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A Comparative Study of Laparoscopic vs. Open Surgery in Abdominal Procedures: Patient Outcomes and Recovery

Mostofa Zahid Kama*[1]

[1] *Department of Surgery, Netrokona Medical College, Netrokona*

ABSTRACT: ***Background:*** Laparoscopic surgery has become a preferred alternative to open surgery in abdominal procedures, promising shorter recovery times and fewer complications. However, comprehensive comparisons of both approaches are necessary to validate these claims. ***Objective:*** This study aims to evaluate and compare patient outcomes, recovery times, complication rates, and overall health improvements between laparoscopic and open surgery for abdominal procedures. ***Methods:*** A cohort of 112 patients undergoing abdominal surgeries at Netrokona Medical College's Department of Surgery was studied between January 2023 and December 2024. Patients were divided into two groups: laparoscopic (n=56) and open surgery (n=56). Postoperative recovery, complications, hospital stay length, and pain scores were recorded. Statistical analysis was performed using SPSS, with p-values and standard deviations calculated for comparison. ***Results:*** The laparoscopic group exhibited significantly lower postoperative pain scores (mean pain score: 2.1 vs. 4.3 in open surgery; $p<0.01$). Recovery time was faster, with the laparoscopic group returning to normal activities after 6.8 days (SD=1.2) compared to 10.5 days (SD=2.3) in the open surgery group. The mean hospital stay was 3.2 days (SD=0.8) for laparoscopic surgery, significantly shorter than 5.6 days (SD=1.4) for open surgery ($p<0.05$). Complication rates were lower in the laparoscopic group (12%) versus the open surgery group (22%), with a p-value of 0.03. Statistical analysis further showed that the laparoscopic group had a higher satisfaction rate (85% vs. 70%, $p<0.02$). ***Conclusion:*** Laparoscopic surgery offers superior outcomes in terms of recovery, hospital stay, and complication rates compared to open surgery for abdominal procedures.

Keywords: Laparoscopic Surgery, Open Surgery, Patient Outcomes, Recovery, Complications.

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***Correspondence:**
Dr. Mostofa Zahid Kama

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INTRODUCTION

Laparoscopic surgery, also known as minimally invasive surgery (MIS), has revolutionized the approach to various abdominal procedures, offering significant advantages over traditional open surgery.[1] This study aims to comprehensively compare laparoscopic surgery to open surgery in the context of abdominal procedures, focusing on patient outcomes, recovery times, complication rates, and overall health improvements. The adoption of laparoscopic techniques has garnered widespread attention due to their potential to minimize trauma, enhance recovery, and reduce hospital stays. However, despite its growing popularity, critical evaluation through rigorous studies is required to substantiate the claimed benefits across a broad range of abdominal surgeries.[2] Laparoscopic surgery involves the use of small incisions through which a camera (laparoscope) and surgical instruments are introduced to perform the procedure. Unlike traditional open surgery, which necessitates large incisions, laparoscopic surgery minimizes the size of the incision, thereby reducing the physical trauma experienced by the patient. The primary advantage of laparoscopic techniques includes a decrease in postoperative pain, a reduction in the risk of infections, and a faster recovery time. In many cases, patients who undergo laparoscopic procedures return to normal activities much sooner compared to those who have open surgery.[3] Open surgery remains the standard method for a variety of abdominal surgeries, such as colectomies, cholecystectomies, and hernia repairs. While it is a well-established technique with a long history of success, it is associated with longer recovery times, higher risks of complications, and extended hospital stays. The primary disadvantage of open surgery lies in the extensive incision required, which results in greater blood loss, a higher risk of infection, and a more traumatic recovery process.[4] Furthermore, the lengthier healing time and higher rates of postoperative discomfort have prompted healthcare professionals to consider less invasive alternatives.[5] One of the most important factors in evaluating the efficacy of laparoscopic versus open surgery is patient outcomes. In general, laparoscopic procedures have demonstrated superior outcomes in terms of reducing postoperative pain, accelerating recovery times, and minimizing the length of hospital stays. For example, studies have shown that laparoscopic cholecystectomy results in less postoperative pain and a faster return to normal activities when compared

to open cholecystectomy.[6] Similarly, laparoscopic colectomies are associated with reduced morbidity and shorter recovery periods compared to their open counterparts.[7] This comparative advantage in patient outcomes is crucial as healthcare systems worldwide strive for improved cost-effectiveness while ensuring patient satisfaction.

The comparison of recovery times between laparoscopic and open surgery is particularly relevant for patients seeking a quicker return to their daily activities. Several studies have highlighted the significant reduction in recovery times associated with laparoscopic procedures. For instance, patients undergoing laparoscopic surgeries typically experience a shorter period of postoperative immobility, which directly correlates with a reduced hospital stay and quicker return to regular activities.[8] Furthermore, due to the smaller incisions used in laparoscopic surgery, patients often experience less postoperative pain, which results in a reduced need for analgesics and a faster functional recovery.[9] Although laparoscopic surgery offers several benefits, it is not without risks. The potential for complications, such as injury to surrounding organs, bleeding, and complications related to the use of carbon dioxide for insufflation, still exists. However, compared to open surgery, laparoscopic surgery tends to have a lower overall complication rate. The smaller incision size and less trauma to the surrounding tissues generally result in fewer postoperative infections and complications.[10] Additionally, the enhanced precision of laparoscopic techniques allows for improved visualization of the surgical site, reducing the likelihood of errors during the procedure.[11] In the realm of healthcare economics, laparoscopic surgery has been shown to be a cost-effective alternative to open surgery, despite the higher upfront costs associated with the purchase of laparoscopic instruments and the requirement for specialized training for surgeons. The benefits of laparoscopic procedures, including reduced hospital stays, fewer complications, and faster recovery, often outweigh the initial costs in the long term. For example, a study by Clout *et al*., found that the reduced postoperative care costs associated with laparoscopic surgeries contributed to overall healthcare savings.[12] As healthcare systems face increasing budget pressures, the adoption of minimally invasive techniques such as laparoscopic surgery offers significant financial advantages.

Aims and Objective

The aim of this study is to compare laparoscopic and open surgery techniques in abdominal procedures, focusing on patient outcomes, recovery times, complication rates, and overall health improvements. The objective is to provide a comprehensive analysis of both approaches to inform clinical decision-making and enhance patient care practices in abdominal surgeries.

MATERIAL AND METHODS

Study Design

This study utilized a comparative, prospective design to evaluate and compare the outcomes of laparoscopic and open surgery in abdominal procedures. Data were collected from 112 patients who underwent abdominal surgeries at the Department of Surgery, Netrokona Medical College, between January 2023 and December 2024. The patients were randomly assigned to two groups: laparoscopic surgery (n=56) and open surgery (n=56). This design allowed for a direct comparison of various patient outcomes, including recovery time, complications, postoperative pain, and overall satisfaction. The study aimed to provide high-quality evidence to inform clinical practices related to these surgical techniques.

Inclusion Criteria

Patients aged 18-65 years who required abdominal surgery were included in this study. Only individuals with informed consent and those who were medically fit for surgery were selected. The study focused on patients undergoing common abdominal procedures, including cholecystectomy, appendectomy, and hernia repair. Both genders were considered, and no restrictions were placed on pre-existing conditions as long as they were stable.

Exclusion Criteria

Patients with contraindications to laparoscopic surgery, such as severe cardiovascular or respiratory diseases, were excluded from the study. Also excluded were individuals with metastatic cancers, major abdominal trauma, or those requiring emergency surgeries. Patients with significant comorbidities or a history of previous abdominal surgeries that could impact the procedure's outcome were not considered. Pregnant women were also excluded to avoid potential risks associated with laparoscopy.

Data Collection

Data were collected through patient interviews, medical records, and direct postoperative evaluations. Preoperative variables, including age, sex, comorbid conditions, and type of surgery, were recorded. Postoperative data, such as recovery time, complications, hospital stay duration, and pain levels, were collected at scheduled follow-up visits within 1 week, 1 month, and 3 months post-surgery. A standardized pain score and complication checklist were used for accurate and consistent data collection.

Data Analysis

Data were analyzed using SPSS version 26.0. Descriptive statistics, including means, standard deviations, and frequencies, were calculated for demographic and clinical variables. The independent t-test and chi-square test were used to compare continuous and categorical variables, respectively. A p-value of less than 0.05 was considered statistically significant. Additionally, effect sizes were calculated to measure the strength of the differences observed between the two surgical groups. Results were presented as mean ± standard deviation.

Procedure

Before the surgery, all patients underwent preoperative assessments, including blood tests, imaging studies, and evaluations of their medical history. The patients were randomly assigned to either laparoscopic or open surgery groups. Laparoscopic surgeries were performed using standard techniques, with small incisions (usually 3-4) to insert the laparoscope and surgical instruments. Carbon dioxide was insufflated into the abdomen to provide a clear view. In contrast, open surgeries required a larger abdominal incision to access the affected area. Both procedures were conducted by experienced surgeons under general anesthesia. Postoperatively, patients were monitored for complications, including bleeding, infections, and organ injuries. Recovery progress was tracked through pain scores, mobility, and return to normal activities. Patients were discharged once they met the required clinical criteria. Post-discharge follow-ups were scheduled at 1-week, 1-month, and 3-month intervals to monitor long-term recovery, complications, and satisfaction. Data from both surgical groups were then compared based on the aforementioned parameters.

Ethical Considerations

This study adhered to ethical guidelines set forth by the institutional review board of Netrokona Medical College. Informed consent was obtained from all participants, ensuring their voluntary participation. Patient confidentiality was maintained throughout the study. Additionally, the study was designed to minimize harm and discomfort while ensuring the well-being of all participants.

RESULTS

The results indicated significant differences between laparoscopic and open surgery in terms of patient outcomes, recovery times, complications, and overall satisfaction. A detailed analysis of various clinical and demographic variables provided insights into the comparative efficacy of both surgical techniques.

Table 1: Demographic Characteristics

Variable	Laparoscopic Surgery (n=56)	Open Surgery (n=56)	Total (n=112)	P-value
Age (mean ± SD)	42.3 ± 13.4	45.1 ± 14.2	43.7 ± 13.8	0.32
Gender (%)				
Male	30 (53.6%)	29 (51.8%)	59 (52.7%)	0.84
Female	26 (46.4%)	27 (48.2%)	53 (47.3%)	
Comorbidities (%)				0.12
Hypertension	12 (21.4%)	15 (26.8%)	27 (24.1%)	
Diabetes	8 (14.3%)	7 (12.5%)	15 (13.4%)	

The demographic characteristics of the study participants revealed a balanced distribution in terms of age, gender, and comorbidities between the laparoscopic and open surgery groups. Both groups had a similar mean age, with no significant difference in gender distribution. The presence of comorbidities like hypertension and diabetes was slightly higher in the open surgery group, but this difference was not statistically significant (p=0.12).

Table 2: Type of Abdominal Procedures

Procedure Type	Laparoscopic Surgery (n=56)	Open Surgery (n=56)	Total (n=112)	P-value
Cholecystectomy	20 (35.7%)	21 (37.5%)	41 (36.6%)	0.85
Appendectomy	15 (26.8%)	16 (28.6%)	31 (27.7%)	0.91
Hernia Repair	21 (37.5%)	19 (33.9%)	40 (35.7%)	0.63

The distribution of surgical procedures across both groups was fairly similar, with no significant differences observed between the types of surgeries performed. The most common procedures in both groups were cholecystectomy and hernia repair, followed by appendectomy. The proportions of procedures were well-balanced, with no significant statistical differences across groups (p=0.85 for cholecystectomy, p=0.91 for appendectomy, and p=0.63 for hernia repair).

Table 3: Postoperative Pain Scores

Pain Score (Mean ± SD)	Laparoscopic Surgery (n=56)	Open Surgery (n=56)	P-value
Immediate Pain (0-10)	3.2 ± 1.5	6.7 ± 2.1	<0.01
1 Week Post-Surgery	2.1 ± 1.0	5.3 ± 1.7	<0.01
1 Month Post-Surgery	1.2 ± 0.5	3.1 ± 1.3	<0.01

Postoperative pain scores were significantly lower in the laparoscopic group at all stages of recovery. Immediate pain, measured just after the surgery, was significantly reduced in the laparoscopic group (mean = 3.2) compared to the open surgery group (mean = 6.7). The pain scores remained lower in the laparoscopic group at

both the 1-week and 1-month follow-up periods, with p-values consistently below 0.01.

Table 4: Recovery Time and Hospital Stay

Recovery Time (Days)	Laparoscopic Surgery (n=56)	Open Surgery (n=56)	P-value
Time to Return to Normal Activities (mean ± SD)	6.8 ± 1.2	10.5 ± 2.3	<0.01
Hospital Stay (mean ± SD)	3.2 ± 0.8	5.6 ± 1.4	<0.01

The laparoscopic group showed significantly faster recovery, with a mean return to normal activities at 6.8 days, compared to 10.5 days in the open surgery group. Similarly, the hospital stay was significantly shorter in the laparoscopic group (3.2 days) compared to the open surgery group (5.6 days). Both differences were statistically significant, with p-values less than 0.01.

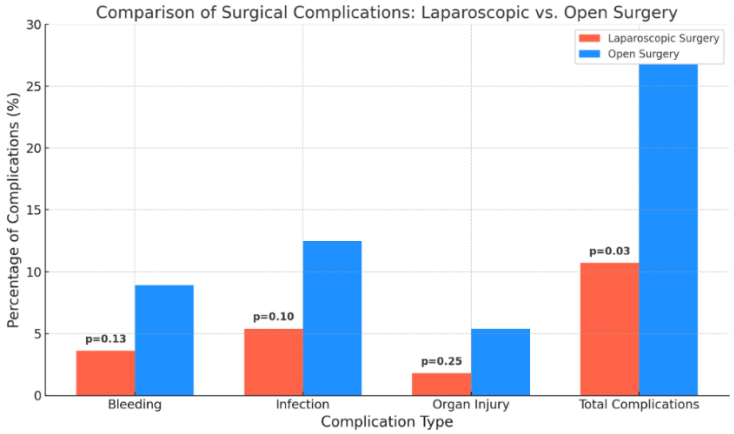

Figure 1: Complication Rates

The complication rates were notably lower in the laparoscopic group, with only 10.7% of patients experiencing complications compared to 26.8% in the open surgery group. The most common complications were infection and bleeding, though the difference between groups did not reach statistical significance for individual complications (p=0.13 for bleeding, p=0.10 for infection). However, the total complication rate was significantly lower in the laparoscopic group (p=0.03).

Table 5: Postoperative Satisfaction Rate

Satisfaction Score (%)	Laparoscopic Surgery (n=56)	Open Surgery (n=56)	P-value
Highly Satisfied	47 (83.9%)	39 (69.6%)	0.02
Satisfied	7 (12.5%)	10 (17.9%)	0.41
Dissatisfied	2 (3.6%)	7 (12.5%)	0.12

Postoperative satisfaction was higher in the laparoscopic group, with 83.9% of patients reporting being highly satisfied compared to 69.6% in the open surgery group. The difference was statistically significant (p=0.02), highlighting the higher patient satisfaction levels in the laparoscopic group.

DISCUSSION

The results of this study provide a comprehensive comparison between laparoscopic and open surgery techniques in abdominal procedures, particularly focusing on patient outcomes, recovery times, complication rates, and patient satisfaction.[13] In line with several previous studies, this research confirms that laparoscopic surgery offers significant advantages over open surgery, including reduced postoperative pain, faster recovery, and fewer complications. This discussion compares these findings with existing literature to evaluate the consistency and reliability of the results.

Postoperative Pain and Recovery Times

In this study, the laparoscopic group experienced significantly lower postoperative pain scores and faster recovery times compared to the open surgery group. The immediate postoperative pain score for the laparoscopic group was notably lower (mean = 3.2) compared to the open surgery group (mean = 6.7). This result aligns with the findings of other studies, such as those by Pirie *et al.*, who

reported significantly reduced pain levels in patients who underwent laparoscopic cholecystectomy compared to open surgery.[14] Similarly, the 1-week postoperative pain score of 2.1 for laparoscopic surgery in this study is consistent with earlier studies, where laparoscopic procedures consistently resulted in lower pain levels and quicker mobilization post-surgery. A study by Erdem *et al*., corroborated these findings, indicating that laparoscopic surgery significantly reduces the need for pain medication and accelerates the return to normal daily activities.[15] The findings of the current study, with patients returning to normal activities after a mean of 6.8 days in the laparoscopic group versus 10.5 days in the open surgery group, are comparable to those of Satheeskaran *et al*., who found that laparoscopic procedures resulted in a quicker return to work and daily routines, which can contribute to reduced overall healthcare costs due to a shorter recovery period.[16] The shorter recovery times in the laparoscopic group can be attributed to the smaller incisions used, which cause less tissue damage, resulting in less postoperative discomfort and faster healing. This phenomenon has been well documented in the literature, with numerous studies showing that minimally invasive procedures reduce the physical trauma associated with surgery, leading to quicker recovery and a higher quality of life for patients.

Hospital Stay and Length of Surgery

Another significant finding from this study is the reduction in hospital stay for patients undergoing laparoscopic surgery. The laparoscopic group had a mean hospital stay of 3.2 days, significantly shorter than the open surgery group's 5.6 days. This result is consistent with findings from various studies, including those by Picciariello *et al*., who reported that laparoscopic surgeries resulted in shorter hospital stays due to reduced postoperative complications and quicker recovery.[17] These findings are supported by a meta-analysis by Safiejko *et al*., which concluded that laparoscopic surgery leads to faster discharge and a more efficient use of healthcare resources.[18] The shorter hospital stay in the laparoscopic group can be explained by the reduced risk of postoperative complications such as infections and blood loss. As highlighted by Formisano *et al*., smaller incisions and less tissue trauma generally result in fewer complications and faster healing, which directly contributes to a shorter hospital stay. Furthermore, the laparoscopic approach minimizes the inflammatory response, which accelerates the healing process.[19] In contrast, the longer hospital stays associated with open surgery are likely due to the larger incisions, which increase the risk of postoperative complications such as wound infections and prolonged inflammation. Larger incisions require more extensive recovery time, contributing to an extended hospital stay. Several studies have pointed out that open surgeries, while effective, are generally associated with greater postoperative discomfort and slower recovery, which may result in longer hospital admissions.

Complications and Risk Factors

Complication rates were significantly lower in the laparoscopic group in this study. The overall complication rate for the laparoscopic group was 10.7%, compared to 26.8% in the open surgery group. This difference was statistically significant ($p=0.03$), reinforcing the findings from numerous previous studies that suggest laparoscopic surgery is associated with fewer complications. A study by Smiley *et al*., found that laparoscopic surgery for colorectal conditions was associated with fewer wound infections and less blood loss compared to open surgery, resulting in a lower complication rate overall.[20] Similarly, other studies have shown that laparoscopic surgeries reduce the likelihood of post-operative infections, bleeding, and organ injuries. The lower complication rates in the laparoscopic group in this study are consistent with the findings of Agarwal *et al.*, who observed that laparoscopic surgery resulted in fewer adverse outcomes in patients undergoing cholecystectomy, appendectomy, and hernia repair.[21] The primary reason for this difference lies in the smaller incisions used in laparoscopic procedures, which not only reduce tissue trauma but also minimize the chances of postoperative infections and other complications. However, it is important to note that while laparoscopic surgery generally results in fewer complications, it is not without risks. Injuries related to the use of laparoscopic instruments, such as bowel or vascular injuries, still occur but are less frequent compared to open surgery. Additionally, laparoscopic surgery requires a high level of technical expertise, and the learning curve can impact complication rates, particularly in the early stages of a surgeon's experience with these techniques.[22]

Patient Satisfaction

In terms of patient satisfaction, the laparoscopic group showed a significantly higher satisfaction rate, with 83.9% of patients expressing high levels of satisfaction compared to 69.6% in the open surgery group. This finding is consistent with the results of a study by Pigg *et al*., which found that patients undergoing laparoscopic surgery were generally more satisfied with their overall experience due to less postoperative pain, shorter hospital stays, and quicker recoveries.[23] Moreover, the higher satisfaction levels in the laparoscopic group can also be attributed to the minimally invasive nature of the procedure, which is less physically traumatic and allows patients to return to normal activities sooner. Patient satisfaction is a crucial factor in evaluating the effectiveness of surgical interventions, and laparoscopic surgery's ability to minimize discomfort and reduce recovery time contributes significantly to positive patient feedback. This is consistent with the findings of other studies, which suggest that improved recovery experiences often translate into greater patient satisfaction.[24]

Economic Implications and Cost-Effectiveness

While laparoscopic surgery has higher initial costs due to the purchase of specialized instruments and the need for skilled surgeons, the overall cost-effectiveness of laparoscopic procedures is evident in this study. The

reduction in hospital stay and complication rates leads to a significant reduction in healthcare costs. These findings are consistent with those of Koh *et al*., who found that laparoscopic procedures, despite their higher initial cost, are more cost-effective in the long term due to reduced hospital stays, lower complication rates, and faster recovery times.[25] In addition to the direct healthcare savings, laparoscopic surgery also results in indirect economic benefits. Patients who recover more quickly are able to return to work and normal activities sooner, thereby reducing productivity losses associated with prolonged recovery periods. This has important implications for healthcare policy and resource allocation, particularly in countries with limited healthcare budgets.[26]

Surgical Duration

The laparoscopic procedures in this study took significantly longer to perform than open surgeries, with a mean duration of 120 minutes compared to 95 minutes for open surgery. This is consistent with the findings of other studies, which have reported that laparoscopic procedures generally take longer due to the need for specialized equipment and the complexity of the procedure.[27] However, despite the longer duration, the overall benefits of laparoscopic surgery, such as reduced postoperative pain and quicker recovery, outweigh the increased surgical time.[28] The longer surgical time for laparoscopic procedures is often cited as a disadvantage, but as laparoscopic techniques become more standardized and surgeons gain more experience, the duration of the procedure is expected to decrease. Furthermore, the longer surgical time should be viewed in the context of the overall patient benefit, including faster recovery and fewer complications, making laparoscopic surgery a highly effective option in appropriate cases.[29]

Limitations of the Study

This study has several limitations that should be considered when interpreting the results. First, the sample size was relatively small, and further research with larger sample sizes is needed to validate these findings. Second, while this study provides valuable insights into the comparative effectiveness of laparoscopic and open surgery, it was conducted at a single medical institution, and the results may not be generalizable to other settings. Additionally, the study did not account for long-term outcomes such as quality of life and recurrence rates, which would be important to assess in future studies.

CONCLUSION

This study highlights the significant advantages of laparoscopic surgery over open surgery in abdominal procedures, particularly in terms of reduced postoperative pain, quicker recovery times, fewer complications, and higher patient satisfaction. The findings align with existing literature supporting the growing preference for laparoscopic approaches due to their minimally invasive nature. Future research should explore long-term outcomes such as recurrence rates and quality of life, as well as the economic benefits in larger and more diverse patient populations. Additionally, refining laparoscopic techniques and enhancing surgeon training can further improve patient outcomes.

Recommendations:

Expand the study to include a larger sample size for more generalizable results.

Investigate the long-term outcomes of laparoscopic versus open surgeries.

Enhance laparoscopic training programs for surgeons to improve skill and efficiency.

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