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# Ultrasound-guided ilioinguinal/iliohypogastric nerve block compared to posterior quadratus lumborum block in patients undergoing inguinal hernia repair

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**ABSTRACT**

**Background:** "Ilioinguinal/iliohypogastric nerve block" (IINB) has been described as effective regional anesthetic method for providing analgesia after inguinal hernia operations. Other studies have also reported that the "posterior quadratus lumborum block" (PQLB) is an effective analgesic option for lower abdominal surgeries. Herein, we compared the previous two block techniques for postoperative pain management in adults undergoing unilateral inguinal hernia repair.

**Methods:** According to the block technique, 76 adult patients scheduled for inguinal herniaplasty under general anesthesia were randomly enrolled into two groups; the PQLB and IINB groups. The block was performed after skin closure and before patient extubation. Postoperative analgesic profiles were recorded in both groups.

**Results:** The PQLB had lower heart rate and mean arterial pressure readings during postoperative assessment compared to the other group. Pain scores showed a significant decline in association with the PQLB during the first postoperative day, which resulted in a significant decline in pethidine consumption (49.17 vs. 70 mg in the IINB group) and better patient satisfaction. The duration to the first analgesic request significantly increased in association with the PQLB (13.25 vs. 8.42 hours in the IINB group). The incidence of nausea and vomiting increased significantly in the IINB group secondary to increased pethidine requirements.

**Conclusion:** PQLB is superior to IINB in providing analgesia for patients undergoing inguinal hernia repair.

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## 1. Introduction

Inguinal hernia repair is one of the most commonly performed surgical procedures in general surgical departments around the world [1,2]. Despite being relatively simpler compared to complex intraabdominal procedures, moderate to severe postoperative pain is reported by 60% of the patients after the repair procedure [3]. Not only does postoperative pain hinder patient mobility and impair satisfaction [4], but it also increases the risk of chronic postoperative pain (inguinodynia), as up to 54% of patients reporting improper pain management during the perioperative period could develop chronic pain at the surgical site [3,5].

The application of regional block techniques has been proven an effective method for achieving analgesia in such patients [4,6,7]. A variety of block techniques have been described for that purpose, including the "transversus abdominis plane" (TAP) block [8] and "ilioinguinal/iliohypogastric nerve block" (IINB) [3]. Emerging trials have shown the superiority of IINB compared to the TAP block in both adults and children having surgical intervention for their inguinal hernias [3,6,9].

Multiple trials have described the analgesic efficacy of the "quadratus lumborum block" (QLB) for abdominal surgical procedures, whether in the upper or lower abdomen [10,11]. Four approaches have been described for that approach depending on the site of local anesthetic injection in relation to the quadratus lumborum (QL) muscle (anterior, posterior, lateral, and intramuscular) [12,13]. That creates different ways of local anesthetic spread [12]. The posterior approach is considered simpler and carries a lower risk of internal organ injury [14]. Additionally, previous studies confirmed its analgesic superiority compared to other approaches in lower abdominal wall operations [15,16].

Although a previous study compared the previous two block techniques (PQLB and IINB) in the pediatric population undergoing inguinal hernial operations

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[17], no previous studies have compared the same blocks in adult patients undergoing inguinal hernioplasty. That was a fair motive for us to conduct the present trial, aiming to compare PQLB and IINB regarding their analgesic profiles in adult patients undergoing unilateral inguinal hernioplasty.

## 2. Patients and methods

### 2.1. Study design

We conducted this prospective randomized trial at the Mansoura University General Surgery Department, after gaining ethical approval from the local scientific and research committees of our medical school (IRB code: R.22.09.1841, Clinical trial reg. ID. NCT05559437). The study was designed for adult patients aged more than 20 years who were undergoing unilateral inguinal hernioplasty on an elective or emergent basis. Patients who were operated during the period between October 2022 and April 2023 were enrolled in our trial.

### 2.2. Study outcomes

Regarding study outcomes, 24-hour pethidine consumption was our primary outcome, whereas secondary outcomes included the duration of the block technique, postoperative hemodynamic changes, the time to the first rescue analgesic, pain scores, and the incidence of opioid-related complications(nausea, vomiting, and respiratory depression). The duration of the block was defined by the time interval between the placement of the probe on the patient's skin until needle removal after injecting the local anesthetic.

### 2.3. Preoperative evaluation

Patient evaluation included history taking, clinical assessment, and basic laboratory work-up, in addition to any required investigations for any pre-existing comorbid condition. After proper patient assessment, we excluded patients with coagulation disorders, neuromuscular diseases, major psychiatric illness, body mass index (BMI) > 40 kg/m2, intolerance to the study medications, or local cutaneous infection at the site of block installation. The physical status of our participants was classified according to the "American Society of Anesthesiologists" or ASA [18], and only patients with class I or II were included. Finally, 76 were found eligible to be enrolled in our trial.

The night before the operation, the study protocol and both block techniques were simply explained to the patients, who signed written consent explaining the benefits and risks of each approach. Randomization into either group was done via the "sealed envelope method" according to the planned method of regional analgesia (PQLB and IINB groups). The patients were asked to fast for 6–8 hours before the operation. We also ensured that they knew how to use the "Numerical Rating Scale" (NRS) and express their pain sensations on it (0 to 10 for no pain and most severe pain, respectively) [19].

### 2.4. General anesthesia

On arrival to the operating room, basic hemodynamic monitoring was established, followed by the insertion of an 18-gauge cannula into a peripheral forearm vein, where IV midazolam (0.01–0.03 mg/kg) was administered for sedation, followed by a normal saline infusion (6 ml/kg). We used the following medications for anesthetic induction; propofol (2–3 mg/kg), fentanyl (1–2 mcg/kg), along with atracurium besylate (0.6 mg/kg) to facilitate tracheal intubation. Mechanical ventilation was done via the volume-controlled mode, with 10–14 breaths/minute respiratory rate, 6–8 ml/kg tidal volume, and a 1:2 I:E ratio in order to maintain end tidal CO2 of 35 mmHg. Anesthesia maintenance was achieved with isoflurane (1.2%) using the minimum alveolar concentrations and 60% air in O2 mixture. Increments of atracurium besylate (0.1 mg/kg) were administered when needed. The administration of intraoperative fluid was adjusted by body weight and intraoperative blood loss.

### 2.5. The block procedures

The block techniques were performed after the closure of the skin incision and before patient extubation. Both blocks were performed under ultrasound guidance (Siemens Acuson P300 device) using the high-frequency (7–12 MHz) linear transducer. The procedure was performed under complete aseptic technique, as we covered the probe with a sterile adhesive dressing and sterilized the skin injection area with Povidone-iodine.

### 2.6. The PQLB procedure

In the PQLB group, the block was performed when the patient was in a lateral decubitus with the operating side facing the operator. The probe was placed between the lower costal margin and the upper margin of the iliac crest, in the midaxillary plane, till the three abdominal muscle layers were identified. Then, the probe was moved posteriorly till we identified the junction between the external oblique, internal oblique, and QL muscles. A sonovisible needle was inserted in anteroposterior direction, aiming to the plane between the QL muscle and the underlying latissimus dorsi and erector spinae muscles. After ensuring negative aspiration, we installed 20 ml of levobupivacaine (0.25%).

### 2.7. The IINB procedure

In the IINB group, the block was done when the patient was supine. The probe was positioned in a transverse manner over the anterior abdominal wall, superior and anterior to the anterior superior iliac spine. The three anterior abdominal muscle layers were identified, and the two nerves were identified as solid hyperechoic cord-like structures in the abdominal neurovascular plane. A sonovisible needle was inserted in a medial- to lateral direction. After ensuring negative aspiration,5 ml of saline was injected to ensure the needle tip position then levobupivacaine 0.25% (5 ml) was injected close to the two nerves.

### 2.8. Post-block and postoperative care

After completing the blocks in both groups, the reversal of general anesthesia was done by neostigmine (0.05 mg/kg) and atropine (0.02 mg/kg). After extubation and fulfilling discharge criteria, the patients were transferred to the PACU, then to the internal surgical ward. NRS, O2 saturation, heart rate, and mean arterial blood pressure (MAP) were recorded in both groups at PACU and at 2, 6, 12, 18, and 24 hours after the operation. If the patient reported an NRS > 3, IV paracetamol (1 gm/8 hours) was administered. If no pain relief was reported within 30 minutes, IV pethidine was commenced (20 mg bolus dose) [20]. The duration to the first rescue analgesic and total 24-hour pethidine consumption were recorded in both groups. Also, opioid-related adverse effects were recorded. Respiratory depression was established when O2 saturation was less than 92% and/or respiratory rate was < 8 breaths per minute.

### 2.9. Sample size calculation

It was estimated using the PASS software (version 2021 for Windows). A pilot study conducted in our department included 10 patients undergoing the same procedures. Five patients had PQLB with a total postoperative pethidine consumption of 36 ± 14.97 mg, while the other five patients had IINB with a pethidine consumption of 48 ± 20.4 mg. Thirty-six patients were needed in each group to achieve 80% power and a 0.05 significance level.

### 2.10. Statistical analysis

For the statistical analysis of the previous data, we used the SPSS software (version 26 for MacOS). We presented our categorical variables as numbers and percentages. In contrast, the numerical variables tested by the Kolmogorov – Smirnov test and the Shapiro – Wilk test were presented as means and standard deviations (medians and ranges for skewed data). To compare between the PQLB and IINB groups, we applied the Chi-square and student t tests for the previous types of data, respectively. Any obtained p-value was considered statistically significant if it was less than 0.05.

## 3. Results

Preoperative patient criteria, including age, gender distribution, BMI, and ASA status, showed statistically comparable findings between the two groups. Patients in the PQLB group had a mean age of 37 years, compared to 34.21 years in the IINB group ($p = 0.198$). The majority of our participants were men, who comprised 94.7% and 89.5% of patients in the PQLB and IINB groups, respectively ($p = 0.395$). The mean BMI of the study participants was 28.01 kg/m2 in the PQLB group versus 28.66 kg/m2 in the IINB group ($p = 0.601$). Most of our patients were classified as ASA class I (68.4% and 57.9% of patients in the same groups, respectively), while the remaining patients were class II ($p = 0.342$).

The duration of the surgical procedure showed no significant difference between the two groups (59.21 vs. 59.47 minutes in the same groups, respectively). Regarding the block techniques, both groups showed comparable imaging, needling, and total block times ($p > 0.05$). The latter had a mean duration of 3.29 minutes in the PQLB group versus 3.32 minutes in the IINB group ($p = 0.893$). In both blocks, the mean number of needle passes was 1.61 (Table 1).

Postoperative hemodynamic assessment revealed that PQLB patients had a lower heart rate and MAP

**Table 1.** Basic demographic data, ASA physical status, and block performance data in the two groups.

| | | PQLB group ($n = 38$) | IINB group ($n = 38$) | 95% CI | P |
|---|---|---|---|---|---|
| Age (years) | | 37.00 ± 9.878 | 34.21 ± 8.826 | −1.49, 7.07 | 0.198 |
| Gender | Male | 36 (94.7%) | 34 (89.5%) | - | 0.395 |
| | Female | 2 (5.3%) | 4 (10.5%) | | |
| BMI (kg/m$^2$) | | 28.01 ± 5.094 | 28.66 ± 5.771 | −3.14, 1.83 | 0.601 |
| ASA | I | 26 (68.4%) | 22 (57.9%) | - | 0.342 |
| | II | 12 (31.6%) | 16 (42.1%) | | |
| Duration of surgery (minutes) | | 59.21 ± 8.969 | 59.74 ± 9.075 | −4.65, 3.60 | 0.800 |
| Imaging time (seconds) | | 14.18 ± 3.965 | 14.45 ± 3.984 | −2.08, 1.55 | 0.774 |
| Needling time (minutes) | | 3.06 ± 0.791 | 3.08 ± 0.722 | −0.36, 0.33 | 0.928 |
| Total block performance time (minutes) | | 3.29 ± 0.797 | 3.32 ± 0.725 | −0.37, 0.32 | 0.893 |
| Number of needle passes | | 1.61 ± 0.547 | 1.61 ± 0.679 | −0.28, 0.28 | 0.999 |

Data is expressed as mean and standard deviation or as percentage and frequency. P is significant when < 0.05. n=Number of patients, BMI=Body mass index, ASA= American Society of Anesthesiologists.

**Table 2.** Assessment of hemodynamic changes during the postoperative period in the two groups.

| | | PQLB group ($n = 38$) | IINB group ($n = 38$) | 95% CI | P |
|---|---|---|---|---|---|
| Heart rate (bpm) | PACU | 76.84 ± 11.224 | 78.13 ± 10.514 | −6.26, 3.68 | 0.607 |
| | 2 hours | 80.32 ± 11.887 | 83.21 ± 10.445 | −8.01, 2.22 | 0.263 |
| | 6 hours | 83.45 ± 11.406 | 89.84 ± 10.894 | −11.49, −1.30 | **0.015** |
| | 12 hours | 89.58 ± 12.343 | 92.00 ± 10.601 | −7.68, 2.84 | 0.362 |
| | 18 hours | 90.08 ± 12.939 | 93.95 ± 11.065 | −9.37, 1.63 | 0.165 |
| | 24 hours | 89.34 ± 13.185 | 93.05 ± 12.134 | −9.50, 2.08 | 0.206 |
| MAP (mmHg) | PACU | 99.68 ± 6.695 | 101.21 ± 7.462 | −4.77, 1.71 | 0.351 |
| | 2 hours | 102.08 ± 6.377 | 104.63 ± 7.567 | −5.75, 0.65 | 0.116 |
| | 6 hours | 104.26 ± 6.856 | 109.21 ± 8.224 | −8.41, −1.49 | **0.006** |
| | 12 hours | 108.50 ± 6.689 | 110.79 ± 8.511 | −5.79, 1.21 | 0.196 |
| | 18 hours | 108.79 ± 7.110 | 112.03 ± 9.140 | −6.98, 0.51 | 0.089 |
| | 24 hours | 108.34 ± 7.386 | 111.32 ± 9.068 | −6.75, 0.81 | 0.121 |

Data is expressed as mean and standard deviation P is significant when < 0.05. n=Number of patients.

**Table 3.** Postoperative O2 saturation in the two groups.

| SpO2%) | PQLB group ($n = 38$) | IINB group ($n = 38$) | 95% CI | P |
|---|---|---|---|---|
| PACU | 98.58 ± 1.222 | 98.50 ± 1.133 | −0.46, 0.62 | 0.771 |
| 2 hours | 98.68 ± 1.093 | 98.29 ± 1.137 | −0.12, 0.90 | 0.127 |
| 6 hours | 98.55 ± 1.108 | 98.13 ± 1.044 | −0.07, 0.91 | 0.092 |
| 12 hours | 98.32 ± 1.042 | 98.45 ± 1.108 | −0.62, 0.36 | 0.595 |
| 18 hours | 98.50 ± 1.157 | 98.55 ± 1.155 | −0.58, 0.48 | 0.843 |
| 24 hours | 98.55 ± 1.108 | 98.61 ± 1.220 | −0.59, 0.48 | 0.844 |

Data is expressed as mean and standard deviation or as percentage and frequency. P is significant when < 0.05.

readings compared to patients in the IINB group. Nonetheless, most differences were statistically irrelevant apart from the six-hour reading that turned out to be statistically different between the two groups ($p =$ 0.015 and 0.006 for heart rate and MAP, respectively) (Table 2).

All O2 saturation readings were statistically comparable between the two groups during the first postoperative day (Table 3).

The PQLB was associated with a marked reduction in postoperative pain scores compared to the IINB method, and that was evident after patient discharge from PACU till the end of the first postoperative day ($p < 0.05$) (Table 4 and Figure 1)

Twenty-four patients requested rescue analgesia in each study group (63.2%). The PQLB was associated with a significant prolongation in the time to the first rescue analgesic (13.25 vs. 8.42 hours in the IINB group – $p < 0.001$). In addition, patients receiving PQLB expressed lower needs for postoperative pethidine (49.17 vs. 70 mg in the IINB group – $p < 0.001$).

Secondary to decreased postoperative opioid consumption, the incidence of nausea and vomiting decreased significantly in the PQLB group ($p = 0.007$ and 0.047, respectively). No patients developed postoperative respiratory depression in our study (Table 5).

The PQLB was associated with significantly better patient satisfaction compared to the IINB (Table 6)

## 4. Discussion

Herein, we compared the analgesic efficacy of PQLB and IINB in adult patients undergoing unilateral inguinal hernia repair. This is the first comparison in the literature to include adult patients, and that poses an advantage in favor of our research. The reader should also notice no statistical difference between our preoperative data, which indicates our proper randomization. Besides, that should decline the risk of any bias skewing our results in favor of one block over the other. We noted that the PQLB is significantly superior to the IINB in all aspects of postoperative analgesia. That was evident in decreased heart rate and MAP readings, reduced pain scores, prolonged duration to the first analgesic request, and less pethidine consumption in association with the PQLB.

Pain after inguinal hernia repair is multifactorial in origin. Sources include incisional site pain, visceral pain from the hernial sac or intestinal manipulation or resection anastomosis (if required), and dynamic pain that occurs during movement, coughing, or straining [21]. Thus, a multimodal analgesic approach should be prescribed for all patients to cover the previous multiple nociceptive sources [22]. Regional anesthetic techniques are effective for achieving perioperative analgesia with a marked superiority compared to systemic opioids. It also decreases the need for opioid administration and its related adverse effects [23].

The reader should also notice that we injected a large amount of local anesthetic in the PQLB group. That could be explained by the nature of the two blocks; the PQLB is a fascial plane block that necessitates a larger volume of injectate to be successful [12]. On the other hand, the IINB is a truncal nerve block that requires the installation of a small local anesthetic amount around the nerve trunk [17].

Our findings regarding the superiority of the PQLB technique could be explained by the findings of

**Table 4.** Postoperative pain scores in the study groups.

| NRS | PQLB group ($n = 38$) | IINB group ($n = 38$) | 95% CI | P |
|---|---|---|---|---|
| PACU | 1.0 (0.0, 2.0) | 1.0 (0.0, 2.0) | −0.33, 0.12 | 0.350 |
| 2 hours | 2.0 (1.0, 3.0) | 2.0 (1.0, 4.0) | −0.75, −0.14 | 0.005 |
| 6 hours | 2.0 (1.0, 4.0) | 3.0 (2.0, 6.0) | −1.51, −0.75 | 0.000 |
| 12 hours | 3.0 (2.0, 5.0) | 4.0 (2.0, 6.0) | −0.87, −0.03 | 0.037 |
| 18 hours | 4.0 (2.0, 5.0) | 4.5 (3.0, 6.0) | −1.12, −0.14 | 0.012 |
| 24 hours | 3.0 (2.0, 6.0) | 4.0 (2.0, 6.0) | −1.13, −0.08 | 0.025 |

Data is expressed as a median (range). P is significant when ˂ .05 NRS: Numerical rating scale.

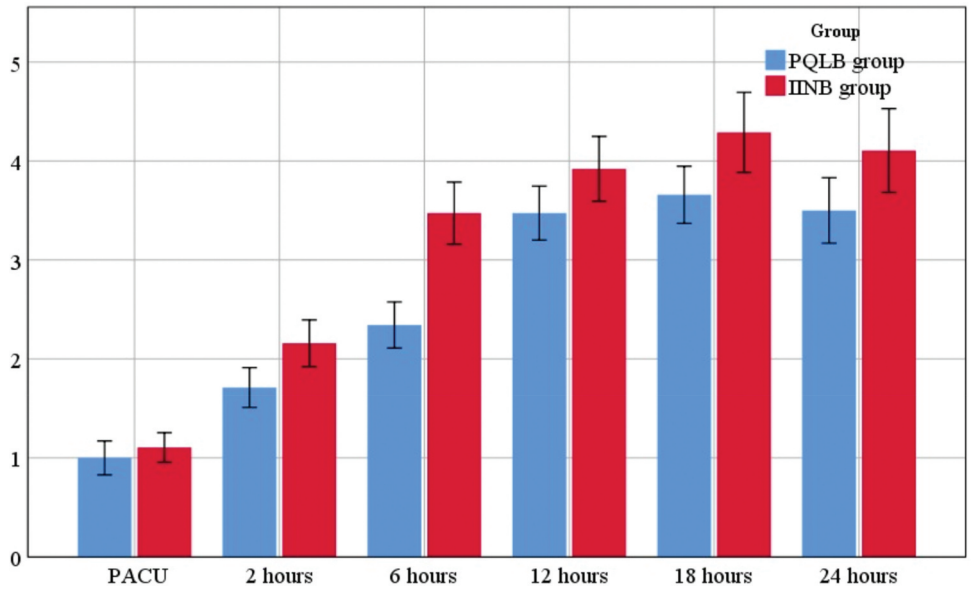


**Figure 1.** Pain score changes in the two study groups.

**Table 5.** Postoperative analgesic profile and opioid-related complications in the study groups.

| | | PQLB group ($n = 38$) | IINB group ($n = 38$) | 95% CI/Odds ratio | P |
|---|---|---|---|---|---|
| Patients who needed rescue analgesia | | 24 (63.2%) | 24 (63.2%) | 1 | 1 |
| Time to the first analgesic request (hours) | | 13.25 ± 3.948 | 8.42 ± 4.680 | 2.32, 7.35 | ˂ **0.001** |
| Total dose of pethidine (mg) | | 49.17 ± 17.673 | 70.00 ± 18.650 | −31, −10 | ˂ **0.001** |
| Complications | Nausea | 4 (10.5%) | 14 (36.8%) | 4.96 | **0.007** |
| | Vomiting | 1 (2.6%) | 6 (15.8%) | 6.94 | **0.047** |
| | Respiratory depression | 0 (0.0%) | 0 (0.0%) | 1 | 1 |

Data is expressed as mean and standard deviation or as percentage and frequency. P is significant when < 0.05.

previous cadaveric studies, which evaluated the spread of the dye when injected along the posterolateral aspect of the QL muscle at L3–4 level. Spread of the dye was noticed in T11 – L1 nerve roots, the lower thoracic paravertebral space, the ilioinguinal, and the iliohypogastric nerves [12,13]. The previously blocked nerves should cover most of the somatic and visceral nerve supply included in the nociceptive transmission after inguinal hernia repair. That could explain why PQLB could provide a superior analgesic profile compared to the IINB, which is considered a part of the nerves covered during PQLB.

Our findings are supported by Samerchua et al., who compared the same two blocks in pediatric patients undergoing inguinal herniotomies. The authors noted that PQLB led to a significant decrease in the number of patients requiring rescue analgesia (15.8% vs. 52.6% in the IINB group) as well as a significant decline in acetaminophen consumption during the postoperative period [17].

**Table 6.** Patient satisfaction in the study groups.

| | | PQLB group ($n = 38$) | IINB group ($n = 38$) | P |
|---|---|---|---|---|
| Patient satisfaction | Poor | 0 (0.0%) | 2 (5.3%) | **0.037** |
| | Fair | 0 (0.0%) | 4 (10.5%) | |
| | Good | 4 (10.5%) | 9 (23.7%) | |
| | Very good | 13 (34.2%) | 10 (26.3%) | |
| | Excellent | 21 (55.3%) | 13 (34.2%) | |

*Data is as percentage and frequency. P is significant when < 0.05. n=Number of patients.*

Priyadarshini et al. compared QLB, IINB, and TAP block in children undergoing elective open inguinal hernia repair. The authors reported that the QLB group had the lowest postoperative tramadol consumption (3 mg), compared to 11 and 4 mg in the TAP and IINB groups, respectively. Additionally, the duration to the first analgesic request showed significant prolongation in the QLB group (720 minutes) compared to 480 and 360 minutes in the IINB and TAP groups, respectively ($p < 0.05$) [24].

Mostafa et al. compared the anterior QLB and IINB in children undergoing the same operations. Although both blocks had a significant beneficial impact on the analgesic profile compared to controls, the QLB was superior to the IINB regarding pain scores and analgesic consumption [25]. The previous three studies agree with our findings regarding the superiority of QLB compared to IINB.

One should note that, despite the efficacy of PQLB, most patients required rescue analgesia. That could be explained by the fact that the hernial sac is supplied by the genital branch of the genitofemoral nerve (L1–2) which is not covered by that type of block [26–28].

Despite the unique scientific point discussed in our research, it has some limitations. The small sample of patients collected from one surgical institution is the major drawback. Also, the study lacks intermediate and long-term outcomes regarding the incidence of chronic postoperative pain. More studies should be performed to cover these limitations.

## 5. Conclusion

Based on the preceding findings, PQLB has a significantly superior analgesic profile compared to IINB. Its application provides effective pain relief, lower analgesic consumption, and better patient satisfaction. It is recommended to perform that kind of block in patients undergoing unilateral inguinal hernia repair to enhance patient outcomes.

## Disclosure statement

No conflict of interest was reported by the author(s).

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