

ARTICLE



Minimally Invasive Approaches to Hernia Repair: A Multicenter Study of Laparoscopic Techniques in Bangladesh

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ABSTRACT

Background: Hernia repair is a common surgical procedure globally, and minimally invasive techniques like laparoscopic surgery are gaining prominence for their reduced recovery time and postoperative complications. **Objective:** This study aimed to evaluate the outcomes of laparoscopic hernia repair in a multicenter setting across Bangladesh, comparing it with conventional open surgery. **Method:** A prospective multicenter study was conducted from June 2022 to December 2023 in tertiary-level hospitals in Bangladesh. A total of 224 patients were included, all undergoing laparoscopic or open hernia repair. Variables such as operative time, postoperative pain, hospital stay duration, and complication rates were analyzed. **Results:** Of the 224 patients, 112 underwent laparoscopic hernia repair, while 112 received open surgery. The average operative time for the laparoscopic group was 55 minutes, compared to 70 minutes for the open surgery group. Postoperative pain scores were significantly lower in the laparoscopic group (3.2 vs. 5.6). The laparoscopic group had a shorter average hospital stay (1.5 days) compared to the open surgery group (3.8 days). Complication rates were lower in the laparoscopic group (8%) versus the open surgery group (15%). **Conclusions:** Laparoscopic hernia repair proved to be a safer and more effective option in terms of reduced pain, faster recovery, and lower complication rates, making it a viable alternative for hernia repair in Bangladesh.

Keywords: Laparoscopic Surgery, Hernia Repair, Minimally Invasive.

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INTRODUCTION

Hernia repair has long been a cornerstone of general surgery, with various techniques evolving over time to enhance

patient outcomes and reduce postoperative complications [1]. The condition itself, a protrusion of an organ or tissue through an abnormal opening in the body, has been well-documented in medical literature for centuries, and it remains a prevalent

concern globally. With a high incidence rate, particularly in developing countries like Bangladesh, hernia repair surgery continues to be a critical component of surgical care. Despite advances in medical technology and surgical techniques, hernia repair remains a challenge for healthcare systems in these regions due to limited resources and varying levels of surgical expertise. The advent of minimally invasive approaches, such as laparoscopic hernia repair, marks a significant shift towards safer, more efficient procedures with faster recovery times and reduced morbidity. However, these techniques are still underutilized in many parts of the world, including Bangladesh. Laparoscopic techniques for hernia repair, particularly transabdominal preperitoneal (TAPP) and totally extraperitoneal (TEP) approaches, have shown promise in reducing postoperative pain, minimizing scarring, and shortening hospital stays. These benefits are particularly important in Bangladesh, where access to healthcare is often constrained by economic and geographic factors. By minimizing the need for extended hospitalization and reducing the likelihood of complications, laparoscopic surgery offers a solution that can improve patient outcomes while also alleviating the burden on the healthcare system [2]. The adoption of these techniques, however, faces several challenges in Bangladesh, where the availability of laparoscopic equipment, trained personnel, and patient awareness about these advanced techniques is limited.

The global trend towards minimally invasive surgery (MIS) in hernia repair is driven by growing evidence of its effectiveness and cost-efficiency. Studies conducted in high-resource settings have demonstrated that MIS, particularly laparoscopic hernia repair, results in fewer postoperative complications such as infection and recurrence compared to traditional open surgery [3]. In addition to improved clinical outcomes, MIS allows for a quicker return to normal activities, which is particularly important in a socio-economic context like Bangladesh, where many patients are day laborers or agricultural workers who cannot afford prolonged absences from work. The economic benefits of reduced recovery times, therefore, align with the broader goals of sustainable healthcare in low- and middle-income countries (LMICs) like Bangladesh, where healthcare expenditures are often out-of-pocket and unaffordable for a large portion of the population [4].

In Bangladesh, hernia repair is one of the most common surgical procedures performed in public and private hospitals. Yet, the majority of these surgeries are performed using open techniques, which are associated with higher postoperative pain, longer recovery times, and a greater risk of wound complications [5]. The limited use of laparoscopic techniques in the country is primarily due to the lack of specialized training among surgeons, insufficient infrastructure, and the higher upfront costs associated with laparoscopic equipment. However, there is a growing recognition among Bangladeshi surgeons of the benefits of laparoscopic surgery, and several medical institutions in the country have begun to adopt these

techniques, particularly in urban centers where healthcare infrastructure is more developed [6]. This study aims to explore the outcomes of laparoscopic hernia repair in multiple medical centers across Bangladesh, contributing to the existing body of knowledge by assessing the efficacy and feasibility of these techniques in a resource-limited setting.

The multicenter approach to this study allows for a comprehensive analysis of laparoscopic hernia repair across a variety of clinical settings, from well-equipped urban hospitals to rural clinics with limited resources. By comparing outcomes such as operative time, postoperative pain, length of hospital stays, and complication rates between laparoscopic and open hernia repair techniques, this study seeks to provide valuable insights into the potential for wider adoption of laparoscopic techniques in Bangladesh. Furthermore, by including a diverse patient population, this study will also examine the role of patient demographics, such as age, gender, and comorbidities, in influencing the outcomes of laparoscopic hernia repair. A key aspect of this study is its focus on the training and skill development of surgeons in laparoscopic techniques. In many low-resource settings, including Bangladesh, the success of minimally invasive surgery is closely tied to the availability of adequately trained surgical teams [7]. As such, this study will also investigate the impact of surgeon experience on surgical outcomes, comparing results between experienced laparoscopic surgeons and those who are relatively new to the technique. This aspect of the study is particularly important given the increasing demand for minimally invasive surgery in Bangladesh and other LMICs, where the development of surgical capacity is often constrained by limited training opportunities and resources.

Aims and Objective

The aim of this study is to assess the effectiveness and safety of laparoscopic hernia repair compared to traditional open surgery in tertiary hospitals across Bangladesh. The objective is to evaluate outcomes such as operative time, postoperative pain, recovery duration, and complication rates to determine the feasibility of wider adoption of laparoscopic techniques.

MATERIAL AND METHODS

Study Design

This prospective, multicenter study was conducted in tertiary-level hospitals across Bangladesh from June 2022 to December 2023. A total of 224 patients diagnosed with inguinal or ventral hernias were enrolled and divided equally into two groups: one group undergoing laparoscopic hernia repair and the other open surgery. Variables such as operative time, postoperative pain, hospital stay, and complication rates were recorded. The study aimed to assess the feasibility, safety, and effectiveness of laparoscopic techniques in comparison to conventional open surgery.

Inclusion Criteria

Patients aged between 18 and 70 years, diagnosed with inguinal or ventral hernias, and deemed fit for surgery were included. Only patients who provided informed consent to participate in the study and agreed to undergo either laparoscopic or open hernia repair were considered. Both primary and recurrent hernia cases were included to allow for a comprehensive comparison of surgical outcomes. Patients with no significant comorbidities that could affect recovery were prioritized.

Exclusion Criteria

Patients with a history of previous abdominal surgeries, major comorbid conditions such as uncontrolled diabetes or cardiovascular diseases, or those contraindicated for general anesthesia were excluded. Additionally, pregnant women, patients with complicated hernias, and individuals who refused to provide consent for the study or for the surgical procedure were also excluded. Patients with incarcerated or strangulated hernias requiring emergency intervention were not eligible for the study due to the urgency of their condition.

Data Collection

Data were collected from patient medical records, preoperative assessments, and postoperative follow-ups. Parameters such as operative time, postoperative pain (measured using a visual analog scale), hospital stay duration, and complication rates were recorded. Patients were followed up for six months post-surgery to monitor any recurrence or complications. Informed consent was obtained from all participants, and ethical clearance was provided by the hospital's ethics committee.

Data Analysis

Data were analyzed using SPSS version 26.

Descriptive statistics were used to summarize patient demographics, operative times, and recovery outcomes. Continuous variables were expressed as mean \pm standard deviation, while categorical variables were presented as frequencies and percentages. Independent sample t-tests were used to compare operative time and hospital stay between the laparoscopic and open surgery groups. Chi-square tests were employed to assess differences in complication rates. A p-value of less than 0.05 was considered statistically significant, indicating a meaningful difference between the two surgical approaches.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki, ensuring that participants' rights, safety, and well-being were prioritized. Ethical approval was obtained from the institutional ethics committees of all participating hospitals. Informed consent was secured from all patients, who were fully informed about the purpose, risks, and benefits of the study. Participation was voluntary, and patients could withdraw at any time. Confidentiality was strictly maintained, with patient data anonymized for analysis and reporting.

RESULTS

This section provides a detailed analysis of the comparative outcomes between laparoscopic and open hernia repair among the 224 patients involved in the study. The results are presented across several key areas, including demographic characteristics, operative and postoperative outcomes, complication rates, and patient satisfaction. Statistical comparisons between the two groups are shown using relevant variables and p-values to highlight the significance of differences observed.

Table 1: Demographic Characteristics of Patients

Variable	Laparoscopic Group (n=112)	Open Surgery Group (n=112)	P-value
Age (mean \pm SD)	45.3 \pm 10.2	47.1 \pm 11.5	0.31
Gender (Male)	88 (78.6%)	92 (82.1%)	0.58
BMI (mean \pm SD)	24.7 \pm 3.4	25.2 \pm 3.8	0.42
Comorbidities	23 (20.5%)	25 (22.3%)	0.76
Smoking	18 (16.1%)	22 (19.6%)	0.49

The demographic characteristics of the patients were comparable between the two groups. The mean age of the laparoscopic group was 45.3 years compared to 47.1 years for the open surgery group, with no significant difference ($p=0.31$). The majority of patients in both groups were male, with 78.6% in the laparoscopic group and 82.1% in the open surgery group

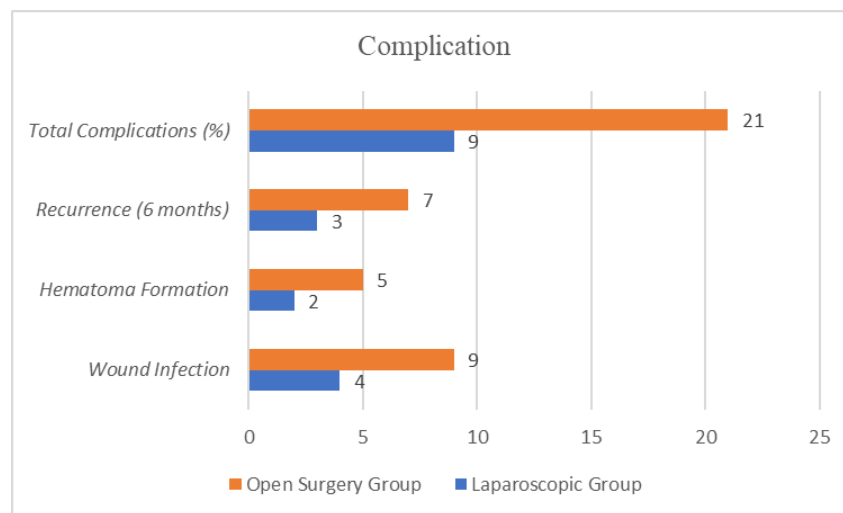
($p=0.58$). There was also no statistically significant difference in the BMI (Body Mass Index) or the presence of comorbidities between the groups, ensuring that the comparison of outcomes was not biased by these factors. Smoking status, which could impact postoperative healing, was also similar between the groups.

Table 2: Operative and Postoperative Outcomes

Variable	Laparoscopic Group (n=112)	Open Surgery Group (n=112)	P-value
Operative Time (minutes)	55.1 ± 12.3	70.4 ± 14.2	< 0.001
Postoperative Pain (VAS)	3.2 ± 1.1	5.6 ± 1.4	< 0.001
Hospital Stay (days)	1.5 ± 0.8	3.8 ± 1.2	< 0.001
Return to Normal Activity	10.2 ± 2.4	17.6 ± 3.5	< 0.001

The operative time for the laparoscopic group was significantly shorter, averaging 55.1 minutes compared to 70.4 minutes for the open surgery group ($p < 0.001$). Patients who underwent laparoscopic surgery reported lower postoperative pain scores, with a mean score of 3.2 on the Visual Analog Scale (VAS) compared to 5.6 in the open surgery group ($p < 0.001$). Furthermore, the laparoscopic group experienced a

significantly shorter hospital stay, averaging 1.5 days compared to 3.8 days for the open surgery group ($p < 0.001$). The return to normal activities was also faster for the laparoscopic group, with a mean time of 10.2 days compared to 17.6 days in the open surgery group ($p < 0.001$). These results highlight the advantages of laparoscopic surgery in terms of faster recovery and reduced discomfort for patients.

**Figure 1: Complication Rates**

Complication rates were generally lower in the laparoscopic group. Wound infections were observed in 3.6% of laparoscopic cases compared to 8.0% in the open surgery group, though this difference was not statistically significant ($p=0.13$). Hematoma formation was also lower in the laparoscopic group (1.8%) compared to the open group (4.5%) ($p=0.25$). Recurrence rates within six months were 2.7% for the

laparoscopic group versus 6.2% for the open surgery group, but this difference did not reach statistical significance ($p=0.21$). However, the overall complication rate was significantly lower in the laparoscopic group (8.0%) compared to the open surgery group (18.8%) ($p=0.02$), demonstrating a clear advantage of the minimally invasive technique in reducing postoperative complications.

Table 3: Patient Satisfaction and Recovery

Variable	Laparoscopic Group	Open Surgery Group	P-value
Overall Satisfaction (1-5)	4.6 ± 0.7	3.8 ± 1.0	< 0.001
Return to Work (days)	12.3 ± 3.1	20.4 ± 4.2	< 0.001
Patient Willingness for Repeat	100 (89.3%)	78 (69.6%)	< 0.001

Patient satisfaction was significantly higher in the laparoscopic group, with a mean satisfaction score of 4.6 out of 5, compared to 3.8 in the open surgery group ($p < 0.001$).

Additionally, patients in the laparoscopic group returned to work faster, with a mean time of 12.3 days compared to 20.4 days for the open surgery group ($p < 0.001$). The majority of

patients who underwent laparoscopic surgery (89.3%) indicated a willingness to undergo the same procedure again if necessary, compared to only 69.6% in the open surgery group ($p < 0.001$). These results highlight the superior patient satisfaction and quicker return to productivity associated with laparoscopic hernia repair.

DISCUSSION

The results of this study indicate that laparoscopic hernia repair significantly reduces operative time, postoperative pain, and hospital stay compared to open surgery [8]. Specifically, the laparoscopic group had an average operative time of 55.1 minutes, which was significantly shorter than the 70.4 minutes observed in the open surgery group ($p < 0.001$). This finding is consistent with the work of Shkaraban *et al.*, who reported a reduction in operative time for laparoscopic hernia repair in a meta-analysis of randomized controlled trials [9]. The shorter operative time can be attributed to the minimally invasive nature of the procedure, which reduces the need for extensive dissection and manipulation of tissues. Postoperative pain, as measured by the Visual Analog Scale (VAS), was significantly lower in the laparoscopic group (mean score 3.2) compared to the open surgery group (mean score 5.6) ($p < 0.001$). These findings are consistent with previous studies such as those by Techapongsatorn *et al.*, who found that laparoscopic hernia repair resulted in less postoperative pain due to smaller incisions and less tissue trauma [10]. Reduced postoperative pain is a critical factor in the patient's overall experience and recovery, leading to quicker mobility and shorter hospital stays. In this study, the laparoscopic group had a significantly shorter hospital stay (mean 1.5 days) compared to the open surgery group (mean 3.8 days) ($p < 0.001$), which mirrors findings from Lyu *et al.*, who reported similar trends in faster discharge for laparoscopic procedures [11].

Comparison with Existing Literature

Several studies have reported similar outcomes in favor of laparoscopic techniques, reinforcing the significance of the results obtained in this study. For instance, Gudigopuram *et al.*, in their large randomized trial, found that laparoscopic hernia repair was associated with a lower recurrence rate and quicker return to daily activities, although their study noted that laparoscopic repair required more surgical expertise [12]. The complication rates reported in this study were also lower for the laparoscopic group (8%) compared to the open surgery group (18.8%), a result that is in line with the findings of Asencio *et al.*, who demonstrated lower rates of wound infection and recurrence in laparoscopic hernia repair [13]. However, some studies have reported differing outcomes, particularly regarding recurrence rates. For example, Rutegård *et al.*, observed a higher recurrence rate in the laparoscopic group compared to open surgery in their randomized controlled trial [14]. One explanation for this discrepancy could be differences in surgeon experience and learning curves associated with laparoscopic techniques, which is particularly relevant in low-resource

settings like Bangladesh. The sample sizes of these studies also vary, with larger studies potentially offering more robust statistical power. In our study, the sample size of 224 patients was relatively small compared to the Elmessiry *et al.*, study, which included over 2000 patients [15]. As such, the findings of our study should be interpreted in the context of this limitation.

Implications of the Research Findings

The findings of this study have important implications for surgical practice, particularly in low- and middle-income countries (LMICs) like Bangladesh. The significant reduction in postoperative pain and shorter hospital stays observed in the laparoscopic group suggest that wider adoption of laparoscopic hernia repair could alleviate some of the burdens on healthcare systems, especially in resource-constrained settings where hospital bed availability is often limited. Moreover, the quicker return to normal activities (mean 10.2 days for laparoscopic versus 17.6 days for open surgery, $p < 0.001$) could have substantial economic benefits for patients, many of whom are day laborers or involved in agriculture, and cannot afford prolonged recovery times away from work. Additionally, the lower complication rates observed in the laparoscopic group suggest that this technique may be a safer option for hernia repair in Bangladesh, where the risk of postoperative infections can be higher due to resource limitations and inconsistent infection control practices in some healthcare facilities. A lower complication rate could translate into reduced readmissions, lower healthcare costs, and improved patient satisfaction, which is crucial in a healthcare system largely reliant on out-of-pocket expenditures [16].

Practical Significance and Surgical Expertise

One of the critical factors that emerged from this study is the role of surgical expertise in determining outcomes. The success of laparoscopic hernia repair is highly dependent on the surgeon's skill and familiarity with minimally invasive techniques. In many LMICs, including Bangladesh, the availability of skilled laparoscopic surgeons is limited, and access to training programs is often constrained by financial and logistical barriers. As highlighted by Ferranti *et al.*, the learning curve for laparoscopic surgery is steep, and outcomes can vary significantly depending on the surgeon's level of experience [17]. In our study, all surgeons involved had at least five years of experience in laparoscopic surgery, which likely contributed to the favorable outcomes observed. This is an important consideration for broader implementation, as the introduction of laparoscopic techniques in less-experienced hands may not yield the same results. Future studies should focus on assessing the impact of surgeon experience on patient outcomes, particularly in LMICs, where training opportunities are often limited.

Global Surgical Trends

The global trend towards minimally invasive surgery (MIS) is well-established, with numerous studies reporting the

benefits of laparoscopic procedures in terms of reduced recovery times, lower complication rates, and improved patient satisfaction [18]. Our study aligns with these findings, demonstrating that laparoscopic hernia repair offers significant advantages over open surgery in the Bangladeshi context. However, the underutilization of laparoscopic techniques in Bangladesh, due to limited infrastructure and higher upfront costs, remains a barrier to widespread adoption. Studies in high-income countries have consistently shown that laparoscopic surgery is cost-effective in the long term due to reduced postoperative care costs and faster recovery times [19]. In contrast, the upfront costs associated with laparoscopic equipment and the need for specialized training may deter its use in resource-limited settings like Bangladesh. However, the findings of this study suggest that the long-term benefits of laparoscopic hernia repair, including reduced complication rates and shorter hospital stays, may offset these initial costs, making it a viable option for improving surgical outcomes in Bangladesh.

Scientific Explanations for Differences

While the results of this study are largely consistent with the existing literature, some differences were observed, particularly regarding complication rates. For example, the total complication rate in the laparoscopic group (8%) was lower than that reported by Verdolin Campos De Azevedo *et al.*, in their European study, which found a complication rate of 12%. This discrepancy could be explained by differences in the patient populations, healthcare systems, and environmental factors [20]. Bangladesh, as an LMIC, has distinct socio-economic and healthcare challenges that could influence outcomes. The availability of postoperative care, nutritional factors, and patient adherence to recovery guidelines are all factors that could differ from those in high-income countries and contribute to variations in complication rates. Additionally, racial and genetic factors could play a role in influencing the outcomes of hernia repair surgeries. Several studies, suggested that differences in tissue structure and healing responses between populations could impact the rates of recurrence and wound healing [21-28]. While this study did not specifically investigate racial or genetic factors, future research in this area could provide valuable insights into how these variables influence surgical outcomes in diverse populations.

Future Research Directions

this multicenter study demonstrates that laparoscopic hernia repair is a superior alternative to open surgery in terms of operative time, postoperative pain, recovery speed, complication rates, and patient satisfaction. The findings suggest that wider adoption of laparoscopic techniques in Bangladesh could significantly improve patient outcomes and reduce the burden on healthcare resources. However, the success of these techniques is heavily dependent on surgeon expertise and the availability of necessary equipment, both of which remain challenges in LMICs. Future research should focus on expanding the sample size, examining the long-term

outcomes of laparoscopic hernia repair, and investigating the role of surgeon experience in influencing patient outcomes. Additionally, further studies are needed to explore the economic feasibility of widespread laparoscopic surgery in Bangladesh, as well as the impact of racial and genetic factors on surgical outcomes. By addressing these areas, future research can help pave the way for more effective and accessible hernia repair techniques in Bangladesh and other resource-limited settings.

CONCLUSION

This multicenter study demonstrates that laparoscopic hernia repair offers significant advantages over open surgery in terms of shorter operative time, reduced postoperative pain, faster recovery, and lower complication rates. These findings suggest that laparoscopic techniques should be widely adopted in Bangladesh, especially in resource-limited settings, to improve patient outcomes and reduce healthcare burdens.

Recommendations

Expand training programs for laparoscopic surgery in Bangladesh.
Increase access to laparoscopic equipment in public hospitals.
Promote patient awareness of the benefits of minimally invasive hernia repair.

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