal ropivacaine has better hemodynamic stable profile compared to intrathecal bupivacaine making it ideal drug for geriatric patients with cardiac pathology¹³.

There is inadequacy of literature utilizing heavy ropivacaine intrathecally in spinal anaesthesia. The aim of our study was to compare the effect of position that is 20° Trendelenburg and horizontal positions on the height of sensory block after giving SA with hyperbaric ropivacaine and to compare the total dose of vasopressor required to evaluate if any hemodynamic instability was caused by Trendelenburg positioning.

II. Materials And Methods

Study was conducted after obtaining hospital ethics committee approval, scheduled for elective lower abdominal surgeries.

All patient's aged between 18-55 years of either sex, ASA grade I and II were randomized to two groups of 35 patients each using www.randomizer.org. Patients with ASA grade II with uncontrolled hypertension, cardiovascular disease, obstetric patients and patients with BMI > 30 were excluded from study.

Informed written consent taken from patients after obtaining detailed history, doing complete physical examination and routine investigations. On the night before surgery T. Ranitidine 150 mg. and T. Alprazolam 0.5 mg. were given to patients.

On the day of surgery, patients were allocated to one of the groups as per randomization. In the Operation theatre, NIBP, ECG, Spo₂, were put, iv cannula secured. Preloading was done with 10ml/kg of ringer lactate before initiation of the spinal block. Under strict aseptic conditions, using 25 G spinal needle, intrathecal block was given using 3 ml of 0.75% Ropivacaine heavy at L3 L4 intervertebral space in sitting position with midline approach. Sensory block was used for the onset and duration of anaesthesia.

After successful intrathecal injection Group H patients were positioned horizontal and Group T patients were placed in trendelenburg position with 20° head down for 40 seconds. There after patients were placed in horizontal position.

The MAP and HR were recorded at baseline (T₀) and there after every 3 mins after giving SA for 30 mins (T₁ to T₁₀). The vitals were recorded every 15 mins till 90 mins thereafter. The height of sensory block was assessed at 30 seconds, 60 seconds, 3 mins, 5 mins after giving spinal injection and there after every 5 mins interval until two consecutive readings were same and that was taken as maximum sensory block height. Sensory block height was assessed by cold sensation test using cotton soaked in spirit.

Hypotension was defined as fall in MAP by more than 20% of baseline. When hypotension occurred it was treated with inj. mephentermine 6mg bolus. Intravenous fluid was administered according to the haemodynamic status of the patient.

At the end of the surgery, surgeon satisfaction level was assessed on the basis of Likert scale in both groups. Likert scale was scored from 1 to 5 (very bad, bad, average, good and excellent). Patients were monitored for any adverse effects in post operative period.

Statistical analysis was performed by the SPSS program for Windows, version 28.0 (SPSS, Chicago, Illinois). Continuous variables were presented as mean ± SD, and categorical variables were presented as absolute numbers and percentage. Data checked for normality before statistical analysis. Normally distributed continuous variables were compared using the unpaired t test, whereas the Mann-Whitney U test used for variables that were not normally distributed. Categorical variables were analysed using either the chi square test or Fisher's exact test. P<0.05 was considered statistically significant.

III. Results

In our study the two groups were comparable with respect to age, gender, weight, height and BMI.

The distribution of level of sensory block (LSB) at 30 seconds and 60 seconds were comparable between two groups, p value being 0.088 in group H and 0.151 in group T.

At 3 minutes, more patients in Group T reached T₁₀ levels compared to Group H (T₁₀: 91.4% vs. 62.8%; p = 0.022). At 5 minutes, higher block levels such as T₆ and T₈ were more frequent in Group T (T₈: 68.57% vs. 34.29%; T₆: 1.43% vs. 0%; p = 0.004). By 10 minutes, Group T continued to show significantly greater cephalad spread, with more patients reaching T₄ and T₆ (T₄: 14.29% vs. 0%; T₆: 71.43% vs. 22.86%), while Group H had a greater proportion at lower levels (T₈-T₁₀) (p < 0.0001). These findings indicate a faster and higher sensory block onset in Group T.

At 15 minutes, a significantly greater proportion of patients in Group T achieved higher sensory block levels compared to Group H. Specifically, 37.14% of patients in Group T reached a T₄ level versus only 2.86% in Group H (p < 0.0001). In contrast, more patients in Group H had lower block levels such as T₈ (34.29% vs. 0%). This trend persisted at 20 and 25 minutes, where Group T consistently showed higher proportions at T₄ (40% vs. 11.43%), while Group H had more patients at lower levels like T₆ and T₈ (T₆: 71.43% vs. 60%; T₈: 17.14% vs. 0%; p = 0.002 for both time points) as shown in table 2, highlighting a significantly greater cephalad spread in Group T.

There was drop in mean arterial pressure at 0.3, 6, 9 and 12 minutes in group T compared to group H. However it was not statistically significant (figure 1) Variation in heart rate of patients at various time intervals were comparable between the two groups (figure 2).

The distribution of Mephentermine injections was comparable between groups H and T (p=0.71). Among those who received Mephentermine, 8.57% were in group H and 14.29% in group T. Indicating no meaningful difference in Mephentermine administration between the two groups (figure 3).

Segment Level	AT 3 minutes		P value	Segment Level	AT 5 minutes		P value	Segment Level	AT 10 minutes		P value
	H	T			H	T			H	T	
T0	22 (62.8%)	32 (91.4%)	0.022	T6	0 (0%)	1 (1.43%)	0.004	T4	0 (0%)	5 (14.29%)	<0.0001
T12	13 (37.14%)	3 (8.57%)		T8	12 (34.29%)	24 (68.57%)		T6	8 (22.86%)	25 (71.43%)	
				T10	23 (65.71%)	10 (28.57%)		T8	20 (57.14%)	5 (14.29%)	
								T10	7 (20%)	0 (0%)	
Total	35	35		Total	35	35		Total	35	35	

Table 1: Comparison of LSB at 3, 5 and 10 minutes between group H and T

Segment Level	AT 5 minutes		P value	Segment Level	AT 20 minutes		P value	Segment Level	AT 25 minutes		P value
	H	T			H	T			H	T	
T4	1 (2.86%)	13 (37.14%)	0.0001	T4	4 (11.43%)	14 (40%)	0.002	T4	4 (11.43%)	14 (40%)	0.002
T6	22 (62.86%)	22 (62.86%)		T6	25 (71.43%)	21 (60%)		T6	25 (71.43%)	21 (60%)	
T8	12 (34.29%)	0 (0%)		T8	6 (17.14%)	0 (0%)		T8	6 (17.14%)	0 (0%)	
Total	35	35		Total	35	35		Total	35	35	

Table 2: Comparison of LSB at 15, 20 and 25 minutes between group H and T

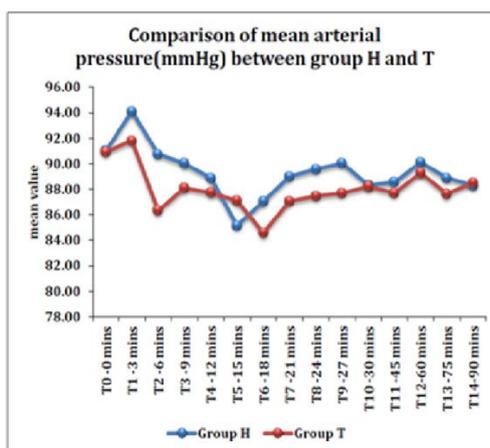


Figure 1: Comparison of trend of mean arterial pressure (mmHg) at different time intervals between group H and T

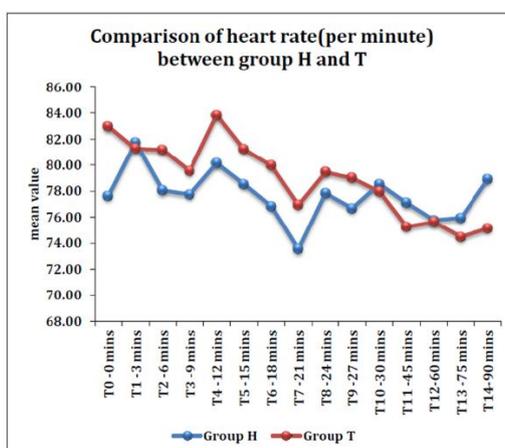


Figure 2: Comparison of trend of heart rate (per minute) at different time intervals between group H and T

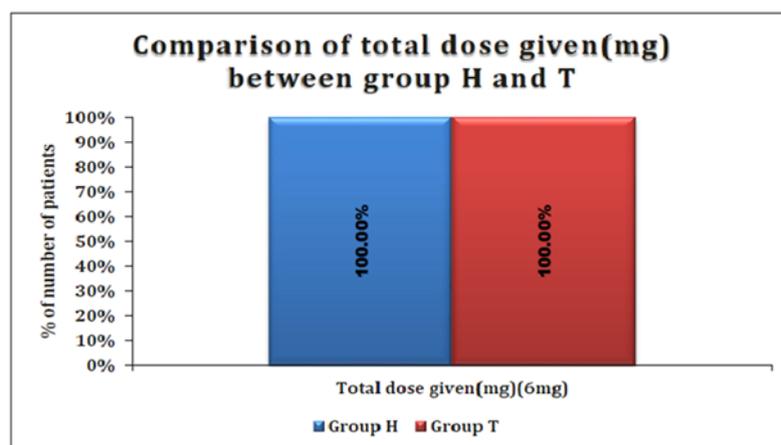


Figure 3: Comparison of total dose given(mg) between group H and T

IV. Discussion

Spinal anesthesia (SA) is preferred over general anesthesia (GA) for infraumbilical surgeries due to several advantages. These include the absence of airway manipulation, reduced intraoperative blood loss, lower opioid requirements, decreased incidence of deep vein thrombosis (DVT), and reduced postoperative nausea and vomiting (PONV). Additionally, SA offers superior postoperative analgesia, more stable hemodynamics, faster ambulation, shorter stays in the post-anesthesia care unit (PACU), and earlier hospital discharge.¹²

Following intrathecal injection, local anaesthetic initial spread occurs via cerebro spinal fluid (CSF) displacement and resultant intrathecal currents. The next most critical phase is controlled by the baricity of the solution relative to CSF under the influence of gravity, which acts through patient positioning (sitting, supine etc) and in supine position the spinal curvature anatomy³. Although most local anesthetic spread occurs within 20–25 minutes of injection, extreme positional changes even up to 2 hours later can still influence block level due to CSF bulk flow⁴. Once bulk spread of local anaesthetic takes place, the drug penetrates into neural tissue. Among all factors, dose, baricity, and patient positioning remain the most effective and controllable in directing anaesthetic drug spread.

In this study, Group T in which patients were positioned in 20° trendelenburg for 40 seconds post SA demonstrated a significantly faster and higher cephalad spread of sensory block compared to Group H in which patients were positioned supine post SA. At 3 minutes, more patients in Group T reached T10 (91.4% vs. 62.8%; $p = 0.022$). This trend continued at 5 and 10 minutes, with larger proportions of patients in Group T achieving higher levels such as T4, T6, and T8 ($p < 0.005$). By 15, 20, and 25 minutes, significantly more patients in Group T reached T4 (up to 40% vs. 11.43%), while Group H showed a predominance at lower levels like T6 and T8 ($p = 0.002$). These findings, supported by Table 2, indicate a more rapid and extensive cephalad block in Group T. The present study showed no statistically significant difference in mean arterial pressure (MAP) or heart rate (HR) between Group T and Group H at any measured time point up to 90 minutes (Fig 1,2). The requirement and timing of Mephentermine administration were also comparable between the groups, indicating similar hemodynamic stability (Fig 3).

Similar studies have highlighted the impact of patient positioning on sensory block height following SA with hyperbaric bupivacaine. Guha and colleagues in (2025)⁵ found the patients who remained in Trendelenburg position of 20° for 40 s after SA with hyperbaric bupivacaine achieved higher level of sensory block earlier as compared to the horizontal group. However no analysis was done on hemodynamic parameters.

Kumar M et al. in (2022)⁶ conducted study on 60 patients for lower limb surgery, where in one group, they were placed horizontally and the other group was positioned with 10° reverse trendelenburg position. It was seen that sensory and motor block level were comparatively lower in patients of reverse trendelenburg group. Also, hypotension was more in horizontal group patients. Thereby it was concluded that the block height could be controlled with 10° reverse trendelenburg position.

Shahriari et al. (2015)⁷ observed that in patients after giving intrathecal hyperbaric bupivacaine placed in 20° trendelenburg position for 40 seconds achieved significantly higher sensory block levels compared to those in the horizontal position. In trendelenburg position group, patients were given 30 mg of ephedrine intramuscularly after achieving horizontal position. No episode of hypotension was seen amongst patients.

In another study by J.T. Kim et al. (2007)⁸ performed on 49 males undergoing lower abdominal and lower limb surgery, it was seen that when after spinal block the level of sensory block was not adequate, it could be used to extend cephalad by trendelenburg position along with hip flexion as compared to trendelenburg position alone.

Contrary to our findings on hemodynamic parameters, studies by Miyabe and colleagues in (1993)⁹ ; Poredos and colleagues in (2017)¹⁰ highlight that positional changes following spinal anesthesia influence hemodynamic responses. Miyabe found that a 10° head-down tilt increased arterial blood pressure only in cases of severe hypotension ($\geq 30\%$ drop), but was ineffective as a preventive measure, and increased cephalad drug spread. Poredos observed no significant differences in overall hemodynamic parameters between high and low spinal blocks, but noted a trend toward less hypotension and reduced vasopressor use in patients placed in a 15° anti-Trendelenburg (head-up) position. However these studies were done using hyperbaric bupivacaine.

In the present study hyperbaric ropivacaine was used intrathecally for SA based on various evidences that it provides favourable hemodynamic profile, earlier ambulation and voiding hence making it ideal for short duration procedures performed in day care settings and also in geriatric population who are more labile to cardiovascular instability.

Studies by Whiteside and Luck have shown that hyperbaric ropivacaine produces a shorter duration and lesser degree of motor block compared to hyperbaric bupivacaine^{5,6}. While Luck and colleagues found no significant hemodynamic differences, Whiteside and colleagues reported a significantly lower incidence of hypotension with ropivacaine (15% vs. 70%)⁶. Dar and colleagues further confirmed that although both drugs (bupivacaine and ropivacaine) provided effective anesthesia, ropivacaine had a slower onset, shorter duration, and caused less hypotension (19% vs. 66%)¹⁴.

V. Conclusion

Based on our present research, we can conclude that trendelenburg position of 20° for 40 seconds post spinal anaesthesia can be used to achieve a higher level of block as compared to horizontal position after successful neuraxial blockade without any haemodynamic disturbances also Hyperbaric ropivacaine can be safely used intrathecal for SA.

References

- [1]. Rodgers A, Walker N, Schug S, Mckee A, Kehlet H, Van Zundert A, Et Al. Reduction Of Postoperative Mortality And Morbidity With Epidural Or Spinal Anaesthesia: Results From Overview Of Randomised Trials. *BMJ*. 2000;321(7275):1493. Doi: 10.1136/Bmj.321.7275.1493
- [2]. Kumar S, Subramanian BV, Kumar V (2023) Current Indications Of Spinal Anaesthesia: A Short Communication. *J Anesth Clin Res*. 14:1108.
- [3]. Hocking G, Wildsmith JA. Intrathecal Drug Spread. *British Journal Of Anaesthesia*. 2004 Oct 1;93(4):568-78.
- [4]. Pitkänen M, Rosenberg PH. Local Anaesthetics And Additives For Spinal Anaesthesia—Characteristics And Factors Influencing The Spread And Duration Of The Block. *Best Practice & Research Clinical Anaesthesiology*. 2003 Sep 1;17(3):305-22.
- [5]. Banerjee SG, Hazra S, Banerjee A, Bandyopadhyay U. Effect Of Position-Trendelenburg And Horizontal On The Height Of Sensory Block In Patients Undergoing Lower Abdominal Surgery. *Asian Journal Of Medical Sciences*. 2023 Jul 1;14(7):52-7.
- [6]. Kumar M, Bhandari S, Thakur A, Thakur S, Verma R, Awasthi B, Bhandari Jr S. Investigating The Effect Of The 10 Reverse Trendelenburg Position On Spinal Block Characteristics And Hemodynamic Parameters In Lower Limb Surgeries. *Cureus*. 2022 Feb 25;14(2).
- [7]. Shahriari A, Khooshideh M, Heidari R, Abianeh SH, Sheikh M, Ghazizadeh S, Rahmati J. The Effect Of Trendelenburg Posture On Sensory Block Level In Spinal Anesthesia With Intrathecal Hyperbaric Bupivacaine For Hernia Repair. *Archives Of Anesthesiology And Critical Care*. 2015 Oct 3;1(2):55-8.
- [8]. Kim JT, Shim JK, Kim SH, Jung CW, Bahk JH. Trendelenburg Position With Hip Flexion As A Rescue Strategy To Increase Spinal Anaesthetic Level After Spinal Block. *British Journal Of Anaesthesia*. 2007 Mar 1;98(3):396-400.
- [9]. Miyabe M, Namiki A. The Effect Of Head-Down Tilt On Arterial Blood Pressure After Spinal Anesthesia. *Anesthesia & Analgesia*. 1993 Mar 1;76(3):549-52.
- [10]. Poredos P. Comparison Of Haemodynamic Parameters Between The High And Low Spinal Block In Young Healthy Patients. *Signa Vitae: Journal For Intensive Care And Emergency Medicine*. 2017 May 15;13(1):32-43.
- [11]. Whiteside JB, Burke D, Wildsmith JA. Comparison Of Ropivacaine 0.5%(In Glucose 5%) With Bupivacaine 0.5%(In Glucose 8%) For Spinal Anaesthesia For Elective Surgery. *British Journal Of Anaesthesia*. 2003 Mar 1;90(3):304-8.
- [12]. Luck JF, Fettes PD, Wildsmith JA. Spinal Anaesthetics For Elective Surgery: A Comparison Of Hyperbaric Solutions Of Racemic Bupivacaine, Levobupivacaine, And Ropivacaine. *Br J Anaesth* 2008;101:705-10.
- [13]. Mohta M. Ropivacaine: Is It A Good Choice For Spinal Anesthesia?. *J Anaesthesiol Clin Pharmacol* 2015;31:457-8.
- [14]. Dar FA, Mushtaq MB, Khan UM. Hyperbaric Spinal Ropivacaine In Lower Limb And Hip Surgery: A Comparison With Hyperbaric Bupivacaine. *J Anaesthesiol Clin Pharmacol* 2015;31:466-70.