Section: Anaesthesiology

Original Research Article

COMPARATIVE STUDY OF PARAVERTEBRAL BLOCK VERSUS UNILATERAL SPINAL ANAESTHESIA FOR NON-COMPLICATED INGUINAL HERNIA REPAIR

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Received : 14/09/2023
Received in revised form : 05/10/2023
Accepted : 18/10/2023

Keywords:
Spinal anesthesia, Paravertebral block, Postoperative complications, Urinary retention, Subarachnoid block, Inguinal hernia repair.

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DOI: 10.47009/jamp.2023.5.5.300

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

Int J Acad Med Pharm
2023; 5 (5); 1518-1523

Abstract

Background: While spinal anesthesia, referred to as subarachnoid block (SAB), is a common choice for inguinal hernia repair, the paravertebral block (PVB) offers a highly successful alternative by providing unilateral, segmental analgesia. **Aim:** This study compares the efficacy and outcomes of paravertebral and subarachnoid blocks in patients undergoing inguinal hernia repair. **Materials and Methods:** This prospective, single-blinded study was conducted at the Department of Anaesthesiology, Tirunelveli Medical College, on 60 patients scheduled for unilateral inguinal hernia repair for one year from March 2022 to April 2023. Patients were divided into two groups: paravertebral block and subarachnoid block. Age distributions, vital parameters, perioperative side effects, and intraoperative hemodynamics were recorded. Postoperative pain scores and recovery parameters were assessed. **Results:** The paravertebral block group showed a higher representation in the 30-39 and 50-60 age categories (33.33% each), while the subarachnoid block group had a higher percentage in the 50-60 age group (50%). Baseline vital parameters indicated subtle differences between the groups. Significant differences in perioperative side effects favoured the paravertebral block group. Intraoperative heart rate and blood pressure varied significantly at specific time intervals. Postoperatively, the paravertebral block group exhibited lower pain scores and achieved higher discharge scores earlier. The subarachnoid block group showed higher postoperative blood pressure trends. **Conclusion:** Spinal anesthesia demonstrated superior efficacy, patient cooperation, and procedural efficiency compared to paravertebral block. Paravertebral block, while effective, primarily addresses somatic pain and may not comprehensively alleviate visceral pain.

INTRODUCTION

Inguinal herniorrhaphy is one of the males' most commonly performed surgical procedures.[1] It may be conducted using different anaesthetic techniques like Subarachnoid block, Epidural Anaesthesia, General Anaesthesia, and regional nerve block by itself or in combination.[1,2] The choice of anaesthetic technique depends on the surgeon and anaesthesiologist's preference, feasibility, intraoperative and postoperative pain control, expected procedure duration, postoperative morbidity, recovery time, and cost-effectiveness.[1] Spinal anaesthesia provides the advantages of suppressing the stress reaction to surgical treatment, lessening morbidity in high-risk individuals, and enabling the upkeep of analgesia in the postoperative time.[3] Spinal anaesthesia has undesirable haemodynamic responses, and adverse effects like hypotension and bradycardia might be difficult.[4] Paravertebral block (PVB) offers analgesia equivalent to considerable peripheral nerve block for inguinal herniorrhaphy, providing an alternate technique of postoperative pain control with a lot fewer negative events.[5]

PVB has been discovered to be far more useful than typical spinal anaesthesia for inguinal hernia repair because of earlier ambulation and far better postoperative pain scores.[6] The paravertebral block could likewise be used for surgical anaesthesia of individuals with severe comorbidities in whom general anaesthesia and neuraxial blocks pose greater morbidity.[7] PVB can be done at 2, 4, 5 segment techniques, and 4-segment PVB is usually a much better option for SAB.[1] It is judged by looking at the

ISSN (O): 2687-5365; ISSN (P): 2753-6556

time of ambulation, the period of postoperative analgesia, and the likelihood of negative event.[1] The adaptability of spinal anaesthesia is afforded by a broad selection of local anaesthetics and additives, which determine the time of beginning and the duration of spinal anaesthesia.[1]

The distribution of regional anaesthetic solutions in the subarachnoid space determines the level of neural blockade created by spinal anaesthesia.[1] Hyperbaric Bupivacaine, an amide local anaesthetic, is frequently used for spinal anaesthesia.[1] A minimal dose of hyperbaric bupivacaine creates short-lasting spinal anaesthesia, which could be clinically helpful in ambulatory procedures.[8,9] Nevertheless, long postoperative analgesia on the operative side is needed for nearly all lower abdominal surgeries.[1] Therefore, the study aimed to compare paravertebral block with unilateral spinal anaesthesia for inguinal hernia repair for time to ambulation, time to first analgesic (duration of postoperative analgesia), total rescue analgesic consumption in the first 24-h period, and incidence of adverse events.[1]

MATERIALS AND METHODS

This prospective, single-blinded study was conducted at the Department of Anaesthesiology, Tirunelveli Medical College, on 60 patients scheduled for unilateral inguinal hernia repair for one year from March 2022 to April 2023.

Inclusion Criteria

ASA physical status I & II, age group of patients 18-60 years, and patients scheduled for unilateral inguinal hernia repair procedure were included.

Exclusion Criteria

Patients' refusal, morbid obesity, all complicated, strangulated hernia cases, previous inguinal hernia repair on the same side, coagulopathy, significant cardiovascular, respiratory, renal, hepatic or metabolic disease, peripheral neuropathy, and history of substance abuse, mental dysfunction, active gastrointestinal reflux, chronic analgesic use, and allergy to local anaesthetics were excluded.

Ethical committee approval and informed consent were obtained before the study started. 60 patients were randomly divided into two groups, each having 30 patients. Group 1 – Patients with Unilateral spinal anaesthesia, and Group II - Patients with Paravertebral block.

In the unilateral paravertebral block (PVB) procedure, patients were positioned in a sitting posture while maintaining aseptic precautions. A reference point 3cm lateral to the cephalad aspect of the T10 and L1 vertebrae spinous processes was marked, corresponding to the transverse process of the vertebra below for T10 and the caudal edge of the homologous transverse processes of L1. Local anaesthesia with 1% lignocaine was administered at this point. An 18G Tuohy needle was inserted perpendicular to the skin, reaching the respective transverse processes at approximately 2–4 cm depth in the thoracic region and 5–8 cm in the lumbar region. The needle was then slightly withdrawn and redirected to the cephalad for thoracic PVB or caudal for lumbar PVB while angling it medially. At a depth of 1–2 cm from the transverse process, a "loss of resistance" to normal saline was typically felt. After confirming negative aspiration for blood and cerebrospinal fluid, 15 ml of 0.5% bupivacaine was injected at T10, and 5 ml of 0.5% bupivacaine was injected at L1 slowly. Following the block, patients were repositioned into a supine position.

Unilateral spinal anaesthesia was administered through a midline approach using a 25-G Whitacre needle at the L3-4 or L2-3 intervertebral space, with the patient in the lateral decubitus position and the surgical side dependent. Approximately 2.5ml-3.0ml of hyperbaric bupivacaine (5 mg/ml) was injected into the chosen space. The patient was maintained in the same position for 15 minutes. After the procedure, both groups of patients received dressings extending from T9 to L4, and the observer gained access to the patients only after the dressings were applied. The success of the paravertebral block (PVB) was determined based on specific criteria: the onset of loss of pinprick discrimination started within 15 minutes, and the sensory block from T10-L2 was achieved within a maximum time frame of 30 minutes. Successful unilateral spinal anaesthesia was defined as having achieved surgical anaesthesia (loss of pinprick sensation at L1 and complete motor block) exclusively on the dependent side. In contrast, the non-dependent side maintained somatic sensibility to the pinprick test at L1 and a motor block lesser than the first degree.

Various parameters were examined, including recording the time it took for patients to experience their first analgesic requirement, determining the total number of rescue-analgesic doses needed within the initial 24 hours, assessing the duration required to meet discharge criteria, documenting the time taken to perform the block, measuring the time until surgical anaesthesia was achieved, and tracking the time for patients to regain ambulation. Hemodynamic changes were monitored, adverse effects were documented, and levels of patient satisfaction were evaluated as part of the comprehensive data analysis process.

Statistical Analysis

All the data were entered into MS Excel, and all continuous variables were expressed as Mean and Standard Deviation. All categorical variables were expressed as percentages and proportions. A p-value (<0.05) indicates a statistically significant between the groups.

RESULTS

The study group of the paravertebral block has more individuals aged 30-39 & 50-60 (33.33% each), while the subarachnoid block group has more percentage among the 50-60 age group (50%). The mean age is

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47.17 among the paravertebral block group and 52.02 among the subarachnoid block group [Table 1].
The right-sided inguinal hernia was common among the paravertebral block group (66.67%) and the subarachnoid block group as well (56.67%) (Table 1).

Baseline vital parameters before the block
The mean heart rate is 83.17, systolic blood pressure is 123.33, diastolic blood pressure is 81.06, Mean arterial pressure is 95.03, and Spo2 is 98.83 among the paravertebral block group.
The mean heart rate is 81.27, systolic blood pressure is 121.53, diastolic blood pressure is 78.60, mean arterial pressure is 93.20, and Spo2 is 99.30 among the subarachnoid block group [Table 2].

Table 1: Age and diagnosis between the groups

		Paravertebral block	Subarachnoid block
Age	30-39	10 (33.33%)	2 (6.67%)
	40-49	8 (26.67%)	9 (30%)
	50-60	10 (33.33%)	15 (50%)
	>60	2 (6.67%)	4 (13.33%)
	Mean	47.17 9.02	52.2 8.02
Diagnosis	LT inguinal hernia	10 (33.33%)	13 (43.33%)
	RT inguinal hernia	20 (66.67%)	17 (56.67%)

Table 2: Perioperative side effects between the groups

Perioperative side effect		Paravertebral block	Subarachnoid block	P-value
Nausea	Yes	0	3 (10%)	0.075
	No	30 (100%)	27 (90%)	
Urinary catheterisation	Yes	0	2 (6.67%)	0.15
	No	30 (100%)	28 (93.33%)	
Headache	Yes	0	3 (10%)	0.075
	No	30 (100%)	27 (90%)	
Backache	Yes	0	3 (10%)	0.075
	No	30 (100%)	27 (90%)	

There were no perioperative side effects seen in a paravertebral block group. But in the subarachnoid block group, side effects, like nausea in 3 (10%), urinary catheterisation in 2 (6.67%), headache in 3 (10%), and backache in 3 (10%). There was no significant difference in perioperative side effects between groups.
A significant difference was found between the groups in the intraoperative heart rate at 0, 10, 15, 20, 30, and 75 mins, but insignificant at 5, 25, 45, 60, and 90 mins.
Insignificant at 0 mins, but a significant difference was found in the intraoperative systolic blood pressure between the groups at 5 to 90 mins.
A significant difference was found in the intra-operative diastolic blood pressure at 5 to 45 mins between the groups, but insignificant at 0, 60, 75, and 90 mins.
A significant difference was found between the groups in the intraoperative mean arterial pressure at 5 to 60 mins but insignificant at 0, 75, and 90 mins.
The intra-operative SpO2 was insignificant between the groups at 0 to 25 mins, but there was a significant difference at 30, 45, 60, and 75 mins.

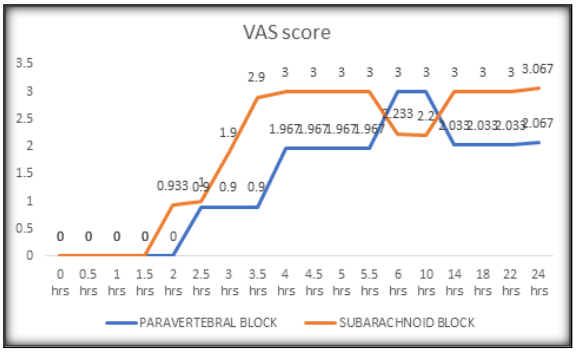

Figure 1: Postoperative VAS score between the groups

A significant difference between the groups was found in the postoperative VAS score at 2 to 24 hours (Figure 1). The mean duration of postoperative analgesia was 6.000 ± 0 hours, and there is a significant difference ($p<0.0001$).
Higher postoperative discharge scoring seems to be attained earlier in the paravertebral block group than the subarachnoid block group, which reached 10.00 only after 14 hours.
A significant difference was found between the groups' postoperative modified post-anaesthetic discharge scoring at 0 to 10 hours (Figure 1).

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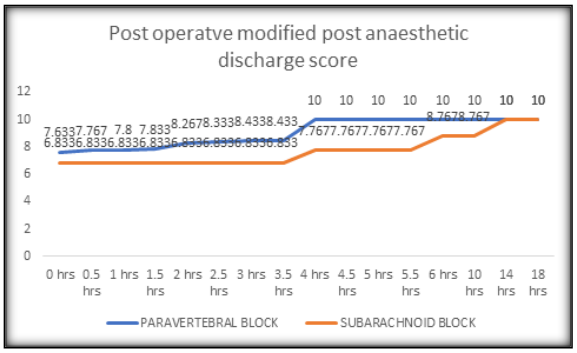

Figure 2: Postoperative modified post-anaesthetic discharge score

The subarachnoid block group recorded a mean value of 8.067 hours to reach the discharge criteria compared to the paravertebral block group, with a mean value of 3.100. A significant difference was found between the groups in the time to reach discharge criteria ($p<0.0001$).

Postoperative heart rate maintains almost constant values over both groups, and the minor differences seem statistically insignificant.

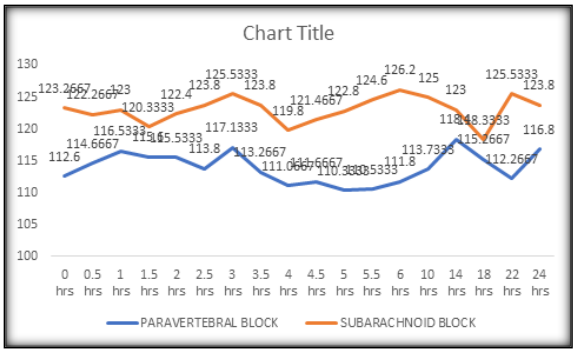

Figure 3: Postoperative systolic blood pressure between the groups

The postoperative systolic blood pressure trend is higher for the subarachnoid block group than the paravertebral block group, which is recorded at 30-minute intervals for 24 hours (Figure 3).

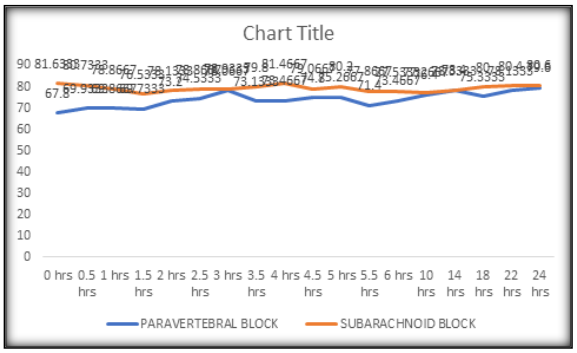

Figure 4: Postoperative diastolic blood pressure between the groups

The postoperative diastolic blood pressure trend is higher for the subarachnoid block group than the paravertebral block group, which is recorded at 30-minute intervals for 24 hours (Figure 4).

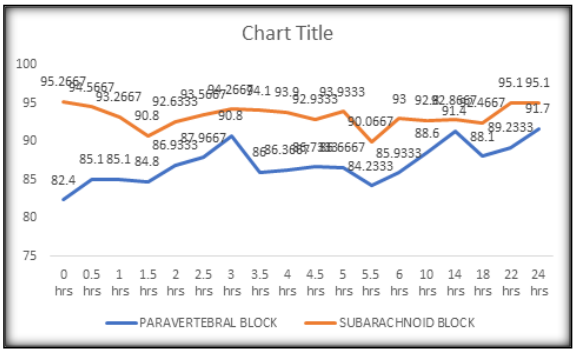

Figure 5: Postoperative mean arterial pressure between the groups

Mean arterial pressure in the postoperative period is recorded to be higher in the subarachnoid block group than the paravertebral block group, which is statistically significant (Figure 5).

Postoperative Spo2 was maintained at 99 for both the groups of paravertebral block and subarachnoid block. Rescue analgesia of injection Tramadol is not needed for both groups till the 24-hour time lapse.

DISCUSSION

This study observed distinct age distributions between the two anaesthesia groups, paravertebral and subarachnoid blocks, and noted potential clinical implications. The paravertebral block group demonstrated a notable representation of individuals aged 30-39 and 50-60, comprising 33.33% of the cohort. In contrast, the subarachnoid block group exhibited a higher proportion of patients within the 50-60 age range, constituting 50% of the group. This age-related discrepancy was further substantiated by mean age values of 47.17 years for the paravertebral block group and 52.02 years for the subarachnoid block group. These findings raise questions regarding the influence of patient age on the selection and efficacy of different anaesthesia techniques, suggesting the need for further investigation into age-specific considerations in clinical practice.

Baseline vital parameters before the block administration revealed subtle distinctions between the two groups. Notably, the paravertebral block group exhibited a marginally higher mean heart rate (83.17 bpm), systolic blood pressure (123.33 mm Hg), diastolic blood pressure (81.06 mm Hg), mean arterial pressure (95.03 mm Hg), and slightly lower Spo2 (98.83%) in comparison to the subarachnoid block group. These variations in pre-operative parameters may have implications for patient selection and risk assessment in the context of anaesthesia choice.

The assessment of perioperative side effects unveiled significant differences between the groups, with the subarachnoid block group reporting side effects such as nausea (10%), urinary catheterisation (6.67%), headache (10%), and backache (10%). In contrast, the paravertebral block group did not experience any of these complications. This disparity raises

ISSN (O): 2687-5365; ISSN (P): 2753-6556

important questions about these anaesthesia methods' safety and tolerability profiles and their potential impact on patient outcomes and satisfaction. Intraoperative hemodynamic monitoring revealed significant differences in heart rate and blood pressure at specific intervals. While the clinical significance of these variations merits further investigation, it is essential to consider how these findings may relate to the choice of anaesthesia and surgical procedures.

Postoperatively, the paravertebral block group exhibited lower postoperative VAS scores, indicative of reduced pain intensity, across the 2 to 24-hour observation period. This finding suggests potential advantages in postoperative pain management associated with the paravertebral block. Moreover, the paravertebral block group achieved higher postoperative discharge scores earlier, reaching a score of 10.00 after 14 hours compared to the subarachnoid block group. These results underscore the potential for enhanced recovery and earlier discharge with paravertebral block. Additionally, we observed significant differences in postoperative parameters, including systolic blood pressure, diastolic blood pressure, and mean arterial pressure, favouring the subarachnoid block group. These findings necessitate further investigation into the clinical implications of these differences and their impact on postoperative care.

Mandal et al. posited that employing a two-segment paravertebral block encompassing T10 and L1 vertebrae could serve as a viable alternative to unilateral spinal anaesthesia, primarily attributed to its facilitation of early mobilisation and prolonged analgesic efficacy. These findings align with the broader endeavours to implement outpatient anaesthesia techniques in inguinal hernia surgeries to curtail hospitalisation durations. Given the unintended repercussions associated with general anaesthesia, including challenges in postoperative recovery and airway compromise, and spinal anaesthesia, marked by a propensity for hemodynamic instability, heightened incidence of nausea and vomiting, and postoperative headache, there is a growing impetus to explore alternative anaesthesia modalities.[4]

Our current investigation concurs with prior research, affirming that Paravertebral Block (PVB) intervention is linked with expeditious ambulation, superior postoperative analgesia, and the circumvention of the recovery room. Notably, no untoward side effects were discerned in either study cohort. The study conducted by Rani KR et al. reported that the PVB group received more intraoperative supplemental analgesics, with a prolonged time for the first postoperative analgesics [10]. In addition, Bhattacharya et al. also revealed that the time interval before the initial postoperative analgesia was notably prolonged in the PVB group (342 ± 73 minutes) in contrast to the SAB group (222 ± 22 minutes). Additionally, the cumulative need for postoperative analgesics within the initial 24 hours was diminished in the PVB group, attributable to administering tramadol boluses based on the patient's VAS score assessment.[11]

Our study corroborates these observations, demonstrating the superiority of PVB over spinal anaesthesia in terms of hemodynamic equilibrium, diminished postoperative pain scores, and reduced analgesic necessity. The time required to ambulate was less in the PVB group when compared to the SAB group. Similar findings were reported by Rani et al.[10] This could be attributed to the segmental characteristics of the sensory block, resulting in extended pain alleviation even after patients resumed ambulation. In contrast, the non-segmental nature of the sensory block in the SAB group led to only transient pain relief.

Furthermore, the low Bromage score indicating minimal motor blockade likely played a role in the early ambulation observed in the PVB group in our study. This contrasts the high Bromage score noted in the SAB group, aligning with findings in other studies by Sinha et al,[12] and Joshi et al.[13] However, few studies have reported that adverse effects were more prevalent in the SAB group when compared to the PVB group.[11,14]

In their study on inguinal hernia repair, Bhattacharya et al,[11] opted for a paravertebral block involving four segments, whereas Mandal et al,[4] utilised a paravertebral block with only two segments. In contrast to the multiple injection technique, Saito and colleagues advocated for a single injection approach encompassing multiple segments of the paravertebral block. Although the multi-segmental PVB achieved satisfactory anaesthetic conditions, patients reported discomfort due to repeated needle insertions. Lonnquist and Hildngston highlighted an interruption of the paravertebral space at the T12 level caused by the psoas muscle. Consequently, Mandal et al,[4] employed a two-segment PVB targeting T10 and L1, mirroring the approach adopted in our study, which employed the same strategy.

Utilising a paravertebral block (PVB) offers the potential to circumvent challenges associated with spinal anaesthesia, such as postoperative urinary retention requiring catheterisation, postoperative nausea and vomiting (PONV), and post-dural puncture headaches (PDPH). Additionally, employing finer small-gauge pencil-point needles (25G) has demonstrated efficacy in reducing the occurrence of PDPH. Nonetheless, it is worth noting that PVB may entail certain limitations, including a time-intensive application, a potential for occasional ineffectiveness, and an increased risk of pneumothorax, particularly when administered in the thoracic region.[13,15-16]

The efficiency of the Paravertebral block can further be enhanced by integrating a Peripheral nerve stimulator (PNS) and ultrasound-guided techniques. However, our findings indicate that spinal anaesthesia may hold an edge regarding efficacy, patient cooperation and relaxation, surgeon satisfaction, and procedural efficiency. Notably,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

employing PNS and ultrasound guidance may optimise the execution of PVB, potentially economising procedural time.

CONCLUSION

Our study concludes that spinal anesthesia surpasses paravertebral block in effectiveness, patient compliance, relaxation, surgeon contentment, and procedural expediency. It is crucial to highlight that while paravertebral block is productive, it primarily addresses somatic pain and may not comprehensively alleviate visceral pain encountered during inguinal hernia repair, particularly concerning manipulations of the hernia sac or spermatic cord. However, paravertebral block offers distinct advantages, including its capability to deliver segmental anesthesia, facilitate prompt ambulation, and provide extended pain relief, rendering it a promising analgesic option, particularly for high-risk patients. Furthermore, this technique can seamlessly integrate into routine clinical practice with a peripheral nerve stimulator or ultrasound guidance.

Limitations

This study is limited by its single-centre design and may benefit from multi-centre validation for broader applicability. Further investigations into age-specific considerations and long-term outcomes are warranted. Additionally, exploring alternative anaesthesia modalities is encouraged to refine clinical practice in hernia surgeries.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556