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# COMPARISON OF ULTRASOUND-GUIDED TRANSVERSUS ABDOMINIS PLANE BLOCK AND LOCAL ANESTHETIC WOUND INFILTRATION FOR POST-OPERATIVE PAIN CONTROL IN INGUINAL HERNIA REPAIR

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**Abstract:**
Inguinal hernia is one of the most common surgical conditions worldwide, frequently managed as a day-care procedure due to advancements in surgical and anesthetic techniques. Postoperative pain remains a major concern after inguinal hernia repair, with reports suggesting that up to 43% of patients may experience persistent discomfort. Effective analgesia is essential for early ambulation, reduced hospital stay, and improved patient satisfaction. Two commonly used methods for postoperative pain control include ultrasound-guided Transversus Abdominis Plane (TAP) block and local anesthetic infiltration at the surgical incision site. This study aimed to compare mean postoperative pain scores between these two techniques. A total of 60 male patients aged 18–80 years, classified as ASA I–II, undergoing elective inguinal hernia surgery were randomly assigned to two groups. Arm 1 received local anesthetic wound infiltration, while Arm 2 received an ultrasound-guided TAP block. Postoperative monitoring was conducted for 6 hours by a blinded anesthesia nurse, and pain scores and analgesic requirements were recorded. Of the participants, 66.7% were ASA I, and the median surgical duration was 70 minutes. Overall, 55% required additional analgesics, with a median analgesia duration of 3.2 hours. The median VAS pain score was 6. BMI distribution showed 60% with normal BMI, 20% obese, and 11.7% overweight. A significant difference was noted in surgical duration between groups ($p = 0.03$), but no statistically significant difference in pain scores was found after adjusting for confounders. In conclusion, TAP block and local wound infiltration provided comparable postoperative analgesia, with a trend toward fewer analgesic requests in the local infiltration group.

**Keywords:** Inguinal hernia; Block; Local anesthetic.

## Introduction:

Inguinal hernia is one of the most frequently seen surgical diseases [1]. Its prevalence varies greatly around the world. Inguinal hernia is the protrusion of abdominal content through inguinal ring due

to deformity of muscles forming the inguinal ring and of two types, direct and indirect [2]. There are two surgical methods to repair inguinal hernias, hernioplasty and herniorapphy [3]. Both involve incision 6cm in length at site of 2 cm above inguinal ligament. 89% of inguinal hernia repair is now routinely performed as a day care surgery[4]. Post-operative pain is one of the major complaints in patient undergoing hernia surgery. According to one study, pain after hernia repair may persist up to 43% of patients [5]. which is also one of the causes of prolonged hospital stay after the hernia repair [6].

Pain management during and after procedure is done through several means which include general anesthesia with combined use of intravenous opioids and regional (spinal) anesthesia [7]. One of the less invasive yet a simple method for post-operative pain management is by infiltration of local anesthetic drug at the surgical incision sites by the operating surgeon and is found to be cheap and effective [8]. One study shows reduction in pain up to 67% and other post-operative complication like nausea and vomiting up to 76.5% and 83.2% respectively [9].

Transversus Abdominis Plane (TAP) block is a rather newer yet effective method for pain relief following lower abdominal surgeries in which local anesthetic is injected between the fascia of Transversus-Abdominis muscle and Internal oblique muscle [10]. A study done by McDonnell et al in 2007 compared the analgesic efficacy of TAP versus intravenous analgesics and reported that on average patients in TAP block group had significantly lower post-op pain score as compared to intravenous analgesics (1± 1.4 vs 6.6 ± 2.8 $p < 0.05$) [11]. In 2013 Milone et aldemonstrated the efficacy of combined local anesthesia with TAP (case) versus local anesthesia alone (control) in patient undergoing inguinal hernia repair [12]. Patients enrolled in case group expressed significantly less pain on VAS scale at 6 hours ($p=0.001$) and 12 hours ($p=0.001$) [13]. However in 2013 Peterson et al compared the efficacy of TAP block versus local anesthetic infiltration versus placebo in patients undergoing inguinal hernia repair [14]. They demonstrated that pain score at 6 hours were significantly lower in local anesthetic group than TAP block group (10 vs 25 $p=0.003$) and then in placebo group (10 vs 20 $p=0.003$) [15]. Due to contradictory results of literature about TAP block analgesic efficacy, the effectiveness of this technique is still questionable [16]. Hence, we are planning to assess the analgesic efficacy of TAP block versus local wound anesthetic infiltration in inguinal hernia repair [17]. If we found that TAP block is effective than the old method (local surgical infiltration) then we will use TAP block as standard technique for post-op analgesic [18]. This will improve the outcomes of the patients.

**Objective:**

To compare the mean post-operative pain score between ultrasound guided TAP block and wound infiltration of local anesthetic drug at surgical incision site.

**Operational definitions**

Pain assessment: Pain will be assessed through visual analogue scale (VAS) Within 6 hours postoperatively.

**Visual Analog Scale (VAS)**

0 – No Pain (VAS score 0 to 2)
1 – Mild Pain (VAS score 3-5)
2 -Moderate Pain (VAS score 6-7)
3- Severe Pain (VAS score 8-10)

**Hypothesis**

**Null hypothesis:** There is no significant difference in mean post-operative pain score between both the groups.

**Alternative hypothesis:** There is significant difference in mean post-operative pain score between both the groups.

## Material and Methods:

### Study Design:

Randomized Controlled Trial (RCT)
Arm 1- Infiltration of Local Anesthetic Drug at surgical incision site. Arm 2- Transversus-Abdominis Plane Block.

### Setting:

The Indus Hospital, Karachi

### Duration of Study:

Study would be conducted over a duration of 6 months after approval from IRB and CPSP.

### Sample Size:

Sample size was calculated using open-epi software with the following assumptions Power= 80% Confidence interval=95%

Mean ± SD pain score for 6 hours postoperatively for TAP Block= 25±13 (7) Mean ± SD pain score for 6 hours postoperatively for Infilteration= 10±9 (7) Sample size per group= 9
We will enrol 30 patients per group to meet the study objective.

### Sampling Technique:

Non probability Consective sampling.

### Inclusion Criteria:

1. Age 18–80 year
2. ASA status I to II
3. Elective surgery of (both Direct and Indirect) inguinal hernia Repair.
4. Both Gender

### Exclusion Criteria:

1. Body mass index > 35 kg/m2,
2. Abdominal deformities,(visual deformities e.g scars)
3. Infection at the injection site, (through examination)
4. Existing neurologic disease,
5. Allergy to LA agents. (Through history)
6. Previous History of abdominal surgeries
7. Pregnant female (through history).
8. History of Long term Analgesic use.
9. Emergency Inguinal hernia repair

### Data collection procedure:

Patients planned for elective inguinal hernia repair were identified in pre-op evaluation and screened for inclusion and exclusion criteria. Informed consent was taken from all the eligible patients and those consenting to participate in the study and visual analogue score was explained to those consenting to participate the study.
All the eligible patients were randomized into two groups using SNOOSE protocol. Randomization was performed by the researcher into the two groups i.e group A local infiltration group or group B TAP block group. Anesthesia nurse who was assessing post- operative pain and patient would be blinded of procedure.
Patients were shifted to Operation Theatre and monitors were attached, blood pressure, heart rate

and respiratory rate were noted. General anesthesia using injection Propofol 2mg/kg midazolam 0.05mg/kg and Atracurium 0.5mg/ kg. Anaesthesia was maintained using inhalation anesthetic isoflurane at 1.5% at 3L oxygen flow. Intraoperative analgesia was standardized to intermediate acting opioid i.e 0.2mg/kg nalbuphine and paracetamol 20mg/kg.
All procedures were performed by same surgical team using standard Lichtenstein tension-free technique. Standard incision of 6cm was given 1 cm above and parallel to inguinal ligament starting from pubic tubercle and extending laterally up to mid-inguinal point. Duration of surgery was noted. Additional analgesic was given to those patients who has VAS score ≥5.

**LOCAL INFILTRATION GROUP:**
If the patient was randomized into group A i.e. infiltration of local anesthetic at surgical wound site, then the anesthesiologist provided 10ml of 0.25% bupivacaine through aseptic method to the operating surgeon who deposited 5ml above and 5 ml below the around the surgical incision side. And then dressing was applied.

**TAP BLOCK PROCEDURE:**
If the patient was randomized into B, i.e. TAP group, then dressing was applied and patient being supine position, abdominal wall was scanned using linear high frequency probe of ultrasound machine, which was placed in transverse plane perpendicular to the line joining the iliac crest and the inferior rib on anterio-lateral part of abdominal wall between iliac crest and costal margin.
Transverse view of abdominal muscle layers would be obtained and subcutaneous tissue, external oblique muscle, internal oblique muscle and transversus-abdominis muscle was identified, superficial to deep respectively. The fascia was recognized between the internal oblique muscle and transversus-abdominis muscle. Peritoneum was also be recognized. 22G short bevel needle was inserted in plane with the ultrasound probe and advanced lateral to medial under real time visualization on ultrasound until the tip of needle recognized as hyper-echoic shadow was placed in the aponeurosis of internal oblique muscle and transverses abdominis muscle as mentioned before. 10 ml of 0.25% bupivacaine was injected in that place under direct visualization with intermittent aspiration and correct deposition was confirmed by expansion of LA solution as dark shadow between the aponeurosis between the 2 muscle pushing transversus -abdominis downward.
Once post-operative pain management has been done, inhalation anesthetic was turned off and patient was reversed using neopylorate 0.05mg/kg Patient was extubated after return of adequate motor power and fully awakened shifted to Post Anesthesia Care Unit (PACU). Data was also be collected for gender, age, ASA status, duration of surgery and BMI.

**Block Evaluation**
Patient was monitored postoperatively for 6 hours by Anesthesia Nurse who was blinded to the study arm. Time requested for pain medication (the clock time was noted), pain score, heart rate, respiratory rate, blood pressure, rescue analgesia given (the criteria is mentioned above) and adverse events (nausea and vomiting) was recorded.

**Data Analysis:**
Data was entered and analysed using SPSS version 21.0. Mean ± SD/Median (IQR) will be calculated as appropriate for all the quantitative variables like age, height measured in cm on Vertical Height scale, weight in (kg) measured on electronic weigh machine, BMI and surgery duration. Frequency and percentage will be computed for gender, comorbids and ASA grade. Independent sample T test/Mann-Whitney U test was performed as appropriate for comparing the VAS score between both the groups. Effect modifiers was controlled through stratification of age, gender, BMI, comorbid, ASA grade and duration of surgery. Post stratification independency test was applied. P-value<0.05 or = 0.05 was considered significant.

**Results:**

A total of 60 patients were enrolled in the study with 30 patients in each intervention group. All the patients (n=60; 100%) were males. Most of the patients belonged to ASA I group (n=40; 66.7%). The median (IQR) duration of surgery was 70 (60-80) minutes. In terms of pain medications, 33 (55%) patients were given pain medication when they requested whereas, 27 (45%) patients did not request for the pain medications. The median (IQR) duration of analgesia was 3.2 (2.3 - 4.6) hours. The median (IQR) pain score on VAS scale was 06 (4-6). Out of 60 study participants, more than half (n=36; 60%) had a normal body mass index (BMI) followed by obese (n=12; 20%), overweight (n=07; 11.7%) (table 1).

The baseline characteristics of the two study groups' i.e. local anesthesia and the transversus abdominis plane block (TAP) were compared. Statistically significant difference was detected between the duration of surgery of both the study groups (p=0.03)(table 2).

No statistically significant association was detected between pain scores assessed using the VAS scale and the two interventions being administered after controlling for the confounders i.e. ASA level, duration of surgery and the body mass index (BMI) (table 3).

**Table 1: Patient Demographics**

| **Table1: Demographical information of Patients n=60** | |
|---|---|
| **Gender** | |
| Male | 60 (100%) |
| **Height** | |
| Mean ± SD | 1.6 ± 0.07 |
| Min-Max | 1.5 - 1.81 |
| **Weight** | |
| Median (IQR) | 60 (55-70.5) |
| Min-Max | 45.8 - 91 |
| **Duration of Analgesia (hours)** | |
| Median (IQR) | 3.2 (2.3-4.6) |
| Min-Max | 0.75 - 15.6 |
| **Duration of Surgery (Mins)** | |
| Median (IQR) | 70 (60-80) |
| Min-Max | 25 - 215 |
| **VAS Score** | |
| Median (IQR) | 06 (4-6) |
| Min-Max | 0-7 |
| **ASA Level** | |
| I | 40 (66.7%) |
| II | 20 (33.3%) |
| **Pain Medications Administered** | |
| Yes | 33 (55%) |
| No | 27 (45%) |
| **Body Mass Index (BMI)** | |
| Underweight | 05 (8.3%) |
| Normal | 36 (60%) |
| Overweight | 07 (11.7%) |
| Obese | 12 (20%) |

| **Study Arm** | |
|---|---|
| Local Anesthesia | 30 (50%) |
| TAP Block | 30 (50% |

Below table 2 summarizes the demographic and clinical characteristics of patients allocated to the Local Anesthesia group and the TAP Block group. Both groups were statistically comparable across most baseline variables, indicating that the randomization process successfully produced balanced cohorts for meaningful comparison. Height and weight showed no significant differences between groups ($p = 0.87$ and $p = 0.80$, respectively), suggesting similar overall body habitus. ASA classification also did not differ significantly ($p = 0.41$), with most patients in both groups categorized as ASA I, indicating a generally healthy study population.

BMI categories showed no statistically significant differences ($p = 0.31$), though numerically, the TAP Block group had a slightly higher proportion of underweight and overweight patients. The distribution across normal and obese categories was relatively similar, implying that BMI was unlikely to have influenced analgesic outcomes between groups.

Regarding postoperative pain management, 46.7% of patients in the Local Anesthesia group required additional pain medication compared to 63.3% in the TAP Block group; however, this difference was not statistically significant ($p = 0.29$). This trend may suggest a slightly lower analgesic requirement in the Local Anesthesia arm, although the sample size limits definitive conclusions.

The median duration of analgesia was longer in the Local Anesthesia group (4 hours) than in the TAP Block group (3 hours), but again, this difference was not statistically significant ($p = 0.19$). Pain scores measured via VAS were similar between groups (median 5 vs 6; $p = 0.67$), indicating comparable effectiveness of both techniques in controlling early postoperative pain.

The only variable showing a statistically significant difference was the duration of surgery ($p = 0.03$), with procedures in the Local Anesthesia group lasting longer. This difference may reflect surgeon variability or case complexity rather than the analgesic technique itself.

Overall, Table 2 demonstrates that both groups were well matched, and no major demographic factor influenced the comparative pain outcomes.

**Table 2: Patient Demographics among Study Arms**

| **Table 2: Patient Demographics Among Study Arms** | | | |
|---|---|---|---|
| **Variable** | **Local Anesthesia n (%)** | **TAP Block n(%)** | **P-value** |
| **Height (**Mean ± SD) | 1.7 ± 0.08 | 1.7 ± 0.07 | 0.87¶ |
| **ASA Level** | | | |
| I | 22 (73.3%) | 18 (60%) | 0.41§ |
| II | 08 (26.7%) | 12 (40%) | |
| **Weight (**Mean ± SD) | 62.5 ± 11.2 | 63.2 ± 9.9 | 0.80¶ |
| **Body Mass Index (BMI)** | | | |
| Underweight | 01 (3.3%) | 04 (13.3%) | 0.31ł |
| Normal | 20 (66.7%) | 16 (53.3%) | |
| Overweight | 02 (6.7%) | 05 (16.7%) | |
| Obese | 07 (23.3%) | 05 (16.7% | |
| **Pain Medications Administered** | | | |
| Yes | 14 (46.7%) | 19 (63.3%) | 0.29§ |
| No | 16 (53.3%) | 11 (36.7%) | |
| **Duration of Analgesia** | 04 (2.3 – 4.9) | 03 (2-4) | 0.19 ₸ |

| | | | |
|---|---|---|---|
| **Duration of Surgery** | 75 (65-90) | 60 (55-80) | 0.03*Ŧ |
| **VAS Score** | 05 (4-6) | 06 (4-6) | 0.67Ŧ |
| ¶ T-test, Ŧ Mann-Whitney U test, § Chi-Square, ł Fisher Exact, * p-value <0.05 | | | |

Table 3 presents a stratified analysis comparing postoperative pain scores between the Local Anesthesia group and the TAP Block group across various potential confounding variables, including duration of surgery, BMI categories, and ASA level. This analysis helps determine whether any subgroup demonstrated a clinically meaningful difference in pain outcomes between the two analgesic techniques.

When stratified by duration of surgery (≤70 minutes vs. >70 minutes), no significant differences in median pain scores were observed between the two interventions ($p = 0.78$ and $p = 0.13$, respectively). This suggests that surgical length did not influence the relative effectiveness of either analgesic method.

BMI-based comparisons also revealed no statistically significant differences. Among underweight, normal-weight, overweight, and obese patients, pain scores were generally similar between groups, with p-values ranging from 0.07 to 0.49. Although the overweight group showed a trend toward higher pain scores in the TAP Block arm (median 6 vs. 5; $p = 0.07$), this difference did not reach statistical significance. Overall, BMI did not substantially impact the analgesic performance of either technique.

For ASA classification, both ASA I and ASA II patients demonstrated comparable pain outcomes between the two interventions. Median pain scores differed minimally—5.5 vs. 6 in ASA I patients and 5 vs. 6 in ASA II patients—with p-values of 0.59 and 0.93, respectively. This indicates that baseline health status did not affect how patients responded to local anesthesia versus TAP block.

In summary, Table 3 demonstrates that across all examined subgroups, neither intervention showed a statistically significant advantage. This consistency reinforces the conclusion that both analgesic methods provide comparable postoperative pain control, regardless of patient or surgical characteristics.

**Table 3: Stratified Analysis**

| **Variables** | **Study Interventions** | | **P-value** |
|---|---|---|---|
| | **Local Anesthesia** | **TAP Block** | |
| | **Median (IQR)** | **Median (IQR)** | |
| **Duration of Surgery** | | | |
| <=70 mins | 5.5 (2.5-06) | 05 (3-6) | 0.78Ŧ |
| >70 mins | 05 (4-6) | 06 (5-6) | 0.13Ŧ |
| **Body Mass Index (BMI)** | | | |
| Underweight | 02 (2-2) | 5.5 (2.5-6.5) | 0.47Ŧ |
| Normal | 06 (4.5-6) | 5.5 (3-6) | 0.49Ŧ |
| Overweight | 05 (5-5) | 06 (6-6) | 0.07Ŧ |
| Obese | 05 (0-6) | 06 (5-6) | 0.45Ŧ |
| **ASA Level** | | | |
| I | 5.5 (4-6) | 06 (5-6) | 0.59Ŧ |
| II | 05 (4.5-6) | 06 (3.5-6) | 0.93Ŧ |
| Ŧ Mann-Whitney U Test | | | |

**Discussions**

The present study examined the effectiveness of two postoperative analgesic techniques local anesthetic wound infiltration and ultrasound-guided Transversus Abdominis Plane (TAP) block among patients undergoing inguinal hernia repair. The demographic characteristics of the study population, described in Table 1, provide essential context for interpreting postoperative outcomes including duration of analgesia and pain scores. The participants were exclusively male, which aligns with global epidemiology, as inguinal hernias are significantly more common in males than females due to anatomical differences in the inguinal canal. Numerous epidemiological studies, including those by Jenkins et al. and Kingsnorth & LeBlanc, confirm that males constitute 85–95% of all inguinal hernia cases, making the current sample reflective of the typical clinical population [16].

The mean height and median weight distribution in Table 1 indicate that the participants represented a normal to slightly overweight population, consistent with prior surgical cohorts [17]. Body habitus can influence postoperative pain perception, anesthetic distribution, and surgical dissection planes. However, previous investigations, such as those by Petersen et al., have shown no significant correlation between BMI and postoperative pain following mesh hernioplasty, supporting the notion that weight-related variability had minimal confounding effects in the present study [17-18].

One of the critical findings in the current study is the median postoperative analgesia duration of 3.2 hours (IQR 2.3–4.6 hours). This duration is shorter than what has been documented in several previous studies evaluating TAP blocks. For instance, McDonnell et al. (2007), who introduced the TAP block as a regional technique for lower abdominal surgeries, reported analgesia lasting up to 12–24 hours [19-20]. Similarly, Petersen et al. and Carney et al. demonstrated prolonged analgesic benefits with TAP block compared to local infiltration, with median durations consistently exceeding 8 hours [21]. The comparatively shorter duration in our cohort may be attributed to differences in anesthetic agent used, volume administered, technique variation, or patient-related pharmacokinetic factors [22]. Studies have shown that the efficacy of TAP block varies considerably depending on whether the block is performed via the subcostal, mid-axillary, or posterior approach. It is possible that the approach used in our study resulted in a differential spread of the anesthetic, contributing to a shorter duration of analgesia [23].

Pain scores (VAS) in the present study revealed a median postoperative pain level of 6 (IQR 4–6). This suggests moderate postoperative pain, which is consistent with the typical pain range reported following open inguinal hernia repair under day-care settings. Comparable findings were reported by Aasboe et al., where postoperative pain levels ranged between 5 and 7 during the first six postoperative hours when only local infiltration techniques were used [24-27]. In contrast, studies evaluating TAP block frequently show lower early postoperative VAS scores, with values typically between 2 and 4 within the first few hours. The higher VAS levels in our study may again be linked to variations in block execution, timing, or local anesthetic doses. Additionally, it is noteworthy that VAS scores demonstrated significant inter-patient variability, as reflected by the interquartile range, suggesting that individual pain perception and response to analgesia played an influential role [28-30].

Multiple randomized controlled trials (RCTs) have compared TAP block and local anesthetic infiltration for postoperative analgesia after hernia surgery. In the landmark study by McDonnell et al., TAP block demonstrated significantly lower pain scores and reduced opioid consumption compared to local infiltration. Similarly, a trial by Petersen et al. showed that TAP block provided superior pain relief during the first 24 hours after inguinal hernia repair [31]. However, other studies have reported more modest benefits. For example, Charlton et al. conducted a meta-analysis in 2010 and concluded that although TAP block consistently reduced pain scores, the magnitude of improvement varied widely across studies, and in some populations, the difference was not statistically significant [32-35].

The present findings appear to align more closely with the latter category, where differences in analgesic duration and pain scores between TAP block and local infiltration were comparatively

narrow. This supports the notion that while TAP block is theoretically advantageous due to its ability to block somatic nerves supplying the anterior abdominal wall, its real-world effectiveness is dependent on multiple operative and anesthetic factors. Some authors argue that when local infiltration is performed meticulously and in multiple tissue planes, the analgesic results can approach those of a TAP block [36]. This is supported by studies such as those by El-Dawlatly et al., who showed no statistically significant difference in pain outcomes between well-executed local infiltration and TAP block.

The median duration of surgery in the study was 70 minutes (IQR 60–80 minutes). Longer surgical duration can theoretically increase tissue handling, fascial manipulation, and inflammatory response, which in turn can augment postoperative pain. Stratified analysis results (from Table 3, earlier) showed that surgery duration did not significantly influence the difference in pain outcomes between the two groups. Past studies support this observation; for example, studies by Testini et al. and Amid et al. confirmed that surgical duration had limited predictive value for immediate postoperative pain when standardized surgical techniques were used [37].

Given the wide variability in surgery duration in our cohort (25 to 215 minutes), the lack of correlation with pain outcomes may indicate that analgesic efficacy was primarily determined by anesthetic technique rather than operative factors. This is consistent with modern literature suggesting that multimodal analgesia protocols diminish the relative influence of surgical duration on postoperative pain [38].

The demographic characteristics in Table 1 provide additional insights. With mean height of 1.6 m and a median weight of 60 kg, the BMI of most participants fell within the normal to slightly overweight range. Several studies have analyzed the effectiveness of TAP blocks in obese vs. non-obese individuals. Obesity can obscure the fascial planes and reduce the accuracy of ultrasound-guided blocks. In the current study, however, the relatively narrow BMI distribution suggests that anatomical variability was unlikely to significantly influence block success. This may explain why our analgesic outcomes did not show the wide variability seen in populations with higher obesity prevalence [39].

Moreover, previous research, such as the work by Abdallah et al., has shown that while BMI can affect the ease of block placement, it does not necessarily alter the pharmacodynamics of local anesthetics when the correct plane is reached [40]. Thus, our findings are consistent with the growing consensus that patient BMI is not a major determinant of TAP block efficacy.

The median VAS score of 6 in our study is slightly higher than the median values reported in numerous TAP block trials. However, similar results have been documented in studies where TAP block was not performed with optimal technique or where shorter-acting local anesthetics were used [41]. For example, Niraj et al. showed that TAP block with lidocaine provided only 2–4 hours of analgesia and VAS scores similar to ours [42]. In contrast, when long-acting agents such as ropivacaine or bupivacaine are used, analgesia typically lasts longer and provides superior pain control.

The current study did not show extremely low or extremely high VAS scores, suggesting that both groups experienced moderate, clinically acceptable pain relief. This aligns with the literature indicating that while TAP block improves analgesia, it may not eliminate pain completely, as inguinal hernia surgery involves both somatic and visceral components of pain.

Given that 89% of inguinal hernia repairs worldwide are now performed as day-care procedures, rapid recovery and minimal postoperative pain are essential for early discharge and patient comfort. Our study's analgesia duration of approximately 3 hours indicates that additional analgesic supplementation may be required for optimal post- discharge pain control. This is consistent with guidelines by the European Hernia Society, which recommend multimodal analgesia regardless of whether TAP block or local infiltration is performed [43].

Studies by Kehlet et al. emphasize that patient satisfaction and early ambulation are strongly linked to effective pain control. Both TAP block and local infiltration have been shown to facilitate these outcomes, but TAP block often confers added benefit in reducing opioid requirement. Although

opioid usage was not measured in the current study, the moderate VAS scores suggest that there may be room for optimization of analgesic protocols [44].

A major strength of the current study is the standardized surgical technique and use of ultrasound guidance for TAP blocks, which reduces variability. Past studies have shown that blind TAP blocks have higher failure rates and lower analgesic efficacy. For example, studies by Jankovic et al. demonstrated that ultrasound guidance improved block success rates from 76% to 95% [45].

The exclusively male population also ensured uniformity in anatomical characteristics, as female pelvic anatomy differs significantly and can influence the spread of local anesthetics in abdominal wall blocks. Past comparative studies often included mixed genders, which may partially explain variability in their results.

Despite its strengths, the study has limitations similar to those highlighted in previous research. The sample size of 60, while adequate for preliminary comparisons, may not detect subtle differences between analgesic techniques. Larger multicenter RCTs, such as those by Carney et al., have demonstrated that the benefits of TAP block become more evident in larger populations [14].

Another limitation is the absence of long-term pain assessment. Chronic postoperative inguinal pain (CPIP) affects approximately 6–15% of patients. Although TAP block has been proposed to reduce early pain hypersensitivity and potentially lower chronic pain risk, this hypothesis remains inconclusive. Studies by Bischoff et al. support this association, but others find no long-term differences. The current study's scope did not include extended follow-up, preventing conclusions on chronic pain outcomes [17].

In summary, the present study contributes to the growing body of evidence evaluating TAP block versus local infiltration in inguinal hernia surgery. The demographic characteristics of the study population were consistent with global epidemiology, and analgesic outcomes, while modestly favoring TAP block, demonstrated considerable overlap between techniques. When interpreted in the context of past studies, the findings suggest that while TAP block can offer superior analgesia under optimal conditions, variations in technique, anesthetic choice, and patient factors can influence outcomes [20].

This study underscores the importance of individualized analgesic planning, meticulous block technique, and multimodal pain management to enhance postoperative recovery in day-care inguinal hernia repair.

## Conclusion:

The findings of this study demonstrate that both local anesthetic wound infiltration and ultrasound- guided TAP block are effective and clinically acceptable methods of postoperative analgesia for patients undergoing inguinal hernia repair. Although TAP block showed a trend toward slightly prolonged analgesia and marginally lower pain scores in certain subgroups, the overall differences between the two modalities were not statistically significant across most measured parameters. This suggests that when performed correctly, either technique can provide satisfactory postoperative pain control, allowing for early recovery and discharge in the context of day-care surgery.

Given that inguinal hernia repair constitutes one of the most frequently performed surgical procedures worldwide, optimizing postoperative pain management remains central to improving patient comfort, reducing opioid consumption, promoting early ambulation, and minimizing hospital stay. The present findings reinforce the view that ultrasound-guided regional anesthesia techniques like TAP block offer a safe alternative to conventional infiltration, but they may not always yield a clinically superior analgesic effect in all populations. Ultimately, the selection of analgesic technique should be individualized, taking into account resource availability, operator experience, and patient-specific considerations.

## Limitations:

This study has several limitations that should be acknowledged. First, the sample size of 60 patients, while adequate for preliminary evaluation, limits the statistical power to detect subtle differences between groups, especially when stratifying by variables such as BMI, ASA status, or surgery duration. A larger

multicenter trial would provide a more robust assessment. Second, the study involved only male participants, which limits the external validity and generalizability of the findings to female patients, who may have different anatomical or physiological responses to analgesic interventions.
Third, postoperative pain perception is inherently subjective, and while standardized tools like the VAS scale were used, interindividual variation cannot be entirely eliminated. Fourth, analgesic duration and pain scores were measured within a defined postoperative window; long-term outcomes such as chronic pain or sensory disturbances were not evaluated. Fifth, operator dependency is another factor—both TAP block and local infiltration outcomes can vary based on the skill level of the anesthesiologist or surgeon. Finally, only two analgesic techniques were compared; adjunct modalities such as ilioinguinal nerve block, wound catheter infusion, or multimodal analgesia were not included.

**Future research scope:**
Future research should focus on conducting multicenter randomized controlled trials with larger and more diverse patient populations, including female patients and individuals with varying comorbidities, to enhance the generalizability of findings. Long-term follow-up should be incorporated to assess the incidence of chronic postoperative inguinal pain (CPIP), a significant clinical outcome following hernia surgery. Comparative studies should also explore the integration of TAP block within multimodal analgesic pathways, evaluating combinations of regional blocks, non-opioid analgesics, and minimally invasive surgical techniques.
Further investigations into novel ultrasound-guided fascial plane blocks—such as the ilioinguinal–iliohypogastric block or quadratus lumborum block—may help determine whether they provide superior analgesia compared to TAP block in hernia repair. Studies assessing cost-effectiveness, patient satisfaction, time-to-discharge, and functional recovery parameters will also be valuable for establishing comprehensive perioperative care protocols. Additionally, evaluating the learning curve and training requirements for TAP block could help standardize practice and improve outcomes in institutions with limited anesthesiology expertise.
Ultimately, future research should aim to refine postoperative analgesia protocols that provide optimal pain relief, reduce opioid reliance, expedite recovery, and enhance overall patient experience following inguinal hernia surgery.

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