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Original research article

Comparison of paravertebral block with spinal anaesthesia in unilateral inguinal hernia repair

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Abstract

Background and Objectives: Inguinal hernia repair (IHR) is a common surgical procedure which can be performed under general, regional, or peripheral nerve block anesthesia. Subarachnoid block is the most commonly used modality for IHR. Even with experience, unilateral paravertebral block (PVB) as a primary anaesthetic modality is under-utilized. As a result, this study was conducted to compare the safety and effectiveness of PVB with subarachnoid block (SAB) for inguinal hernia repair surgeries.

Methods: The study comprised patients ranging from 18 to 65 years of age. They were randomly assigned to groups P and S of 30 participants each. A two-segment paravertebral block was given at T10 and L1 in Group P and patients in Group S were given spinal anaesthesia.

Results: The onset of sensory blockade, time taken for first rescue analgesia, time for ambulation and hemodynamic responses showed a statistically significant difference between the two groups (p 0.001). In group S, urinary catheterization was more frequent (p 0.05), whereas no patients in group P required catheterization.

Conclusion: Paravertebral block performs better than spinal anaesthesia for unilateral inguinal hernia repair in terms of prolonged analgesia, early ambulation, and a decrease in spinal anaesthesia-related complications.

Keywords: Comparison, paravertebral block, spinal anaesthesia, unilateral inguinal hernia

Introduction

Inguinal hernia repair (IHR) is a frequently performed daycare treatment modality that can be performed under general anaesthesia (GA)[1],regional anaesthetic techniques such as subarachnoid block (SAB)[13], epidural anesthesia, ilio-inguinal and ilio-hypogastric nerve block or paravertebral block (PVB) [4, 5]

PVB is beneficial as it offers long-lasting unilateral anaesthesia, haemodynamic stability, early ambulation, and pain relief for an extended period of time. However, this block is not routinely used due to its complex technique [5-8].

PVB causes ipsilateral segmental analgesia by administering local anaesthetic into the spinal nerve roots adjacent to the vertebral column. It is most commonly used for unilateral procedures such as thoracotomy, breast surgery, chest wall injury, hernia repair, and renal surgery[9, 10]. However there have been few studies comparing its effectiveness as an anaesthetic method to SAB[6,11]. As a result, this study was conducted to compare the effectiveness and safety of unilateral PVBs and unilateral SAB in patients undergoing IHR.

Materials and Methods

The present trial is randomised, prospective, single-blinded study conducted at the Department of Anaesthesiology and Critical Care, Maharajahs Institute of Medical Sciences. Institutional ethcis committee clearance was obtained. A total of 60 American Society of Anesthesiologists physical status (ASA PS) class I-II patients aged between 18 and 65 years posted for unilateral inguinal hernia repair were randomly enrolled in the present study. Patients excluded from the study were those refusing to participate, ASA III & IV and those contraindicated to undergo spinal anaesthesia.

The cases were randomised into two groups of 30 each by closed envelope method to receive either PVB

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block (n = 30) or SAB block (n= 30).
Informed and written consent was obtained and patients were shifted to the operation theatre. ASA standard monitors were attached and baseline HR, NIBP, SpO2 were recorded. Intravenous access with 18G IV cannula was secured. All patients were premedicated with intravenous (IV) 1 mg midazolam in the operating room before the procedure. All the spinal and paravertebral blocks were performed by the same anaesthesiologist to prevent interoperator variability.
In Group S, the patient was placed laterally, with the side to be operated in the dependent position. A 25G Quincke needle was used to enter the subarachnoid space, and 4 ml of 0.5% levobupivacaine was administered over 30 seconds. The patient was placed in the lateral decubitus position for 10 minutes before being turned to the supine position. After confirming sensory blockade at the T10 dermatome level, surgery was initiated.
The PVB was performed under ultrasound guidance at two levels, T10 and L1 interspace. Under strict aseptic precautions with the patient in a sitting position, Paravertebral space was identified using a high-frequency linear ultrasound transducer (4-13 MHz, Sonosite) which was used to identify the order of the laminae of lumbar vertebrae and paravertebral spaces. Under ultrasound guidance, after a skin wheal was raised using 2 ml of 1% lidocaine, a 10cm, 22-gauge block needle (Stimuplex® D Plus; B Braun, Melsungen, Germany) was inserted in-plane in a caudad-to-cephalad direction. 10 mL of 0.5% levobupivacaine was injected at T10 and L1 levels after negative aspiration. The block was considered as 'successful' if the onset of pinprick discrimination started within 15 min or if the sensory block (T10–L1) was achieved within a maximum period of 30 min. Otherwise, it was considered as "block failure" and the patient was given general anaesthesia and was excluded from the study. Motor block was assessed by the Bromage scale.
The primary outcome, i.e. the time to the first analgesic requirement, was recorded using a visual analogue scale (VAS). When the VAS score was more than 3, rescue analgesia (50 mg IV tramadol hydrochloride, repeated if necessary) was administered. The overall number of rescue analgesia doses needed in a 24-hour period was also recorded.
The secondary outcome was to compare the block characteristics i.e. time to surgical anaesthesia, time to ambulation, and total rescue analgesic consumption, hemodynamic changes, adverse effects were assessed.
Hemodynamic parameters were recorded preoperatively, then intraoperatively till 120 min.Hypotension, bradycardia and vomiting were treated accordingly. Any other side effects during the intraoperative or postoperative period were also noted.
The patients were observed for the ability to dorsiflex the foot and regaining of proprioception of the great toe. When the patient satisfied these findings, he was encouraged to ambulate when there are stable hemodynamic parameters, adequate pain relief, and no residual motor block and the time to ambulation was noted.
The raw data were entered into a Microsoft Excel Spreadsheet and analyzed using StatisticalPackage for the Social Sciences (SPSS Inc., version 22, Chicago, IL, USA). Continuous data were presented as mean with standard deviation while discrete categorical data were expressed as median (range) and number of patients and/or percentage of cases. Categorical variables were analyzed using Pearsons Chi-square test and normally distributed continuous variables were analyzed using the independent sample t-test.
$p < 0.05$ was considered statistically significant difference and $p < 0.001$ as highly significant.

Results

In Group P, one patient had failed block and two patients had epidural spread of local anaesthetic (bilateral sensory block) and were excluded from the study. Data from sixty patients were analysed, thirty in each group. The two groups were comparable with respect to demographic data (age, weight, height) and ASA class.
The baseline pulse rate, systolic blood pressure, diastolic blood pressure, and MAP were comparable between both the groups.

Table 1: Patients undergoing inguinal hernia repair: demographics

Parameters	Group P (n =30)	Group S (n =30)
Age (in years)	49±8.67	47±12.10
Weight (in kg.)	60.08±9.34	58.47±9.67
ASA 1 / 2(%)	60/40	66.6/33.3

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Table 2: Block Characteristics

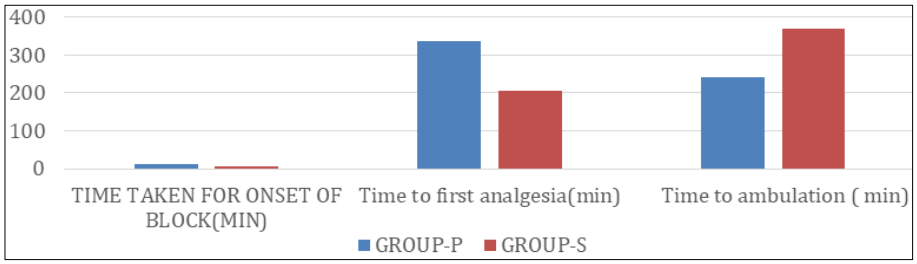
Parameters	Group P	Group S
Time taken for onset of block(min)	13.11±3.412	6.15 ±2.362*
Time to first analgesia(min)	338±39	205±26*
Time to ambulation (min)	242±20	371±18*
Total analgesia consumption(tramadol in mg.)	73±32	120±36*

*Significant (p<0.05)

The mean time to the first analgesic requirement in Group P was significantly prolonged as compared to Group S (p< 0.05). Total analgesic consumption in first 24 h was significantly less in Group P (p< 0.05). Motor block was not seen in any of the patients in Group P, and ambulation occurred earlier in Group P as compared to Group S.

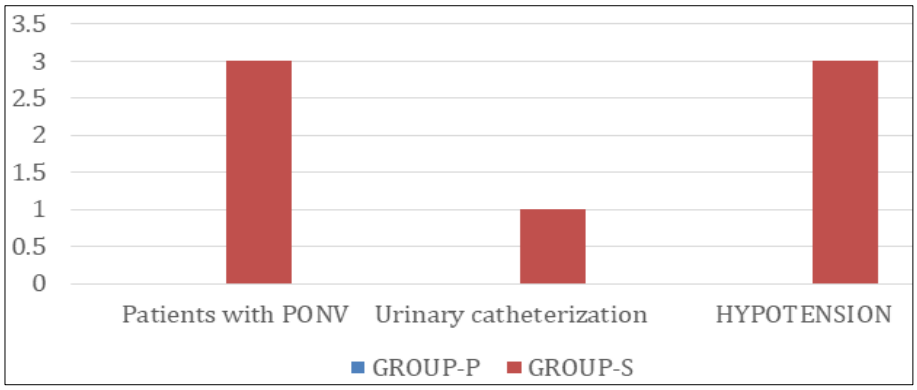
Time to perform the block and time to surgical anesthesia were significantly prolonged in Group P as compared to Group S.

Intraoperative mean SBP, DBP, and HR, were significantly reduced in Group S (p< 0.001) after the block. No patients in Group P needed either ephedrine or atropine for any hemodynamic changes. However, two patients in Group S needed ephedrine for treatment of hypotension(6.66%). There was no incidence of urinary retention in Group P while 3 (10%) patients in Group S had urinary retention (p< 0.05). In Group S, three (10%) patients experienced nausea and vomiting.



Graph 1: Block Characteristics

Adverse effects	Group P	Group S
Patients with PONV(n)	0	3
Hypotension	0	3
Urinary catheterization(n)	0	1



Graph 2: Adverse effects

Table 3: Comparison of haemodynamic data

Parameter	Time Interval (min)	Group P Mean ± SD (mmHg)	Group S Mean ± SD (mmHg)
Heart rate (per min)	Baseline	79.8±11.05	76.27±13.11
	5	76.15±12.90	78.9±14.12
	10	80.33±14.93	73.54±14.43
	15	79.81±12.90	68.72±12.80
	30	82.55±10.77	68.35±13.47
	60	78.10±10.71	67.00±14.9
	120	80.10±10.77	68.00±17.9
Systolic blood pressure (mmHg)	Baseline	133.38±20.62	132.6±18.1
	5	133.47±21.74	110.89±19.4
	10	134.47±30.7	112.89±19.4

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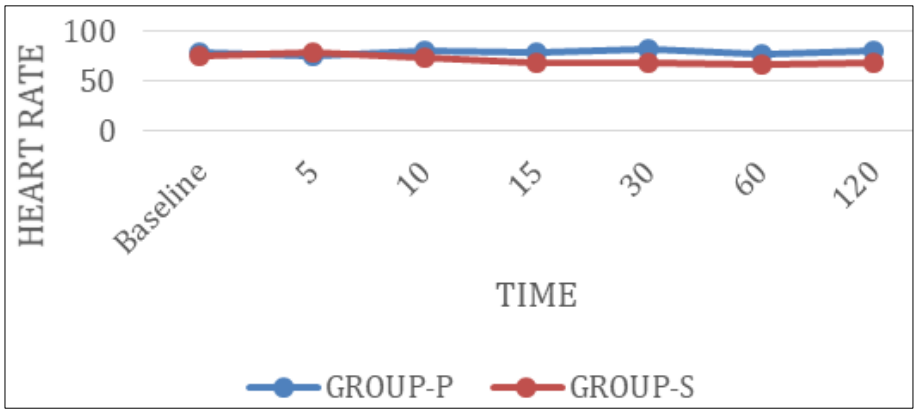
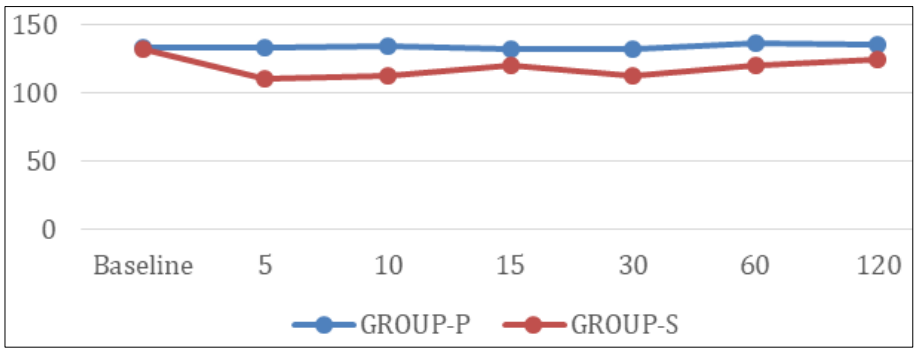
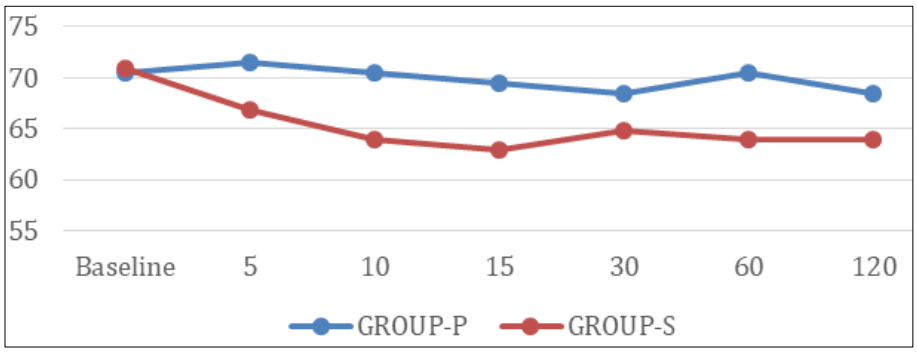
	15	132.47±20.7	120.89±59.4
	30	132.47±21.7	112.89±19.4
	60	136.47±25.7	120.89±19.4
	120	135.47±24.5	124.89±16.6
Diastolic blood pressure (mmHg)	Baseline	70.47±20.7	70.89±18.4
	5	71.47±55.7	66.89±11.4
	10	70.47±20.7	63.89±19.4
	15	69.47±56.7	62.89±69.4
	30	68.47±24.7	64.89±89.4
	60	70.47±20.7	63.89±19.4
	120	68.47±20.7	63.89±19.4
Mean arterial pressure (mmHg)	Baseline	91.44± 2.55	91.46± 3.24
	5	93.80± 2.15	80.22± 3.20
	10	91.47± 2.18	78.89± 3.28
	15	93.80± 4.76	82.89± 2.63
	30	92.13± 2.64	79.55± 3.27
	60	91.80± 2.68	82.22± 3.29
	120	92.86± 3.49	81.27± 3.26



Graph 3: Heart Rate



Graph 4: Systolic blood pressure



Graph 4: Diastolic blood pressure

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Discussion

In our study, the use of PVB for inguinal hernia repair was found to be a useful alternative to SAB with the advantage of prolonged postoperative analgesia, shorter time to reach the discharge criteria, better haemodynamic stability and minimal adverse effects.

Inguinal hernia repair, as a daycare treatment, requires effective postoperative analgesia, speedy recovery, early discharge, and prevention of PONV or other adverse consequences. The anaesthesiologist's ability, the practicality of the technique, the complexity and predicted duration of the treatment, intra and postoperative pain control, recovery time, postoperative morbidity, and cost-effectiveness significantly influence the approach used for inguinal hernia repair.

In our institute, SAB is a more frequently used technique of anaesthesia for inguinal hernia repair. However, due to adverse effects such as postdural puncture headache, urinary retention, hypotension, motor block of the lower extremities, delayed mobility, and delayed discharge from the hospital; it is not an ideal anaesthetic technique for a fast-track ambulatory surgery. In contrast to SAB, PVB preserves lower extremity motor function, provides unilateral segmental anaesthesia of the operative side with prolonged postoperative analgesia, and reduced incidence of PONV. A review of the literature has revealed limited data comparing its potential as an effective anaesthetic technique with SAB. For this reason, we decided to compare the anaesthetic and postoperative analgesic efficacy of the PVB technique at two levels with SAB using levobupivacaine in patients undergoing IHR.

Onset of analgesia in Group P was 13.11±3.412min and in Group S was 6.15 ±2.362 min. Time to first analgesia in Group P was 392±39 min and group S was 205±26 min.Patients in Group P took 242±20 minutes to ambulate, while group S took 371±18 minutes.

The results were comparable to the study conducted by Mandal *et al.* [17] in which they compared PVB to unilateral spinal anaesthesia. In the group that received spinal anaesthesia, poor recovery room time was observed as a result of prolonged motor block (p 0.001).

The delayed ambulation in the spinal group is likely related to the residual motor and sympathetic blockade. In contrast, ambulation can begin significantly sooner following PVB for the surgery of an inguinal hernia. This is likely because group P patients experience less motor blockade in their lower limbs.

In their study on inguinal hernia, Bhattacharya P *et al*. utilized a paravertebral block with 4 segments, whereas Mandal *et al*. [12] used a paravertebral block with 2 segments. As an alternative to the multiple injection technique, Saito T and his fellow researchers favoured the single injection, multi-segment Paravertebral block. Although a good anaesthetic condition was achieved with multi-segmental PVB, the patient experienced discomfort as a result of the repeated pricks. Lonnquist and Hildngston described an interruption of the paravertebral space at the level of T 12 caused by the psoas muscle. So Mandal *et al*. [12] employed a two-segment PVB at T 10 and L 1, and we did the same thing in our research using the same strategy.

In the spinal anaesthesia, hypotension was observed. However, this was not observed in the paravertebral block group, indicating that there was satisfactory hemodynamic control in the P group in comparison to group S. After three hours of the postoperative period, urine catheterization was necessary for three patient in group S, whereas none of the patients in group P required it. This higher prevalence of urine retention could be attributed to hypotension, which needed more frequent volume expansion, as Fanelli *et al*., [13] also assumed. The difficulties that are associated with spinal anaesthesia, such as urine retention and the need for catheterization, postoperative nausea and vomiting (PONV), and post-dural puncture headaches(PDPH), could be avoided during the postoperative period by using a paravertebral block (PVB). The use of finer small bore pencil-point needles (25G), on the other hand, has been shown to reduce the incidence of PDPH. The limitations for paravertebral block were that it was time demanding, that it had a possibility of failing, and that it had a higher chance of pneumothorax mainly when given in the thoracic region [14-16]. Due to a lack of familiarity with the technique and the unpredictable nature of the block, there is a greater possibility that only a partial block or no block will be achieved. The use of a peripheral nerve stimulator (PNS) or ultrasound guidance reduces the failure rate while simultaneously increasing the block's overall effectiveness.

Conclusion

For IHR, PVB can be recommended as a more effective and safer alternative anaesthetic approach to SAB because it offers unilateral and segmental anaesthesia, sustained postoperative analgesia, early ambulation, stable intraoperative hemodynamics, and fewer negative effects. However, the level of knowledge required, the length of the process, and the delayed start of impact are major issues.

Conflict of Interest: None

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