



INTRAOPERATIVE DETERMINANTS INFLUENCING CONVERSION FROM LAPAROSCOPIC TO OPEN APPENDICECTOMY: A CROSS-SECTIONAL STUDY AT A TERTIARY CARE CENTER

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ABSTRACT

Background: Laparoscopic appendicectomy is the preferred surgical approach for acute appendicitis due to its minimally invasive nature and faster recovery. However, intraoperative challenges may necessitate conversion to open surgery, increasing morbidity and hospital stay. Identifying factors influencing conversion helps optimize surgical planning and outcomes. This study aimed to analyze intraoperative and clinical determinants responsible for conversion of laparoscopic appendicectomy to open appendicectomy. **Methods:** A cross-sectional observational study was conducted on 100 patients aged 18–75 years diagnosed with acute appendicitis and undergoing laparoscopic appendicectomy at a tertiary care hospital between January and December 2022. Demographic, clinical, intraoperative, and postoperative parameters were analyzed. Statistical tests including chi-square and t-test were applied using SPSS software, with significance set at $p < 0.05$. **Results:** Out of 100 patients, 75 (75%) underwent successful laparoscopic appendicectomy, while 25 (25%) required conversion to open surgery. The most common reasons for conversion were perforated appendix (52%), gangrene (24%), and appendicular abscess (24%). Significant predictors included age ≥ 50 years (60%), diabetes mellitus (52%), delayed presentation ≥ 3 days (80%), and dense adhesions (84%). Patients converted to open surgery had longer operative times and higher rates of surgical site infection (9%) compared to laparoscopic cases. **Conclusion:** Conversion from laparoscopic to open appendicectomy is primarily associated with advanced age, diabetes, delayed presentation, and complicated appendicitis. Recognizing these predictors can guide preoperative counseling, optimize patient selection, and improve intraoperative decision-making to minimize conversion rates and enhance outcomes.

KEYWORDS : Laparoscopic Appendicectomy, Conversion, Intraoperative Factors, Acute Appendicitis, Complicated Appendicitis

INTRODUCTION

The appendix was first identified in 1521, and diseases involving the appendix have been recognized as medical issues since 1759. However, it wasn't until 1886 that Reginald Fitz introduced the term "appendicitis" when he described the condition [1]. Today, appendicitis is the most frequent indication for abdominal surgery, carrying a lifetime risk of approximately 7–8%. It predominantly affects younger individuals and shows a slight male bias, with incidence peaking during early adulthood [2]. In the United States, appendicitis represents the most frequent urgent or emergency general surgical procedure, accounting for up to 300,000 hospital admissions each year [2].

Laparoscopic appendicectomy, a minimally invasive surgery, has become the standard procedure for treating acute appendicitis due to its numerous advantages over conventional open appendicectomy, including smaller incisions, reduced postoperative pain, shorter hospital stays, and faster recovery times [3]. However, despite these advantages, certain circumstances necessitate conversion from laparoscopic to open appendicectomy. Several factors can contribute to this conversion, including technical difficulties, intra-abdominal adhesions, obesity, patient comorbidities, and severity of appendicitis. Adhesions from previous surgeries can obscure the appendix, while complicated appendicitis with perforation or abscess formation may challenge laparoscopic completion [4]. The incidence of conversion varies widely, ranging from 1% to 20% of cases, influenced by surgical techniques, patient populations, and surgeon experience [5].

This study aims to systematically analyze the intraoperative factors that contribute to the conversion of laparoscopic appendicectomy to open appendicectomy, providing valuable insights to guide surgeons in making informed decisions and developing strategies to reduce conversion rates and improve patient outcomes.

MATERIALS AND METHODS

The present study was an observational, cross-sectional analysis conducted to evaluate factors contributing to the conversion of laparoscopic appendicectomy to open appendicectomy. The design enabled systematic evaluation of preoperative, intraoperative, and postoperative parameters in real-world hospital settings to identify determinants influencing surgical outcomes and conversion rates.

Study Setting and Duration

The study was carried out in the Department of Surgery at a tertiary care hospital equipped with advanced laparoscopic facilities and experienced surgeons. Data were collected retrospectively and prospectively from both inpatient and outpatient records over one year (January–December 2022), ensuring adequate sample size and seasonal variation representation.

Participants

Inclusion Criteria

- Patients (18–75 years) diagnosed with acute appendicitis undergoing laparoscopic appendicectomy.
- Both genders included.
- Provided written informed consent.
- Laparoscopic approach as the primary procedure.

Exclusion Criteria

- Prior major abdominal surgery with adhesions.
- Appendicular lump cases managed conservatively.
- Age < 18 or > 75 years.
- Conditions requiring upfront open appendicectomy.
- Unable or unwilling to give consent.

These criteria ensured the inclusion of patients suitable for laparoscopic procedures while minimizing confounding factors.

Sampling and Sample Size

A non-probability purposive sampling technique was used. Based on an estimated annual volume of 200 appendicectomies, a sample of 125 patients was selected—100 undergoing successful laparoscopic appendicectomy and 25 requiring conversion to open surgery. The sample size provided 80% power to detect significant associations between patient and surgical factors with conversion rates.

Study Groups and Parameters

Patients were categorized into two groups—those with successful laparoscopic appendicectomy and those converted to open procedures. Data were collected on demographics (age, gender, BMI), preoperative factors (clinical severity, imaging), intraoperative findings (adhesions, bleeding, technical difficulty), postoperative outcomes (hospital stay, complications), conversion reasons, and surgeon experience.

Data Collection and Analysis

Data were obtained from medical records and direct observation. Retrospective cases provided historical data trends, while prospective cases offered real-time intraoperative and postoperative insights. Statistical analysis was performed using SPSS software. Descriptive statistics summarized variables, while chi-square and t-tests identified associations. Multivariate logistic regression determined independent predictors of conversion, with significance set at $p < 0.05$.

Ethical Considerations

Institutional Review Board approval was obtained (Reference Number: CUSMC/IEC(HR)/DI/55/2023/FinalApproval/305/2023), and informed consent was secured from all participants. Confidentiality was maintained by anonymizing patient data. The study adhered to ethical principles of beneficence, non-maleficence, and justice. Findings aimed to enhance clinical decision-making and reduce conversion rates, contributing to improved surgical safety and patient outcomes.

RESULTS AND OBSERVATIONS

Table 1 shows majority of patients were in the 30–39 year age group (36%), indicating appendicitis predominantly affects young adults. Male-to-female ratio was nearly equal (1.1:1). Most patients (65%) had no comorbid conditions, though diabetes (17%) and hypertension (12%) were significant among those converted to open surgery in later tables.

Table 1. Age, Gender Distribution, and Comorbidities (n = 100)

Variable	No. of Patients	Percentage (%)
Age Group (years)		
20–29	26	26%
30–39	36	36%
40–49	22	22%
50–59	15	15%
60–69	1	1%
Gender		
Male	53	53%
Female	47	47%
Comorbidities		
None	65	65%
Diabetes Mellitus	17	17%
Hypertension	12	12%
Cardiovascular Disease	6	6%

Most patients presented within 24 hours (54%) and had classical symptoms of acute appendicitis—RLQ pain (87%) and tenderness (91%). Elevated temperature and leukocytosis ($\geq 11,000$ in 81%) were common, supporting active inflammatory pathology. Delayed presentations (≥ 3 days) correlated strongly with conversion to open surgery. (Table 2)

Table 2. Clinical Presentation and Laboratory Findings (n = 100)

Parameter	No. of Patients	Percentage (%)
Duration of Symptoms		
1 Day	54	54%
2 Days	15	15%
3 Days	16	16%
≥ 4 Days	15	15%
Presenting Symptoms		
RLQ Pain	87	87%
Periumbilical Pain	7	7%
Generalized Pain	6	6%
Nausea/Vomiting	27	27%
Anorexia	56	56%
Fever	41	41%
Clinical Signs		
RLQ Tenderness	91	91%
Rebound Tenderness	51	51%
Migration of Pain	44	44%
Laboratory Findings		
Temperature $\geq 37^{\circ}\text{C}$	78	78%
WBC $\geq 11,000/\text{mm}^3$	81	81%
Mean WBC ($\times 10^3/\mu\text{L}$)	—	12.73 ± 2.27
Mean CRP (mg/dL)	—	18.11 ± 4.77

Laparoscopic appendicectomy was successfully completed in 75% of patients, while 25% required conversion. The predominant cause of conversion was perforation (52%), often complicated by dense adhesions (84%). Postoperative outcomes were generally favorable, though SSI (9%) and prolonged pain (11%) were more frequent in converted cases. (Table 3)

Table 3. Operative and Postoperative Details (n = 100)

Parameter	Mean $\pm$ SD / n (%)
Mean Operative Time (min)	65.9 ± 28.2
Mean Recovery Time (days)	3.44 ± 1.41
Surgical Approach	
Completed Laparoscopic Appendicectomy	75 (75%)
Converted to Open Appendicectomy	25 (25%)
Primary Reason for Conversion (n=25)	
Perforated Appendix	13 (52%)
Gangrenous Appendix	6 (24%)
Appendicular Abscess	6 (24%)
Intraoperative Findings (Converted cases)	
Dense Adhesions	21 (84%)
Technical Difficulty	4 (16%)
Postoperative Complications	
None	80 (80%)
Prolonged Pain	11 (11%)
Surgical Site Infection (SSI)	9 (9%)

Conversion to open appendicectomy was significantly associated with older age, diabetes, delayed presentation, and complicated findings on ultrasound. All patients (100%) with preoperative imaging evidence of perforation, lump, or abscess required conversion. These variables highlight the importance of early diagnosis and careful case selection for laparoscopic procedures. (Table 4)

Table 4. Factors Associated with Conversion to Open Appendicectomy

Variable	Completed Laparoscopy (n=75)	Converted to Open (n=25)
Age ≥ 50 years	1 (1.3%)	15 (60%)
Diabetes Mellitus	4 (5.3%)	13 (52%)
Hypertension	5 (6.7%)	7 (28%)
Duration ≥ 3 days	9 (12%)	20 (80%)
Temperature $\geq 37^{\circ}\text{C}$	55 (73.3%)	23 (92%)
WBC $\geq 11,000/\text{mm}^3$	61 (81.3%)	20 (80%)

Ultrasound showing complicated appendicitis	0 (0%)	25 (100%)
Mantrel's Score ≥ 7	47 (62.7%)	18 (72%)

DISCUSSION

This study demonstrates a clear age-related pattern in appendicitis presentation, with peak incidence in the 30-39 years age group (36%), consistent with established epidemiological data [6]. The slight male predominance (53% vs 47%) aligns with the reported male-to-female ratio of 1.4:1 [6]. Younger patients (20-39 years) had higher rates of successful laparoscopic completion, while older patients (50-59 years) showed substantially higher conversion rates (56%), supporting previous studies identifying advanced age as an independent predictor of conversion [7].

Symptom duration emerged as a critical factor determining surgical approach. Patients presenting within 24 hours had significantly higher rates of successful laparoscopic completion (72%), while those with prolonged symptoms (3-4 days) showed conversion rates of 40-48%. This finding aligns with literature demonstrating that delayed presentation increases perforation risk in a linear fashion [8], making laparoscopic approach more challenging. Right lower quadrant pain (87%) and tenderness (91%) were predominant presentations, while pain migration occurred in only 44%, indicating variable appendicitis presentations [9].

Ultrasound findings strongly predicted surgical approach. All patients with successful laparoscopic appendectomy had uncomplicated acute appendicitis on imaging, while conversions to open surgery showed complicated findings: perforated appendicitis (52%), appendicitis with lump (28%), and collection (20%). This strong association between imaging findings and surgical approach has been previously documented [10].

The conversion rate of 25% was higher than reported rates of 2-7% in recent literature [7,11], possibly reflecting institutional factors or patient complexity. Advanced age, comorbidities, and complicated appendicitis were significant risk factors for conversion. Patients with no comorbidities had high laparoscopic success rates (86.67%), while those with diabetes (52%), hypertension (28%), and cardiovascular disease (20%) had significantly higher conversion rates, consistent with literature identifying comorbidities as independent predictors [12].

Postoperative complications were significantly lower with laparoscopic approach (16% vs 32%), particularly surgical site infections (4% vs 24%), aligning with established literature showing reduced infection rates with laparoscopic technique [13]. The identification of preoperative risk factors for conversion can guide surgical decision-making and patient counseling [14,15].

Limitations

This retrospective single-center study has inherent selection bias and limited generalizability across different healthcare settings and populations. The modest sample size restricted statistical power for detecting subtle associations between risk factors and outcomes. The 25% conversion rate exceeded reported literature standards, possibly reflecting institutional factors or learning curve effects. Short-term postoperative assessment excluded evaluation of long-term complications and quality-of-life measures.

Future Directions

Future prospective multicenter trials with standardized protocols are essential to validate findings across diverse populations and healthcare settings. Development of preoperative risk stratification tools incorporating age,

comorbidities, symptom duration, and imaging findings could optimize surgical planning and patient counseling. Cost-effectiveness analyses, standardized surgical protocols, structured training programs, and artificial intelligence-assisted imaging modalities should be investigated to reduce conversion rates and improve patient outcomes.

CONCLUSION

Laparoscopic appendectomy remains the preferred approach for acute appendicitis; however, conversion to open surgery is more likely in patients with advanced age, delayed presentation, diabetes, or complicated appendicitis. Intraoperative factors such as dense adhesions and perforation were key contributors. Early diagnosis, proper patient selection, and improved surgical expertise can significantly reduce conversion rates and enhance postoperative outcomes.

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