

## A COMPARATIVE STUDY OF THE EFFICACY OF SUB-ARACHNOID BLOCK AT THE LEVEL OF L2-L3 INTERSPINOUS SPACE WITH L4-L5 INTERSPINOUS SPACE FOR ADULT PATIENTS UNDERGOING UNILATERAL HERNIOPLASTY

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Received : 28/01/2023  
Received in revised form : 25/02/2023  
Accepted : 10/03/2023

**Keywords:**  
Hyperbaric Bupivacaine, sensory block, motor block, Blood pressure, SPO<sub>2</sub>, VAS score.

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DOI: 10.47009/jamp.2023.5.4.57

Source of Support: Nil,  
Conflict of Interest: None declared

*Int J Acad Med Pharm*  
2023; 5 (4); 278-282



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### Abstract

**Background:** Subarachnoid block is a straightforward, inexpensive, and favoured approach for unilateral hernioplasty surgery because it efficiently inhibits sensory and motor functions with a rapid start of the action, attenuates the stress response, and minimises the risk of thromboembolic consequences. This study evaluated the effectiveness of L2-L3 interspinous space subarachnoid block with L4-L5 interspinous space subarachnoid block in adult patients with unilateral hernioplasty. **Materials and Methods:** This prospective, randomised, and comparative study was conducted for one year at the Department of Anaesthesiology, Government Chengalpattu Medical College, with 60 patients randomly assigned to two groups: patients hospitalised for inguinal hernioplasty, receiving intrathecal 15 mg (3 ml) Inj. 0.5% Injection Hyperbaric Bupivacaine was administered at the levels L2-L3 (A) and L4-L5 (B) interspinous space, and comparing the sensory and motor block responses, intra-operative hemodynamics and analgesia (VAS score). **Result:** In Group A, sensory and motor blocks began more quickly. Subarachnoid block at L2-L3 interspinous region offers better analgesia, early onset of sensory and motor blockade, and higher sensory blockade than a subarachnoid block at L4-L5 space during surgery for unilateral hernioplasty. When comparing the two groups, there was no discernible difference in the degree of sensory block. Technical issues and major hemodynamic fluctuations were absent in either group. Subarachnoid block in the L2-L3 space and L4-L5 space offers stable hemodynamics and fewer adverse effects without technical issues. **Conclusion:** Our study suggests that adult patients with unilateral hernia surgery benefit from subarachnoid blocks placed at the L2-L3 interspinous region rather than the L4-L5.

## INTRODUCTION

Inguinal hernia surgical repair is one of the most frequently performed operations worldwide. Early patient mobilisation and limited recurrence are the goals of contemporary hernia surgery therapy.<sup>[1]</sup> It has been demonstrated that using regional anaesthesia for inguinal hernia surgery reduces postoperative complications and enables patients to leave the hospital almost immediately. Numerous retrospective and randomised controlled studies have shown that local anaesthesia provides the greatest clinical and financial outcomes. It is safe and efficient

to do this surgery under outpatient anaesthetic.<sup>[2]</sup> Another approach is an outpatient inguinal hernia repair with spinal anaesthesia. Both spinal anaesthesia and local anaesthesia only influence a tiny portion of the body and have no impact on the respiratory system or other organs.<sup>[3]</sup>

Adults who need to have an inguinal hernia repaired frequently undergo spinal anaesthesia. This operation, which involves the infiltration of the surgical layers and the blockage of the ilioinguinal and hypogastric nerves, is only effective if the surgeon has a thorough grasp of the anatomy and physiology of the nerves.<sup>[4]</sup> Depending on the extent of the operation, local anaesthesia may potentially

last throughout the recovery phase, minimising the need for systemic analgesics.<sup>[5]</sup> With spinal anaesthesia, total sensory and motor blocking is feasible. Spinal anaesthesia has drawbacks, including the potential for hypotension and headaches following a spinal puncture. Despite being considered safe, it causes several adverse effects, including headache, nausea, vomiting, urine retention, hypotension, bradycardia, dysrhythmia, and cardiac arrest.<sup>[6]</sup> The most frequent initial physiological alterations are hemodynamic consequences, particularly bradycardia and hypotension. The primary risk factors for developing hypotension under spinal anaesthesia appear to be advanced age, systemic illness, head-up position, and high levels of anaesthesia.<sup>[7]</sup>

An automated record-keeping system's detection of hypotensive episodes was connected with increased mortality.<sup>[8]</sup> While some researchers found no significant differences in the frequency of hypotensive episodes or the distribution of local anaesthetic through the subarachnoid space between L2-3 and lower lumbar levels, others found that performing dural puncture at L2-3 interspace can result in a higher incidence of hypotension and greater cephalic spread of isobaric bupivacaine.<sup>[9]</sup> Even when the difference in the puncture location was just one lumbar interspace apart, local anaesthetic diffusion changes were seen. For this reason, L3-4 vs. L4-5 interspace were used. Regardless of the interspace utilised (L2-3 versus L4-5), pure bupivacaine is not recommended for abdominal surgery since it is an uncertain spinal anaesthetic agent.<sup>[10]</sup> Isobaric bupivacaine can still deliver sufficient anaesthesia and a reliable sensory block for lower abdominal surgery. However, few studies compare the hemodynamic and analgesic effects of 0.5% plain bupivacaine injected at the spinal interspace L2-3 and L4-L5.

In the current study, the start of sensory and motor block was compared in adult patients undergoing unilateral hernioplasty to assess the efficiency of L2-L3 interspinous space subarachnoid block against L4-L5 interspinous space subarachnoid block. The highest level of sensory analgesia and alterations in intraoperative hemodynamics were also evaluated and compared within the two groups.

## MATERIALS AND METHODS

This prospective, randomised, and comparative study was conducted for one year at the Department of Anaesthesiology, Government Chengalpattu Medical College, Tamil Nadu. Before the study began, the ethical committee's permission and the patient's written informed consent were sought.

### Inclusion Criteria

Among the patients hospitalised for inguinal hernioplasty, in categories I and II of the American Society of Anaesthesiologists, 18-65 years undergoing unilateral hernioplasty were included.

### Exclusion Criteria

Patients who refused, allergic to local anaesthetics, infection at the injection site, spine anomaly, Neurological deficit, Cardiac disease, patients on anticoagulants, bilateral hernioplasty, those receiving surgery >2 hours and those belonging to categories III and IV of American Society of Anaesthesiologists were excluded.

Patients were randomly allocated into two groups, those receiving intrathecal 15 mg (3 ml) Inj. 0.5% Injection of Hyperbaric Bupivacaine administered at levels L2-L3 were designated to group A, and those receiving at L4-L5 were designated to group B.

### Pre-anaesthetic Evaluation

Pre-anaesthetic evaluation for all patients was done by recording underlying comorbid illnesses such as Type II Diabetes mellitus, systemic hypertension, bronchial asthma, renal failure, Seizure disorder, and previous history of surgery and exposure to anaesthesia and allergies. A physical examination comprises general investigations (consciousness, orientation, head-to-toe examination and vital signs), Height, weight and BMI. Systemic examination of the cardiovascular system, respiratory system, central nervous system and abdomen. Local examination of the spine and assessment of the airway was done.

### Anaesthetic Procedure

The baseline data was gathered using monitors such as the pulse oximeter, ECG, and non-invasive blood pressure (NIBP). Patients received a 10 ml/kg lactated Ringer's solution preload for 20 minutes, followed by a 2-4 ml/kg/hr infusion. The resuscitation tools and emergency medications were made accessible. Following an explanation, the patients were laid on the operating table with their backs exposed in a right lateral posture. After the patients were positioned in the lateral posture, lumbar puncture was performed in the appropriate intrathecal area in both Groups. Free flow of the cerebrospinal fluid indicated proper spinal needle insertion. The research medication was injected into the subarachnoid space according to group allocation, L2-L3, Group A, and L4-L5, Group B. The patient was positioned in a supine posture following the medication injection.

### Analysis of Sensory and Motor Block

To determine the time required to attain the T8 level, the sensory block was evaluated using the pinprick test with a 24G hypodermic needle at 5, 10, 15, 20, 25, and 30 minutes after intrathecal injection.<sup>(13)</sup> Pinprick numbness was once regarded as a sensory block. Time to T6 was also recorded since surgery may be done if the T6 block was reached. The onset of sensory block was defined as the time to T8, although time to T6 was also recorded. Duration (Duration required to reach T6/T8 dermatomal level). The "Modified Bromage scale" was used to evaluate motor blocks. Additionally, the motor block was evaluated 5, 10, 15, 20, 25, and 30 minutes after the subarachnoid block. The maximum motor block (the maximum Bromage score) and the time the motor block first appeared were also noted.

A Bromage score of three was considered to be a complete motor block. Time to finish the motor block (Time required to get a three on Bromage).

After the subarachnoid block, the patient's pulse rate, systolic blood pressure, diastolic blood pressure, and SPO2 were measured after 5, 10, 15, and 30 minutes. Hypoxia (SpO<sub>2</sub> < 90%), bradycardia, nausea, vomiting, pruritus, and other adverse effects were sometimes observed after surgery and were appropriately managed. A systolic blood pressure reduction of more than 20% from the starting point or systolic blood pressure of less than 90 mm of hg is referred to as hypotension. Ephedrine injections intravenously in increments of 6 mg are used to treat it.(11,14,15) Atropine 0.6 mg IV injections treat bradycardia (a heart rate < 60 beats per minute).(16) Respiratory depression is treated using bag and mask ventilation or, if necessary, endotracheal intubation and IPPV. It is a respiratory rate of less than 8/min (or) an oxygen saturation of less than 90%.

### The outcome of subarachnoid block

If the peak sensory level was reached at T6 and a Bromage score of 2 or 3 was attained within 15 minutes of the subarachnoid block, the operation was permitted to begin, and the case was regarded as a successful subarachnoid block. Suppose the patient complains of intraoperative discomfort after the procedure was started under spinal anaesthesia. General anaesthesia was administered in that case, and the case was deemed unsuccessful and eliminated from future data analysis. When the patient initially complained of surgical pain, that is when the duration of analgesia began, and a rescue analgesic injection of Tramadol 100mg intramuscular was administered.

### Statistical analysis

SPSS 12.0 was used to enter and analyse the data. Both groups demographic information was compared, and the results were presented using detailed descriptive statistics that calculated the mean, standard deviation, numbers, and proportions as needed. We compared group differences in changes to heart rate, systolic, diastolic, and mean arterial blood pressure. A p-value of 0.05 or less was considered significant when using the chi-square test for comparison.

## RESULTS

The mean age and weight (kg) of patients in group A was 44.43 and 64.93 kg, and that of group B was 43.3 and 63.3, with no statistical significance among groups (p>0.05). Among 73% of patients in ASA PS group I, 19 belonged to group A and 25 to group B. Of 16 patients in ASA PS group II, 11 were in group A and 5 in group B (p>0.05). Among 20 patients who required rescue analgesia, 19 were in group A and 25 in group B, while among the 67% of those who did not require rescue analgesia, 11 were in group A and 5 in group B (p>0.05).

Subarachnoid Block Level (SBL), T8 was found only in 2 patients in group B, and 6 of them were observed with T6, which was higher than group A (10). However, group A (20) contained more T4 patients than B (16). Yet the SBL blockade levels were not significantly variable between the groups (p>0.05).

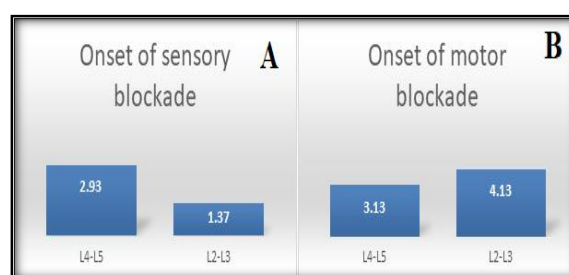


Figure 1. Comparison of onset of sensory and motor blockade

Our study reports no complications or difficulties in techniques associated with both groups. The onset of both sensory and motor blockades was faster in group A than in group B with a statistically significant difference (p=0.001) [Figure 1]. Though baseline VAS score level did not vary significantly among the groups, group VAS score level at 5 min was detected in only group B (0.3) (p<0.05) [Table 1].

Among the groups, the baseline pulse rate was lower in group A (77.07) than in B (81.1), with a distinctive difference (p=0.001). The pulse rate, throughout the time taken, was lower in group A than B, although the statistical difference was significant only at 5 min time. Other hemodynamic parameters, such as blood pressure (SBP and DBP) and SPO2 levels, did not differ significantly among groups (P>0.05) [Table 2].

Table 1: VAS score level comparison

Time	SAB VAS score		P value
	Group A	Group B	
0 min	2.13	2.43	0.716
5 min	0	0.3	0.008
10 min	0	0	NA
15 min	0	0	NA
30 min	0	0	NA

Table 2: Hemodynamic and oxygen saturation parameters

Parameters	Time (min)	Group A	Group B	P value
Pulse rate	0	77.07	81.1	0.001
	5	82.53	85.07	0.04
	10	79.2	80.47	0.326
	15	78.73	80.27	0.227

	30	77.7	80.83	0.011
SBP	0	125.47	125.93	0.786
	5	103.93	103.93	1
	10	106.13	105.8	0.767
	15	109.4	109.4	1
	30	116.27	116.27	1
DBP	0	75.8	76.13	0.824
	5	59.87	60.07	0.819
	10	61.93	61.93	0.867
	15	63.67	63.5	0.327
	30	66.4	66.4	1
SPO2	0	99.16	99.3	0.213
	5	99.2	99.33	0.65
	10	99.26	99.03	0.491
	15	99.3	99.33	0.652
	30	99	99.03	0.786

## DISCUSSION

Various methods and medication regimens have occasionally been utilised during regional anaesthesia to lessen anxiety and relieve postoperative pain. Wherever possible, limiting spinal anaesthesia to the surgical side only to improve cardiovascular stability looks like a promising strategy.<sup>[17]</sup> As a result of conserving the contralateral sympathetic chain and restricting the extent of sympathetic blockage to one side (operation side), there is still a significant amount of vasomotor tone that will prevent a significant drop in blood pressure.<sup>[18]</sup> Since differences in the spread of local anaesthetic, even when the difference in the puncture site was only one lumbar interspace away, the following study aims to compare Sensory and motor block, haemodynamic changes, quality of intraoperative analgesia and complications between adult patients receiving intrathecal 15 mg (3 ml) Inj. 0.5% Injection Hyperbaric Bupivacaine at L3-4 vs. L4-5 spinal interspace.

According to our study, unilateral hernioplasty patients who had intrathecal injections of 15 mg hyperbaric Inj. Bupivacaine in the L2-L3 area experienced a rapid start of sensory and motor blockage. SAB at the L2-L3 space substantially accelerated sensory processing (1.37 min) compared to SAB at the L4-L5 space (2.93 min), while Group A SAB at the L2-L3 space considerably accelerated motor processing (3.13 min) compared to Group B SAB at the L4-L5 space (4.13 min). This was consistent with previous research that found that individuals with dural puncture at L2-L3 instead of L4-L5 had early sensory and motor blockades.<sup>[19]</sup> Pinprick analgesia began more quickly in SAB at L2-L3 Space Group A than in SAB at L4-L5 Space Group B at T8, and there were no reported problems. Ephedrine was needed for hypotension in 9 participants in the L2-L3 group and three patients in the L4-L5 group ( $P>0.05$ ). The frequency of bradycardia and desaturation was similar in both groups, and they responded well to atropine administration and oxygen administration respectively. Shivering was treated conservatively in two patients in Group B and one in Group A. Additionally, it was claimed that keeping sensory

blockade constant at T8 prevented problems, including bradycardia and hypotension.<sup>[20]</sup> Additionally, a fast sensory and motor block start was noted at the L2-L3 level in a previous investigation.<sup>[21]</sup> According to the results of our investigation, patients in groups I and II experienced a maximum height of T4 sensory block during the first 30 minutes following spinal injection with 0.5% hyperbolic bupivacaine at the L2-3 interspace. If the sensory block height was T6 dermatome level 10 minutes after intrathecally administering the local anaesthetic, the risk of circulatory instability was elevated.<sup>[22]</sup> Similar to this, our investigation also found that L2-L3 level sensory and motor block onset was quicker than the L4-L5 level, and the L2-L3 level was where the maximum sensory block level was attained, not the L4-L5. Yet, there was no discernible difference between the two groups in our investigation.

There was no discernible difference in hemodynamic stability between the two groups. Heart rate, blood pressure, and SPO2 levels did not significantly change across groups in Shahzada et al.'s study comparing hemodynamic parameters in patients undergoing spinal anaesthesia at L2-3 vs. L3-4 levels.<sup>[21]</sup> A sympathetic block at the T1 level should stop sympathetic outflow to the heart since sympathetic cardiac accelerator fibres originate from the first four thoracic spinal segments. The observed groups pain levels, measured by a 10 cm VAS, differed considerably after only 5 min. Only the first minute after surgery started, the L2-3 group considerably outperformed the L3-4 group regarding painlessness (VAS 0). The spreading of sensory blockage with bupivacaine after 30 minutes, consistent with earlier observations by Lee et al., may explain this finding.<sup>[23]</sup>

## CONCLUSION

In our study, the subarachnoid block at L2-L3 interspinous area gives better analgesia, early sensory and motor blockade onset, and the strongest sensory blockade than the subarachnoid block at L4-L5 space for unilateral hernioplasty surgery. Subarachnoid block at the L2-L3 space and the L4-L5 space, on the other hand, offers steady hemodynamics and fewer

side effects with no technical issues. As a result of our findings, adult patients having unilateral hernioplasty benefit from the subarachnoid block at the L2-L3 interspinous area rather than L4-L5. There have been several attempts to increase the quality of spinal anaesthesia during unilateral hernioplasty. Injecting bigger doses of local anaesthetic can improve the quality of sensory block; however, increasing volume to increase the dose is not advised since the excessive amount can create a cervical spinal block and severe hypotension. Adrenaline, morphine, or fentanyl added to hyperbaric bupivacaine solution may increase the quality of bupivacaine intraoperative analgesia.

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