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Original Research Article

A PROSPECTIVE STUDY ON POSTOPERATIVE PAIN AND RECOVERY IN PATIENTS UNDERGOING MINIMALLY INVASIVE VERSUS CONVENTIONAL HERNIA REPAIR

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ABSTRACT

Background: Inguinal hernia repair is among the most common surgical procedures globally, with two primary approaches—minimally invasive laparoscopic repair and conventional open repair. While both techniques are widely used, their comparative impact on postoperative pain and recovery remains an important clinical consideration. **Aim:** To compare postoperative pain, analgesic requirement, recovery parameters, and complication rates between patients undergoing minimally invasive versus conventional hernia repair. **Material and Methods:** This prospective, comparative study was conducted at a tertiary care teaching hospital and included 110 adult patients with primary unilateral inguinal hernia. Participants were divided into two groups: Group A (n = 55) underwent laparoscopic TAPP repair, while Group B (n = 55) received open Lichtenstein mesh repair. Postoperative pain was assessed using the Visual Analog Scale (VAS) at 6, 12, 24, and 48 hours, and on day 7. Analgesic consumption (paracetamol and tramadol), ambulation time, resumption of oral intake, hospital stay, and time to return to routine activities were recorded. **Result:** VAS scores were significantly lower in Group A at all time points, with mean scores of 3.9 vs. 6.2 at 6 hours and 0.8 vs. 2.1 on day 7 ($p < 0.001$). Analgesic consumption in Group A was significantly lower (paracetamol: 2450 ± 300 mg vs. 3000 ± 350 mg; tramadol: 85 ± 20 mg vs. 130 ± 25 mg; $p < 0.001$). Early recovery was noted in Group A, with faster ambulation (10.5 ± 2.2 vs. 18.3 ± 3.4 hours), oral intake (8.2 ± 1.6 vs. 12.7 ± 2.5 hours), shorter hospital stay (1.9 ± 0.8 vs. 3.2 ± 1.1 days), and earlier return to activity (8.5 ± 2.6 vs. 13.6 ± 3.1 days), all $p < 0.001$. Complications were lower in Group A (9.09%) than Group B (20.00%), though not statistically significant ($p = 0.106$). Regression analysis identified laparoscopic technique, lower pain scores, and earlier ambulation as significant predictors of faster recovery ($R^2 = 0.520$). **Conclusion:** Minimally invasive hernia repair offers significant advantages over conventional open repair in terms of reduced postoperative pain, lower analgesic needs, faster recovery, and a trend toward fewer complications. These findings advocate for the broader implementation of laparoscopic repair in elective inguinal hernia cases.

INTRODUCTION

Inguinal hernia repair remains one of the most frequently performed surgical procedures worldwide, accounting for millions of operations annually. Traditionally managed via open surgery, the advent of minimally invasive techniques has revolutionized surgical practice, offering new paradigms for reducing postoperative discomfort and enhancing recovery. The rising preference for laparoscopic hernia repair is driven not only by technological advancements but also by a growing body of evidence suggesting superior patient-centered outcomes. Despite these developments, conventional open repair continues to be widely practiced, particularly in low-resource settings, prompting ongoing comparative evaluations to identify the most effective and efficient approach. Minimally invasive surgery (MIS) for inguinal hernia, especially laparoscopic approaches such as Transabdominal Preperitoneal (TAPP) and Totally Extraperitoneal (TEP) repairs, have gained prominence due to their association with reduced tissue trauma, faster functional recovery, and lower postoperative pain levels. These advantages are attributed to smaller incisions, minimal disruption of surrounding musculature and nerves, and enhanced anatomical visualization during the procedure.[1] The benefits of MIS are particularly evident in early postoperative outcomes, where patients frequently report less pain, reduced analgesic requirements, and quicker return to daily activities compared to those undergoing open mesh repair.[2] Open hernioplasty, on the other hand, remains the standard approach in many institutions due to its simplicity, cost-effectiveness, and reduced demand for advanced surgical infrastructure. It is well-established in surgical training and often preferred in emergency cases or for large or complicated hernias. However, open techniques have been linked to higher incidences of postoperative wound complications, delayed mobilization, and persistent groin pain, which can affect long-term quality of life.[3] With the growing demand for outpatient surgeries and faster convalescence, evaluating these two modalities through rigorous clinical comparison becomes vital to optimize patient care. Over the past decade, multiple prospective studies and systematic reviews have examined the outcomes of laparoscopic versus open inguinal hernia repair. Most findings converge on the conclusion that laparoscopic techniques offer advantages in terms of postoperative comfort, reduced length of hospital stay, and earlier resumption of normal activity.[4] Furthermore, newer robotic-assisted laparoscopic techniques have shown promise in enhancing surgical precision and minimizing intraoperative variability, although their widespread use is limited by cost and accessibility.[5] Postoperative pain management remains a pivotal determinant of patient satisfaction and functional recovery in hernia surgery. The extent and duration of postoperative pain directly influence mobility, hospital discharge, and return to work, thereby impacting healthcare resource utilization and socioeconomic outcomes. Several recent studies suggest that patients undergoing laparoscopic hernia repair experience significantly lower pain scores in the early postoperative period, require less opioid analgesia, and report improved quality-of-life indices compared to those treated with the conventional open approach.[6] These observations warrant further investigation in diverse clinical settings to validate their generalizability and relevance. Moreover, the complication profiles between laparoscopic and open repairs also differ. Minimally invasive approaches have demonstrated lower rates of wound infection and hematoma formation but are occasionally associated with longer operative time and a steeper learning curve for surgeons. Understanding these trade-offs is critical in surgical decision-making, particularly for patients with comorbidities, recurrent hernias, or bilateral defects. Current trends suggest a shift toward patient-tailored surgical strategies, where the choice of technique is individualized based on clinical and anatomical considerations as well as patient preferences.[7] In addition to surgical technique, factors such as perioperative education, pain neuroscience education, and enhanced recovery protocols play integral roles in shaping postoperative outcomes. Preoperative counseling and structured education have been shown to alleviate patient anxiety, improve pain perception, and enhance compliance with postoperative instructions. These interventions, when integrated with minimally invasive surgical strategies, create a comprehensive care model that promotes optimal recovery.[8] Despite encouraging results from existing literature, discrepancies in outcomes still exist, particularly in resource-constrained settings where access to laparoscopic equipment and trained personnel may be limited. Variations in surgical expertise, patient demographics, and institutional protocols further contribute to the heterogeneity in reported outcomes. Therefore, prospective comparative studies that standardize surgical procedures, analgesic regimens, and recovery parameters are crucial for generating high-quality evidence that can inform clinical practice guidelines.

MATERIALS AND METHODS

This was a prospective, comparative study conducted in the Department of General Surgery at a tertiary care teaching hospital, following approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment. A total of 110 adult patients diagnosed with primary unilateral inguinal hernia and scheduled for elective hernia repair were included in the study. The participants were recruited consecutively from the outpatient department and preoperative clinics.

Inclusion Criteria

- Adult patients aged between 18 and 65 years
- Diagnosed with primary unilateral inguinal hernia
- ASA physical status I or II
- Willingness to participate and provide informed consent
- Undergoing elective hernia repair using either minimally invasive (laparoscopic) or conventional open technique

Exclusion Criteria

- Recurrent or bilateral hernias
- Emergency hernia repair
- Previous lower abdominal surgeries
- Severe cardiopulmonary comorbidities contraindicating laparoscopic approach
- Coagulopathies or bleeding disorders
- Inability to comprehend the pain scoring system or postoperative instructions

Grouping and Intervention

Patients were divided into two groups based on the surgical technique used:

Group A (Minimally Invasive Group, n=55): Underwent elective laparoscopic transabdominal

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preperitoneal (TAPP) hernia repair using standard three-port technique.

Group B (Conventional Group, n=55): Underwent open Lichtenstein mesh repair via an inguinal incision under spinal or general anesthesia.

All procedures were performed by experienced surgeons with standardized protocols for both techniques. Preoperative, intraoperative, and postoperative care protocols were kept uniform for both groups.

Postoperative Pain and Recovery Assessment

Postoperative pain was assessed using the Visual Analog Scale (VAS) at multiple intervals: 6 hours, 12 hours, 24 hours, 48 hours after surgery, and again on postoperative day 7. This helped in evaluating both the immediate and short-term pain experiences of the patients. The requirement for analgesics was also documented, specifically noting the total dosage of paracetamol and/or tramadol administered during the first 48 hours postoperatively, providing a quantitative measure of pain management needs. Recovery parameters included the time taken for the patient to ambulate independently, the time to resume oral intake, the total duration of hospital stay, and the time required for the patient to return to routine daily activities or work. These metrics collectively offered a comprehensive understanding of postoperative recovery and functional rehabilitation in both surgical groups.

Statistical Analysis

Data were collected using structured proformas and entered into Microsoft Excel. Statistical analysis was performed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using the independent samples t-test. Categorical variables were expressed as frequencies and percentages and compared using the Chi-square test or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Profile of Study Participants

The demographic characteristics of the study population were comparable between Group A (Minimally Invasive) and Group B (Conventional). The mean age of participants in Group A was 41.6 ± 11.2 years, while it was 43.2 ± 10.8 years in Group B, with no statistically significant difference (p = 0.412). The majority of patients in both groups were male (92.73% in Group A and 90.91% in Group B), reflecting the higher prevalence of inguinal hernias in males. The distribution of ASA physical status grades was also similar between the groups, with approximately two-thirds of patients classified as ASA I and one-third as ASA II (p = 0.681). These similarities confirm that the groups were well-matched at baseline, minimizing confounding due to demographic variation.

Table 2: Postoperative Pain (VAS Scores)

Postoperative pain scores, measured using the Visual Analog Scale (VAS), were consistently lower in the minimally invasive group (Group A) compared to the conventional group (Group B) at all time points. At 6 hours post-surgery, Group A reported a mean VAS score of 3.9 ± 1.1, while Group B reported 6.2 ± 1.3 (p < 0.001). This significant difference persisted at 12 hours (3.5 vs. 5.7), 24 hours (2.7 vs. 4.3), 48 hours (1.9 vs. 3.6), and even on postoperative day 7 (0.8 vs. 2.1), with all comparisons showing p-values < 0.001. These results indicate a substantial reduction in postoperative pain with the laparoscopic approach.

Table 3: Analgesic Requirement (First 48 Hours Postoperative)

Consistent with the lower VAS scores, patients in Group A required significantly less analgesic medication. The mean paracetamol dose was 2450 ± 300 mg in Group A compared to 3000 ± 350 mg in Group B (p < 0.001). Similarly, tramadol consumption was lower in Group A (85 ± 20 mg) versus Group B (130 ± 25 mg) (p < 0.001). Notably, only 14.55% of patients in Group A needed additional analgesics, whereas 36.36% in Group B required extra pain control (p = 0.010). These findings reinforce the superior pain control associated with minimally invasive hernia repair.

Table 4: Recovery Metrics Comparison

Recovery was significantly faster in the laparoscopic group across all assessed parameters. Group A patients ambulated earlier (10.5 ± 2.2 hours vs. 18.3 ± 3.4 hours, p < 0.001) and resumed oral intake sooner (8.2 ± 1.6 hours vs. 12.7 ± 2.5 hours, p < 0.001). The mean hospital stay was notably shorter in Group A (1.9 ± 0.8 days) than in Group B (3.2 ± 1.1 days) (p < 0.001). Additionally, Group A returned to routine activities faster (8.5 ± 2.6 days vs. 13.6 ± 3.1 days, p < 0.001). These results clearly demonstrate the enhanced postoperative recovery associated with the minimally invasive technique.

Table 5: Postoperative Complications

Although not statistically significant, postoperative complications were less frequent in the laparoscopic group. Wound infections occurred in 1.82% of Group A compared to 7.27% in Group B (p = 0.362). Seroma formation and urinary retention were also higher in Group B (9.09% and 10.91%, respectively) than in Group A (5.45% and 3.64%). The overall complication rate was 9.09% in Group A versus 20.00% in Group B (p = 0.106). While not reaching statistical significance, this trend suggests a potentially safer profile for the minimally invasive approach.

Table 6: Multiple Regression Analysis for Predictors of Postoperative Recovery Time

The multiple regression model identified several significant predictors of delayed recovery time. The surgical technique was the most influential factor, with laparoscopic surgery associated with a 2.406-day reduction in recovery time compared to the open technique (p < 0.001). Higher pain scores at 24 hours were significantly associated with longer recovery

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durations (B = 0.842, p < 0.001). Increased total analgesic use and delayed ambulation also predicted prolonged recovery (B = 0.005, p = 0.023 and B = 0.127, p = 0.001, respectively). The model had good explanatory power ($R^2 = 0.520$), suggesting that over half the variance in recovery time could be explained by these variables.

Table 1: Demographic Profile of Study Participants (n = 110)

Parameter	Group A (n = 55)	Group B (n = 55)	Total (n = 110)	p-value
Mean Age (years)	41.6 ± 11.2	43.2 ± 10.8	42.4 ± 11.0	0.412
Male	51 (92.73%)	50 (90.91%)	101 (91.82%)	0.739
Female	4 (7.27%)	5 (9.09%)	9 (8.18%)	
ASA Grade I	38 (69.09%)	36 (65.45%)	74 (67.27%)	0.681
ASA Grade II	17 (30.91%)	19 (34.55%)	36 (32.73%)	

Table 2: Postoperative Pain (VAS Score Mean ± SD)

Time Interval	Group A (Minimally Invasive)	Group B (Conventional)	p-value
6 hours	3.9 ± 1.1	6.2 ± 1.3	<0.001
12 hours	3.5 ± 1.2	5.7 ± 1.4	<0.001
24 hours	2.7 ± 1.1	4.3 ± 1.2	<0.001
48 hours	1.9 ± 0.9	3.6 ± 1.1	<0.001
Day 7	0.8 ± 0.6	2.1 ± 0.8	<0.001

Table 3: Analgesic Requirement (First 48 Hours Postoperative)

Analgesic Use	Group A (n = 55)	Group B (n = 55)	p-value
Mean Paracetamol Dose (mg)	2450 ± 300	3000 ± 350	<0.001
Mean Tramadol Dose (mg)	85 ± 20	130 ± 25	<0.001
Additional Analgesia Needed	8 (14.55%)	20 (36.36%)	0.010

Table 4: Recovery Metrics Comparison

Parameter	Group A (n = 55)	Group B (n = 55)	p-value
Time to Ambulation (hours)	10.5 ± 2.2	18.3 ± 3.4	<0.001
Time to Oral Intake (hours)	8.2 ± 1.6	12.7 ± 2.5	<0.001
Duration of Hospital Stay (days)	1.9 ± 0.8	3.2 ± 1.1	<0.001
Return to Routine Activity (days)	8.5 ± 2.6	13.6 ± 3.1	<0.001

Table 5: Postoperative Complications

Complication Type	Group A (n = 55)	Group B (n = 55)	p-value
Wound Infection	1 (1.82%)	4 (7.27%)	0.362
Seroma Formation	3 (5.45%)	5 (9.09%)	0.713
Urinary Retention	2 (3.64%)	6 (10.91%)	0.272
Overall Complications	5 (9.09%)	11 (20.00%)	0.106

Table 6: Multiple Regression Analysis for Predictors of Postoperative Recovery Time

Predictor Variable	Unstandardized Coefficient (B)	Standard Error (SE)	Standardized Coefficient (β)	t-value	p-value
Constant	4.215	0.754	–	5.591	<0.001
Surgical Technique (0 = Open, 1 = Laparoscopic)	-2.406	0.471	-0.582	-5.108	<0.001
Pain Score at 24 hours (VAS)	0.842	0.198	0.316	4.253	<0.001
Total Analgesic Use (mg)	0.005	0.002	0.208	2.304	0.023
Time to Ambulation (hours)	0.127	0.038	0.297	3.342	0.001

DISCUSSION

In the present study, the demographic characteristics were statistically comparable between the laparoscopic (Group A) and open repair (Group B) groups. The mean ages were 41.6 ± 11.2 and 43.2 ± 10.8 years respectively (p = 0.412), with males comprising over 90% in both groups. This distribution reflects the known male predominance in inguinal hernia cases, as previously reported by Stahlman et al (2020),[9] in a U.S. military cohort where inguinal hernias affected over 95% males. The ASA grade distribution in this study was also balanced (ASA I: ~67% vs. ASA II: ~33%), similar to that noted in the prospective study by Patel et al (2025),[10] who found that over 60% of patients undergoing hernia surgery fell under ASA grade I.

Pain scores in Group A were significantly lower than Group B at all postoperative time points. At 6 hours, the VAS score was 3.9 ± 1.1 in Group A versus 6.2 ± 1.3 in Group B (p < 0.001), and this difference persisted through postoperative day 7 (0.8 ± 0.6 vs. 2.1 ± 0.7, p < 0.001). These results are consistent with Somri et al (2017),[11] who found VAS scores averaging 3.2 at 6 hours and 1.1 at 24 hours in patients receiving multimodal analgesia with spinal anesthesia during hernia repair. Similarly, Gupta et al (2021),[12] demonstrated significantly lower early postoperative pain with laparoscopic TEP (mean 2.4 at 6 hours) compared to open mesh hernioplasty (mean 5.9). The consistent reduction in pain scores in this study supports the superior pain outcomes associated with minimally invasive repair.

Total paracetamol and tramadol usage was lower in Group A (2450 ± 300 mg and 85 ± 20 mg respectively) compared to Group B (3000 ± 350 mg and 130 ± 25 mg, both $p < 0.001$). Additionally, only 14.55% of patients in Group A needed rescue analgesia versus 36.36% in Group B ($p = 0.010$). These values mirror the findings by Aiolfi et al (2021),[13] who reported a 25–30% reduction in total analgesic consumption with laparoscopic approaches. Abu Elyazed et al (2016),[14] similarly noted that TAP block significantly reduced opioid needs postoperatively in pediatric hernia patients. The present study reinforces that lower pain scores are directly associated with reduced pharmacologic intervention, reducing side effects and enhancing recovery.

Group A patients had earlier ambulation (10.5 ± 2.2 hours vs. 18.3 ± 3.4 hours), quicker oral intake (8.2 ± 1.6 vs. 12.7 ± 2.5 hours), shorter hospital stay (1.9 ± 0.8 vs. 3.2 ± 1.1 days), and faster return to daily activities (8.5 ± 2.6 vs. 13.6 ± 3.1 days), all with $p < 0.001$. These findings are in close agreement with Patel et al (2025),[10] where laparoscopic patients resumed daily functions in 7.9 ± 2.1 days versus 12.8 ± 3.0 days for open repair. Similarly, Bullen et al (2019),[15] concluded in their meta-analysis that laparoscopic surgery reduced hospital stay by an average of 1.2 days compared to open repair. This study thus adds to the growing evidence that minimally invasive hernia repair accelerates convalescence across all key metrics.

Although the difference was not statistically significant, Group A had fewer complications (9.09%) compared to Group B (20.00%, $p = 0.106$). Wound infection rates were 1.82% in Group A vs. 7.27% in Group B; urinary retention was 3.64% vs. 10.91%, respectively. Simons et al (2009),[16] similarly reported a lower wound complication rate (<5%) in laparoscopic repairs. Wright et al (2019),[17] highlighted the role of minimal dissection and nerve-sparing in laparoscopic surgery as key to reducing chronic pain and complications. Although the sample size here may have limited statistical power, the observed trend supports a lower risk profile with laparoscopic techniques.

The regression model in this study identified laparoscopic surgery as the strongest independent predictor of reduced recovery time, shortening convalescence by 2.406 days ($p < 0.001$). Other significant predictors included higher pain scores at 24 hours ($B = 0.842$), increased analgesic use ($B = 0.005$), and delayed ambulation ($B = 0.127$). These findings align with the recovery model proposed by Aiolfi et al (2021),[13] who emphasized that effective pain control and early mobilization are critical determinants of shorter hospital stays. Gupta et al (2021),[12] also linked delayed recovery to excessive opioid use and prolonged immobility. The R^2 of 0.520 in the current study indicates that these clinical parameters explain more than half the variance in recovery time, providing a robust framework for postoperative planning.

CONCLUSION

This prospective study demonstrates that minimally invasive hernia repair significantly reduces postoperative pain, analgesic requirements, and recovery time compared to the conventional open approach. Patients undergoing laparoscopic repair experienced earlier ambulation, shorter hospital stays, and faster return to daily activities. Although complication rates were comparable, the minimally invasive technique showed a trend toward better safety and patient comfort. These findings support the adoption of laparoscopic repair as a preferred option for elective inguinal hernia surgery when feasible.

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