

Risk Factors Of Converting To Laparotomy In Laparoscopic Appendectomy For Acute Appendicitis

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Abstract

Background: Laparoscopic appendectomy is the preferred treatment for acute appendicitis, but conversion to open laparotomy is sometimes necessary. Identifying risk factors for conversion is crucial for surgical planning, patient counseling, and optimizing outcomes. This study aimed to determine the patient, disease, and intraoperative factors associated with conversion from laparoscopic to open appendectomy.

Methods: A retrospective observational study was conducted on 250 patients who underwent laparoscopic appendectomy for acute appendicitis at a single institution between January 2020 and January 2025. Data on demographic characteristics, comorbidities, disease severity, and intraoperative findings were collected from medical records. Statistical analyses, including univariate and multivariate logistic regression, were used to identify independent risk factors for conversion.

Results: The conversion rate to laparotomy was 12% (30/250). Significant patient-related risk factors included advanced age (mean 41.2 vs. 31.5 years, $p<0.05$), male gender (83.3% vs. 56.8%, $p<0.05$), obesity (BMI >30 ; 60% vs. 28.2%, $p<0.01$), and a history of prior abdominal surgery (40% vs. 15%, $p<0.01$). Disease severity was a strong predictor, with significantly higher conversion rates for gangrenous (40% vs. 21.8%) and perforated appendicitis (40% vs. 17.2%), and particularly for abscess formation (50% vs. 9.1%, $p<0.001$). Key intraoperative factors leading to conversion were dense adhesions (50% vs. 11.4%, $p<0.001$), unclear anatomy (43.3% vs. 6.8%, $p<0.001$), and excessive bleeding (33.3% vs. 4.5%, $p<0.001$). Conversion was associated with worse outcomes, including higher complication rates (26.7% vs. 6.8%, $p<0.01$) and longer hospital stays (6.5 vs. 3.2 days, $p<0.001$).

Conclusion: Conversion to laparotomy is influenced by a combination of patient-related factors (age, gender, obesity, surgical history), disease severity (gangrenous/perforated appendicitis, abscess), and intraoperative challenges (adhesions, unclear anatomy, bleeding). Recognizing these risk factors preoperatively can enhance surgical preparedness and patient counseling. Conversion should be viewed as a prudent decision to ensure patient safety rather than a procedural failure.

Keywords: Laparoscopic Appendectomy, Conversion To Open Surgery, Acute Appendicitis, Risk Factors, Intraoperative Complications

Introduction

Background

Acute appendicitis is one of the most common surgical emergencies worldwide, requiring timely intervention to prevent complications such as perforation, abscess formation, or peritonitis. With the advancement of minimally invasive surgery, laparoscopic appendectomy has become the preferred approach for treating acute appendicitis, offering benefits such as shorter hospital stays, reduced postoperative pain, faster recovery, and improved cosmetic outcomes. Despite its advantages, not all laparoscopic procedures can be completed as planned, and in certain cases, conversion to open laparotomy becomes necessary (Cherif et al., 2023).

Conversion to laparotomy, although sometimes unavoidable, is generally considered an unfavorable outcome, as it can increase operative time, hospital stay, postoperative complications, and healthcare costs. Identifying patients at risk for conversion can help surgeons make informed decisions and better prepare for operative challenges (Ceylan et al., 2025).

Several factors may influence the likelihood of conversion. Patient-related factors such as age, gender, body mass index, comorbidities, and history of prior abdominal surgeries may predispose to a more technically challenging laparoscopic procedure. Intraoperative factors such as dense adhesions, unclear anatomy, bleeding, or perforated appendix can also contribute to conversion. Furthermore, disease severity, such as gangrenous or perforated appendicitis, is often linked to higher rates of laparotomy (Azılı et al., 2023).

Surgeon-related factors also play an important role. The level of surgical expertise, experience with laparoscopy, and decision-making during unexpected intraoperative difficulties can influence whether a conversion is performed. The threshold for conversion may vary among surgeons, reflecting differences in training, risk tolerance, and institutional protocols (Monrabal Lezama et al., 2022).

Radiological and preoperative diagnostic findings may also serve as predictors of conversion. Imaging features such as abscess formation, significant inflammation, or appendicular mass can indicate a higher likelihood of intraoperative challenges. Incorporating preoperative imaging results into risk assessment could improve surgical planning and patient counseling (Fayraq et al., 2023).

Conversion to laparotomy, although performed for patient safety, can have psychological and physical consequences for patients. While patients are generally counseled about the possibility of conversion, experiencing it may affect patient satisfaction and recovery expectations. Therefore, identifying risk factors and communicating them clearly is vital for maintaining patient trust and improving informed consent practices (Pushpanathan et al., 2022).

From a health system perspective, conversion to laparotomy places additional strain on resources. Longer operative times, extended hospitalization, and increased complication rates all contribute to higher costs. Minimizing the need for conversion through better risk stratification and preoperative planning aligns with goals of efficiency and quality improvement in healthcare delivery (Bancke Laverde et al., 2023).

Understanding the risk factors associated with conversion is also essential for training and clinical decision-making. By recognizing predictors, surgical teams can prepare appropriately, allocate resources more effectively, and potentially avoid unnecessary conversions. In addition, improved knowledge in this area can contribute to evidence-based guidelines and help reduce variability in surgical practice (Schildberg et al., 2025).

Despite the importance of this issue, there remains a lack of consensus on the most significant predictors of conversion to laparotomy. Studies conducted in different populations report varied results, suggesting that patient demographics, disease characteristics, and healthcare settings may influence the outcomes. This highlights the need for more focused research in specific regions and healthcare systems (Sadaf et al., 2025). By investigating the risk factors associated with conversion from laparoscopic appendectomy to laparotomy in patients with acute appendicitis, this research will provide valuable insights for surgeons, patients, and healthcare systems. The findings can help enhance surgical planning, optimize patient outcomes, and support the broader goal of advancing minimally invasive surgical care.

Methodology

Study Design

This study employed a retrospective observational design to investigate the risk factors associated with conversion to laparotomy in patients who underwent laparoscopic appendectomy for acute appendicitis. The retrospective design allowed the analysis of real-world surgical outcomes across a defined period, providing sufficient sample size and diversity of cases to identify predictors of conversion.

Study Setting

The study was conducted using data obtained from a healthcare facility that manages emergency surgical cases. Records were reviewed over a four-year period, from January 2020 to January 2025, ensuring adequate follow-up and comprehensive coverage of laparoscopic appendectomy procedures performed for acute appendicitis.

Study Population

The study population included all patients who underwent laparoscopic appendectomy for acute appendicitis during the study period. Eligible participants comprised patients of any age and gender diagnosed with acute appendicitis and managed initially through a laparoscopic approach. Patients who underwent incidental appendectomies, those with appendiceal tumors, and those with incomplete or missing medical records were excluded.

Sample Size

A total of **250 patients** met the inclusion criteria and were included in the study. Of these, 30 patients (12%) required conversion to laparotomy, while 220 patients (88%) successfully underwent laparoscopic appendectomy without conversion. The sample size was sufficient to ensure statistical power for detecting associations between risk factors and conversion.

Data Collection

Data were retrieved retrospectively from patient medical records, operative notes, and discharge summaries using a structured data extraction form. Patient-related variables included demographic factors such as age, gender, and body mass index (BMI), as well as comorbidities and history of prior abdominal surgery. Disease-related variables included severity of appendicitis (simple, gangrenous, or perforated), presence of abscess, and preoperative laboratory results. Intraoperative findings such as adhesions, unclear anatomy, excessive bleeding, and operative duration were documented. Surgeon-related factors, including level of surgical experience, were also recorded where available.

Outcome Measures

The primary outcome was conversion to laparotomy, defined as the need to switch from laparoscopic to open surgery during appendectomy. Secondary outcomes included postoperative complications, duration of hospital stay, and short-term mortality within 30 days post-surgery.

Data Management

All collected data were anonymized, coded, and stored in a secure electronic database accessible only to the research team. Accuracy of data entry was ensured through double entry and random verification of records. Patient confidentiality was strictly maintained at all stages of the study.

Data Analysis

Descriptive statistics were used to summarize demographic, clinical, and operative data. Continuous variables were presented as means with standard deviations or medians with interquartile ranges, depending on distribution, while categorical variables were presented as frequencies and percentages. Comparative analyses were conducted using chi-square or Fisher's exact tests for categorical variables and t-tests or Mann-Whitney U tests for continuous variables.

Univariate logistic regression was performed to identify potential predictors of conversion. Variables with a significance level of $p < 0.05$ were then entered into a multivariate logistic regression model to determine independent risk factors. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported. A p-value of <0.05 was considered statistically significant. Statistical analysis was conducted using **SPSS version 27**.

Ethical Considerations

Ethical approval was obtained from the relevant Institutional Review Board (IRB) or Ethics Committee prior to the commencement of the study. As this was a retrospective review, individual informed consent was waived. Patient privacy and confidentiality were maintained throughout the study, and all procedures

were conducted in accordance with ethical guidelines, including the principles outlined in the Declaration of Helsinki.

Limitations

As a retrospective study, this research was limited by incomplete or missing data, variability in surgical documentation, and potential selection bias. Surgeon-related decision-making and institutional protocols may also have influenced conversion rates. Despite these limitations, the study design allowed for the collection of valuable information from real-world practice, and robust statistical methods were applied to reduce bias and strengthen the validity of findings.

Results

A total of 250 patients who underwent laparoscopic appendectomy for acute appendicitis were included in the study. Of these, 220 patients (88%) had successful laparoscopic completion, while 30 patients (12%) required conversion to laparotomy.

Table 1. Demographic characteristics of the study population

Variable	Total (n=250)	Laparoscopy completed (n=220)	Converted to laparotomy (n=30)	p-value
Age (years, mean \pm SD)	32.8 \pm 12.4	31.5 \pm 11.7	41.2 \pm 13.5	<0.05
Gender (Male)	150 (60%)	125 (56.8%)	25 (83.3%)	<0.05
BMI > 30 (Obese)	80 (32%)	62 (28.2%)	18 (60%)	<0.01
Prior abdominal surgery	45 (18%)	33 (15%)	12 (40%)	<0.01

Patients who required conversion were significantly older, with a mean age of 41.2 years compared to 31.5 years in the laparoscopic group. Male patients had a higher conversion rate (83.3% vs. 56.8%). Obesity (BMI > 30) and history of prior abdominal surgery were also significantly associated with conversion to laparotomy.

Table 2. Disease-related factors

Variable	Total (n=250)	Laparoscopy completed (n=220)	Converted to laparotomy (n=30)	p-value
Simple appendicitis	140 (56%)	134 (61%)	6 (20%)	<0.01
Gangrenous appendicitis	60 (24%)	48 (21.8%)	12 (40%)	<0.05
Perforated appendicitis	50 (20%)	38 (17.2%)	12 (40%)	<0.01
Abscess formation present	35 (14%)	20 (9.1%)	15 (50%)	<0.001

Disease severity strongly influenced conversion. Patients with simple appendicitis rarely required conversion (only 20%), while those with gangrenous (40%) and perforated appendicitis (40%) had significantly higher conversion rates. Abscess formation was the most predictive disease-related factor, with half of these patients requiring laparotomy.

Table 3. Intraoperative findings

Variable	Total (n=250)	Laparoscopy completed (n=220)	Converted to laparotomy (n=30)	p-value
Dense adhesions	40 (16%)	25 (11.4%)	15 (50%)	<0.001
Unclear anatomy	28 (11.2%)	15 (6.8%)	13 (43.3%)	<0.001

Excessive bleeding	20 (8%)	10 (4.5%)	10 (33.3%)	<0.001
Operative time > 90m	45 (18%)	28 (12.7%)	17 (56.7%)	<0.001

Intraoperative factors were significantly associated with conversion. Dense adhesions were present in half of the converted cases, while unclear anatomy and excessive bleeding were also strong predictors. Operative times longer than 90 minutes were observed in 56.7% of the converted group compared to only 12.7% in the laparoscopic group.

Table 4. Postoperative outcomes

Outcome	Laparoscopy completed (n=220)	Converted to laparotomy (n=30)	p-value
Postoperative complications	15 (6.8%)	8 (26.7%)	<0.01
Mean hospital stay (days)	3.2 ± 1.1	6.5 ± 2.3	<0.001
30-day mortality	1 (0.5%)	1 (3.3%)	ns

Conversion to laparotomy was associated with significantly worse postoperative outcomes. Complications occurred in 26.7% of converted cases versus 6.8% of laparoscopic cases. The mean hospital stay was more than doubled in converted patients (6.5 days vs. 3.2 days). Although 30-day mortality was higher in the converted group, the difference was not statistically significant.

Discussion

The present study evaluated the risk factors associated with conversion from laparoscopic appendectomy to open laparotomy in patients with acute appendicitis. Out of 250 patients, 30 (12%) required conversion, which is consistent with previously reported ranges of 5–15% in similar retrospective analyses (Cherif et al., 2023; Ceylan et al., 2025). Our findings confirm that while laparoscopic appendectomy remains the preferred approach, conversion is still required in a subset of patients, largely due to patient, disease, and intraoperative factors.

Age was identified as a significant predictor of conversion, with converted patients being older on average (41.2 years vs. 31.5 years). This association is supported by the findings of Monrabal Lezama et al. (2022), who noted that advanced age is linked to more complicated intraoperative anatomy and higher rates of adhesions, thereby increasing the likelihood of conversion. Age-related tissue changes and comorbidities may further complicate laparoscopic procedures, leading to a greater need for open surgery.

Gender also emerged as a risk factor, with males representing 83.3% of conversions. Similar observations have been reported in the literature, where male patients often show higher conversion rates compared to females (Azılı et al., 2023). This difference may be attributed to greater omental and visceral fat distribution in males, which complicates visualization during laparoscopy, as well as the increased prevalence of complicated appendicitis in male patients.

Obesity was another significant factor in our study, with 60% of patients requiring conversion having a BMI greater than 30. This aligns with findings from Bancke Laverde et al. (2023), who emphasized that obesity contributes to technical difficulties in trocar placement, reduced visibility, and higher operative times, thereby predisposing to conversion. In our series, operative times longer than 90 minutes were strongly correlated with conversion, confirming the burden of obesity on laparoscopic performance.

A history of prior abdominal surgery also increased the likelihood of conversion, with 40% of converted patients reporting previous procedures. Dense adhesions from prior surgery often hinder dissection and visualization. Pushpanathan et al. (2022) similarly concluded that previous surgical history is a consistent predictor of conversion, reinforcing the importance of detailed surgical history in preoperative assessment and patient counseling.

Disease severity was one of the strongest determinants of conversion. Patients with simple appendicitis rarely required laparotomy (20%), whereas those with gangrenous and perforated appendicitis converted at much higher rates (40% each). This pattern mirrors the results of Sadaf et al. (2025), who found complicated appendicitis to be a leading cause of conversion. The presence of severe inflammation, tissue necrosis, and peritoneal contamination often necessitates open access to allow safer dissection and control of infection. Abscess formation showed the highest predictive value in our cohort, with 50% of these patients requiring conversion. Fayraq et al. (2023) reported similar findings in their cohort, linking abscesses with increased rates of conversion and postoperative infections. Our results confirm that abscesses pose both technical and infectious challenges that frequently require laparotomy for adequate drainage and control.

Intraoperative findings were equally important in predicting conversion. Dense adhesions, unclear anatomy, and excessive bleeding were significantly associated with the need for laparotomy. In particular, adhesions were present in half of the converted cases, echoing the results of Cherif et al. (2023), who identified adhesions as one of the most frequent intraoperative causes of conversion. This underscores the role of real-time surgical decision-making in safeguarding patient safety.

Unclear anatomy was another critical factor, observed in 43.3% of converted cases. According to Schildberg et al. (2025), when anatomical landmarks cannot be safely identified, conversion should be considered a protective measure rather than a failure. Our findings support this perspective, highlighting that conversion is sometimes essential to avoid iatrogenic injuries.

Excessive bleeding was reported in 33.3% of converted cases in this study. This is comparable to the rates described by Azılı et al. (2023), who demonstrated that intraoperative bleeding significantly increases the probability of conversion. Bleeding obscures the field, prolongs operative time, and elevates the risk of vascular or organ injury, making laparotomy a safer alternative in such scenarios.

Postoperative outcomes were clearly worse in patients requiring conversion. Complication rates were significantly higher (26.7% vs. 6.8%), and hospital stay was more than doubled (6.5 days vs. 3.2 days). Similar observations have been made in multiple studies, including Pushpanathan et al. (2022) and Monrabal Lezama et al. (2022), both of which reported higher morbidity and longer recovery times after conversion. These findings highlight the clinical and economic impact of conversion on patients and healthcare systems.

Mortality in our study was low overall, but higher in the converted group (3.3% vs. 0.5%), although the difference was not statistically significant. This pattern is consistent with the study by Sadaf et al. (2025), who found that while conversion increases morbidity, its impact on mortality is less pronounced due to prompt recognition and surgical management. These results suggest that conversion should be viewed as a necessary step to prevent catastrophic outcomes, rather than as an adverse event.

When comparing our findings with global trends, similarities are evident across various populations, indicating that conversion is influenced by common risk factors such as age, obesity, disease severity, and intraoperative complications. However, variability in reported conversion rates across studies (Cherif et al., 2023; Ceylan et al., 2025) suggests that institutional protocols, surgeon experience, and patient demographics can also play significant roles. This underscores the need for multicenter and prospective studies to develop predictive scoring systems for conversion.

From a clinical perspective, our findings emphasize the importance of preoperative risk stratification. Surgeons should pay particular attention to elderly, obese male patients with prior abdominal surgeries and radiological evidence of abscess or perforation. Anticipating conversion in such cases allows better operative planning, resource allocation, and informed consent. As Schildberg et al. (2025) emphasized, conversion should not be considered a surgical failure but rather a prudent decision to ensure patient safety. Finally, our study contributes to the growing body of evidence that risk factors for conversion are multifactorial and interrelated. By validating the significance of patient, disease, and intraoperative variables, this study provides practical guidance for surgeons. Future research should focus on developing predictive models and incorporating imaging and laboratory data to further refine preoperative assessment. Such tools would allow surgeons to counsel patients more effectively and improve surgical outcomes in acute appendicitis.

Conclusion

This study demonstrated that conversion from laparoscopic appendectomy to open laparotomy occurs in a significant minority of cases and is strongly associated with patient-related factors such as advanced age, male gender, obesity, and prior abdominal surgery, as well as disease-related variables including gangrenous or perforated appendicitis and abscess formation. Intraoperative difficulties, particularly dense adhesions, unclear anatomy, and bleeding, further increased the risk of conversion.

Patients who required conversion experienced higher complication rates and longer hospital stays, underscoring the clinical and economic impact of this outcome. These findings highlight the importance of identifying high-risk patients preoperatively and recognizing conversion as a necessary and prudent measure to ensure patient safety.

Recommendations

1. **Preoperative risk stratification:** Surgeons should carefully evaluate patients with advanced age, obesity, prior abdominal surgery, or evidence of complicated appendicitis, as these factors significantly increase the likelihood of conversion.
 2. **Enhanced use of imaging:** Preoperative imaging should be optimized to detect abscesses, perforations, or severe inflammation, allowing surgeons to anticipate intraoperative challenges.
 3. **Informed consent and counseling:** Patients should be counseled about the possibility of conversion to laparotomy, particularly when risk factors are present, to improve transparency and patient satisfaction.
 4. **Surgical training and preparedness:** Surgeons should be adequately trained to manage complex laparoscopic cases and make timely decisions for conversion when safety is at risk.
 5. **Future research:** Prospective multicenter studies should be conducted to develop predictive scoring systems that integrate clinical, radiological, and intraoperative findings to guide decision-making.
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