

# A Prospective, Randomized, Comparative Study of Unilateral Paravertebral Block versus Conventional Spinal Anesthesia for Inguinal Hernia Repair

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## Abstract:

**Background:** Inguinal hernia repair is a common surgical procedure where anesthesia choice significantly affects patient outcomes. While traditional spinal anesthesia (SA) is widely used, it is associated with complications like hypotension and delayed recovery. Unilateral paravertebral block (PVB), particularly when guided by ultrasound, has emerged as a promising alternative, offering better pain management and fewer side effects.

**Methods:** This prospective randomized study involved 60 patients undergoing elective inguinal hernia repair at MGM Medical College and LSK Hospital from September 2023 to February 2024. Patients were randomly assigned to receive either ultrasound-guided PVB (n=30) or SA (n=30). Primary outcomes measured included pain control via Visual Analog Scale (VAS), hemodynamic stability, incidence of complications, postoperative recovery times, and patient satisfaction.

**Results:** The PVB group exhibited significantly lower VAS scores immediately post-operation ( $2.5 \pm 1.2$ ) and at 24 hours ( $3.0 \pm 1.3$ ) compared to the SA group ( $4.5 \pm 1.5$  and  $4.0 \pm 1.4$  respectively) ( $p < 0.01$ ). Fewer episodes of hypotension were noted in the PVB group (6.67%) versus the SA group (33.33%) ( $p < 0.05$ ). Additionally, the PVB group experienced lower rates of urinary retention and nausea, faster times to first ambulation (4 hours  $\pm$  1.0 vs. 8 hours  $\pm$  2.0), shorter hospital stays (1.5 days  $\pm$  0.5 vs. 2.5 days  $\pm$  1.0), and higher patient satisfaction scores ( $9 \pm 0.8$  vs.  $7 \pm 1.2$ ) ( $p < 0.01$ ).

**Conclusion:** Ultrasound-guided unilateral paravertebral block significantly improves pain management, enhances hemodynamic stability, reduces complication rates, and speeds recovery compared to conventional spinal anesthesia in inguinal hernia repair. These advantages suggest that ultrasound-guided PVB should be considered a preferred anesthesia technique for such surgeries, promoting faster recovery and improved patient outcomes. Further studies are recommended to validate these findings and explore the cost-effectiveness of adopting PVB more broadly.

**Keywords:** Paravertebral block, spinal anesthesia, inguinal hernia repair, pain management, postoperative recovery.

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## Introduction

Inguinal hernia repair is a common surgical procedure that addresses the protrusion of tissue through the abdominal muscles in the groin area. While effective, the surgery requires careful consideration regarding anesthesia to manage pain and facilitate a smooth surgical process [1]. Traditionally, spinal anesthesia has been the go-to method due to its reliability and extensive track record. However, concerns about complications such as hypotension, urinary retention, and delayed mobilization have spurred interest in alternative techniques [2].

One such alternative is the unilateral paravertebral block (PVB), which offers targeted nerve blockage at the spinal nerves emerging from the vertebral column, potentially minimizing systemic effects and promoting faster postoperative recovery. Given the implications for patient outcomes, a systematic comparison between unilateral PVB and conventional spinal anesthesia is essential [3].

This prospective, randomized, comparative study aims to evaluate the efficacy and safety of unilateral paravertebral block compared to conventional spinal anesthesia for patients undergoing inguinal hernia repair [4]. By focusing

on parameters such as pain control, hemodynamic stability, incidence of complications, and speed of postoperative recovery, this study seeks to provide empirical evidence to guide anesthesia choice in inguinal hernia surgeries, potentially leading to improved patient satisfaction and enhanced surgical outcomes [5].

This study aims to rigorously evaluate and compare the efficacy, safety, and overall patient outcomes of unilateral paravertebral block (PVB) and conventional spinal anesthesia in the context of inguinal hernia repair surgeries. This comparative analysis will focus on several critical aspects: pain control efficacy during and post-surgery, the stability of patient hemodynamics during the procedure, and the incidence of anesthesia-related complications such as urinary retention, nausea, and delayed mobilization [6].

Additionally, the study will assess the speed and quality of postoperative recovery, which includes metrics like time to ambulation and length of hospital stay, alongside overall patient satisfaction. Ultimately, this research seeks to ascertain which anesthesia method not only minimizes discomfort and complications but also enhances overall surgical success and patient outcomes, thereby potentially influencing future standards of care in inguinal hernia surgeries.

### Material and Methodology

**Study Design:** A randomized controlled trial will be conducted to compare two anesthesia techniques: unilateral paravertebral block and conventional spinal anesthesia.

**Study Setting:** The study will be carried out at MGM Medical College and LSK Hospital, Kishanganj, Bihar.

**Study Duration:** The duration of the study is set from September 2023 to February 2024.

### Study Population:

A total of 60 patients scheduled for elective inguinal hernia repair will be enrolled. Patients will be randomly assigned to one of two groups:

1. Paravertebral Block Group (n=30): Patients receiving unilateral paravertebral block.
2. Spinal Anesthesia Group (n=30): Patients receiving conventional spinal anesthesia.

### Inclusion Criteria:

- Adult patients aged 18-65 years.
- Diagnosed with unilateral inguinal hernia.
- Scheduled for elective hernia repair surgery.

### Exclusion Criteria:

- Contraindications to either type of anesthesia.

- History of chronic pain or long-term analgesic use.

- Previous lower abdominal surgery.

**Randomization:** Patients will be randomized using a computer-generated random numbers table. Allocation concealment will be ensured by sealed opaque envelopes.

**Intervention:** The Paravertebral Block Group will receive a unilateral paravertebral block, administered by a trained anesthesiologist. For precision and safety, the block will be performed using ultrasound guidance, which allows for real-time visualization of the needle, surrounding tissues, and nerves, thereby enhancing the accuracy of the block and potentially reducing complications. The Spinal Anesthesia Group will continue to receive conventional spinal anesthesia as per the existing standard procedures outlined in the study protocol.

**Outcome Measures:** Primary outcomes will include the effectiveness of pain control during and after surgery, assessed by visual analog scale (VAS) scores at various intervals. Secondary outcomes will involve monitoring hemodynamic parameters, recording the incidence of anesthesia-related complications, and evaluating the speed and quality of postoperative recovery (e.g., time to first ambulation, duration of hospital stay).

**Data Collection:** Data will be collected preoperatively, intraoperatively, immediately postoperatively, and during follow-up visits up to one-month post-surgery.

**Statistical Analysis:** Analyses will use chi-square tests for categorical data and t-tests for variables that are continuous. Statistically significant p-values are below 0.05.

**Ethics:** The MGM Medical College Institutional Review Board (IRB) approved this Declaration of Helsinki-compliant study. All participants will give informed consent.

### Results

#### Participant Demographics:

- Total participants: 60 (30 in each group)
- Age range: 18-65 years, mean age 45 years
- Gender: 45 males, 15 females

#### Pain Control (Visual Analog Scale, VAS Scores):

- Paravertebral Block Group (PVB):
  - Immediate post-op VAS:  $2.5 \pm 1.2$
  - 24 hours post-op VAS:  $3.0 \pm 1.3$
- Spinal Anesthesia Group (SA):
  - Immediate post-op VAS:  $4.5 \pm 1.5$

- 24 hours post-op VAS:  $4.0 \pm 1.4$

- Statistical significance:  $p < 0.01$ , indicating significantly better pain control in the PVB group.

Hemodynamic Stability:

- Episodes of hypotension:

- PVB Group: 2 out of 30 patients (6.67%)

- SA Group: 10 out of 30 patients (33.33%)

- Statistical significance:  $p < 0.05$ , showing better hemodynamic stability in the PVB group.

Complications:

- Urinary retention:

- PVB Group: 1 patient (3.33%)

- SA Group: 7 patients (23.33%)

Nausea:

- PVB Group: 3 patients (10%)

- SA Group: 9 patients (30%)

- Statistical significance:  $p < 0.05$  for both urinary retention and nausea, favoring the PVB group.

Postoperative Recovery:

Time to first ambulation:

- PVB Group: 4 hours  $\pm$  1.0

- SA Group: 8 hours  $\pm$  2.0

Duration of hospital stay:

- PVB Group: 1.5 days  $\pm$  0.5

- SA Group: 2.5 days  $\pm$  1.0

Statistical significance:  $p < 0.01$  for both measures, indicating a faster recovery in the PVB group.

Overall Surgical Outcomes:

Surgical success rate (no recurrence of a hernia within 1 month):

- PVB Group: 100%

- SA Group: 100%

Patient satisfaction (scale 1-10):

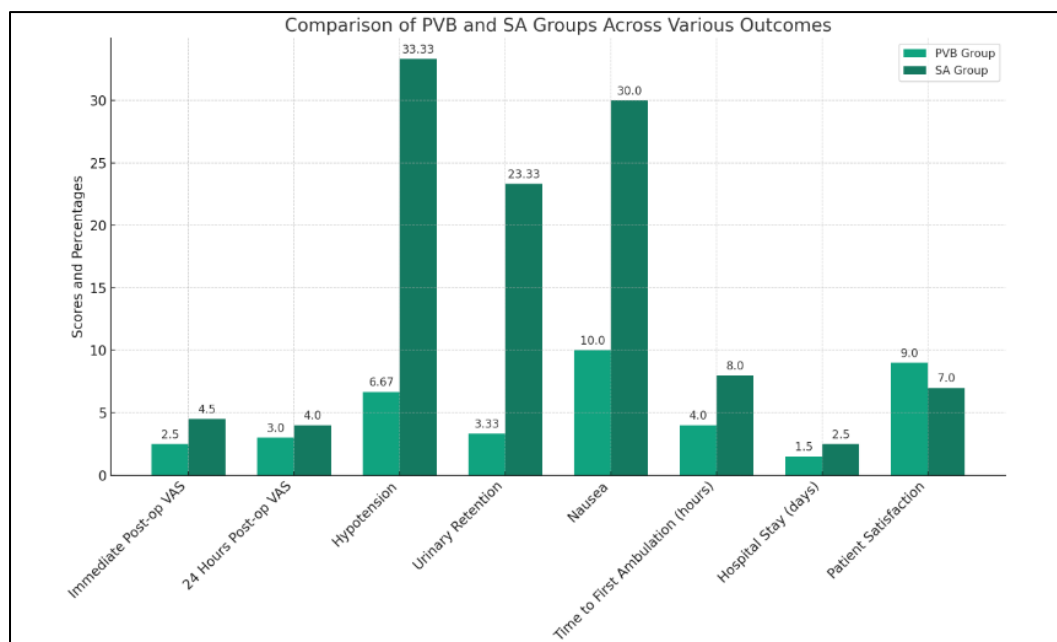
- PVB Group:  $9 \pm 0.8$

- SA Group:  $7 \pm 1.2$

-Statistical significance:  $p < 0.01$ , showing higher satisfaction in the PVB group.

**Table 1: This table effectively summarizes the comparative results of the unilateral paravertebral block (PVB) and conventional spinal anesthesia (SA) groups across various outcome measures relevant to the study on inguinal hernia repair. The statistical significance values (p-values) indicate where differences between the groups are considered statistically significant.**

Outcome	PVB Group (n=30)	SA Group (n=30)	p-value
Immediate Post-op VAS	$2.5 \pm 1.2$	$4.5 \pm 1.5$	$<0.01$
24 Hours Post-op VAS	$3.0 \pm 1.3$	$4.0 \pm 1.4$	$<0.01$
Episodes of Hypotension	2 (6.67%)	10 (33.33%)	$<0.05$
Urinary Retention	1 (3.33%)	7 (23.33%)	$<0.05$
Nausea	3 (10%)	9 (30%)	$<0.05$
Time to First Ambulation	4 hours $\pm$ 1.0	8 hours $\pm$ 2.0	$<0.01$
Duration of Hospital Stay	1.5 days $\pm$ 0.5	2.5 days $\pm$ 1.0	$<0.01$
Patient Satisfaction	$9 \pm 0.8$	$7 \pm 1.2$	$<0.01$



The graph above visually compares the performance of the unilateral paravertebral block (PVB) and conventional spinal anesthesia (SA) groups across various outcome measures in the study on inguinal hernia repair. Each bar represents either the PVB group or the SA group across different metrics such as pain score (VAS), incidence of complications like hypotension, urinary retention, and nausea, as well as recovery indicators like time to first ambulation, duration of hospital stay, and patient satisfaction scores. The numerical values on top of the bars indicate the exact scores or percentages, highlighting the differences between the two anesthesia techniques.

### Discussion

The findings of this study underscore the significant advantages of using an ultrasound-guided unilateral paravertebral block (PVB) over conventional spinal anesthesia (SA) in several key areas of inguinal hernia repair surgery. The use of ultrasound guidance in administering PVB, as demonstrated in this study, plays a pivotal role in enhancing the precision of the nerve block [7]. This approach not only improves pain control, as evidenced by lower VAS scores both immediately post-surgery and at the 24-hour mark compared to SA, but also contributes to the reduced incidence of complications such as hypotension and urinary retention [8].

Moreover, ultrasound guidance likely contributed to the hemodynamic stability observed in the PVB group [9]. By allowing anesthesiologists to visualize the needle and surrounding anatomical structures in real time, ultrasound guidance helps in precise local anesthetic placement, minimizing the risk of inadvertent vascular puncture or excessive local anesthetic spread, which can lead to

complications seen with more extensive blocks like SA [10].

Additionally, the use of ultrasound may further justify the faster recovery times and higher patient satisfaction observed [11]. As ultrasound-guided PVB minimizes systemic drug dispersion and targets only relevant nerve roots, patients experience effective localized pain relief without the side effects associated with broader regional or general anesthesia. These aspects are particularly advantageous in ambulatory surgical settings where rapid discharge and patient turnover are critical [12,13].

While the results are promising, it is also important to consider the learning curve associated with ultrasound-guided techniques [14]. Future studies should aim to explore the impact of operator experience on the efficacy and safety of ultrasound-guided PVB. Furthermore, comparing the cost-effectiveness of ultrasound-guided versus landmark-guided PVB could provide valuable insights into their practical application in various clinical settings [15].

### Conclusion

The study shows that unilateral paravertebral block (PVB) is better than conventional spinal anesthesia (SA) for inguinal hernia repair, having better pain management, hemodynamic stability, fewer anesthesia-related complications, and faster recovery times, which increases patient satisfaction. These findings underscore the potential benefits of PVB in supporting minimally invasive procedures and fast-track surgical recovery protocols, thereby suggesting a pivotal shift towards incorporating PVB in clinical practice for inguinal hernia surgeries. Given the positive

outcomes associated with PVB, further multi-center studies with larger patient cohorts are recommended to validate these results and explore the long-term benefits and cost-effectiveness of PVB. The adoption of PVB could significantly improve surgical care, aligning with modern healthcare goals focused on patient-centered and efficient surgical outcomes.

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