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Predictors for Conversion to Open Appendicectomy in Patients Undergoing Laparoscopic Appendicectomy for Acute Appendicitis

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A B S T R A C T

Background: Laparoscopic appendicectomy (LA) is widely preferred for acute appendicitis due to reduced postoperative pain, faster recovery, and lower wound infection rates. However, conversion to open appendicectomy (OA) may occur due to intraoperative challenges. Identifying preoperative predictors of conversion could optimize surgical planning and patient outcomes.

Objective: This study aimed to identify preoperative factors predicting conversion from LA to OA in patients with acute appendicitis.

Methods: A prospective study was conducted at SS Institute of Medical Sciences and Hospital, Davangere, from January 2023 to December 2024. Sixty patients undergoing LA were evaluated. Parameters including age, sex, comorbidities, ASA grading, Tzanaki's score, leukocyte count, and ultrasound findings were analyzed. Conversion rates and associated factors were assessed using chi-square tests, with significance set at $p<0.05$.

Results: Of 60 patients, 12 (20%) required conversion to OA. Significant predictors included age ≥40 years (66.67% conversion, p=0.0001), comorbidities (90.90% conversion, p=0.0001), ASA grade >2 (88.89% conversion, p=0.001), Tzanaki's score ≤9 (52.38% conversion, p=0.02), and leukocyte count >12,000/mm³ (36% conversion, p=0.02). Sex showed no significant association (p=0.95).

Conclusion: Preoperative factors such as advanced age, comorbidities, higher ASA grade, lower Tzanaki's score, and leukocytosis reliably predict conversion to OA. These findings suggest a preoperative scoring system could guide surgical approach selection, reducing operative time and costs.

Keywords: Laparoscopic appendicectomy, open appendicectomy, conversion predictors, acute appendicitis, preoperative criteria, Tzanaki's score.

INTRODUCTION

Acute appendicitis remains a leading cause of acute abdominal pain, necessitating emergency surgery worldwide. Its incidence ranges from 7-12% in Western populations, with appendicectomy being the standard treatment [1]. Historically performed as an open procedure, appendicectomy has evolved with the advent of minimally invasive techniques. Laparoscopic appendicectomy (LA), introduced in 1983 by Semm, has gained widespread acceptance due to its advantages over open appendicectomy (OA), including reduced postoperative pain, shorter hospital stays, lower wound infection rates, and improved cosmetic outcomes [2]. Studies report wound infection rates dropping from 10-15% in OA to 2-5% in LA, alongside a reduction in hospital stay by 1-2 days [3,4].

Despite these benefits, LA is not universally successful. Conversion to OA occurs in 5-20% of cases, driven by intraoperative complications or disease severity that precludes safe laparoscopic completion [5]. Conversion negates the advantages of minimal access surgery, increases operative time, and elevates healthcare costs. Common reasons for conversion include abnormal appendix position, adhesions from prior inflammation, appendicular mass, abscess,

perforation, diffuse peritonitis, or technical difficulties such as inadequate dissection space [6]. A meta-analysis by Zhang et al. reported a conversion rate of 8.6%, with perforated appendicitis and adhesions as leading causes [7].

Identifying preoperative predictors of conversion is critical to optimize surgical planning. Previous studies have highlighted factors such as age, comorbidities, and inflammatory markers, yet consensus remains elusive due to variability in study populations and methodologies [8]. For instance, Ricci et al. found age >50 years and ASA grade >2 as significant predictors ($p<0.01$), with a conversion rate of 12.3% in a cohort of 500 patients [9]. Similarly, Wagner et al. identified leukocytosis (>15,000/mm³) and peritonitis as risk factors ($p<0.05$) in a retrospective analysis of 300 cases [10]. These findings underscore the need for a standardized preoperative assessment tool.

Acute appendicitis diagnosis relies on clinical evaluation, laboratory investigations, and imaging. The Tzanaki's score, incorporating right iliac fossa (RIF) tenderness (4 points), rebound tenderness (3 points), leukocyte count >12,000/mm³ (2 points), and ultrasound evidence of appendicitis (6 points), offers a diagnostic accuracy of 85-90% for scores ≥10 [11]. However, its role in predicting surgical outcomes, such as conversion, is underexplored. The American Society of Anesthesiologists (ASA) grading system, which assesses patient fitness for surgery, also correlates with perioperative risks. Patients with ASA grade >2 face higher complication rates, including conversion, due to systemic disease burden [12].

In India, where healthcare resources vary widely, optimizing surgical approaches is paramount. Laparoscopy requires specialized equipment and expertise, which may not be universally available. Conversion to OA in such settings increases operative time by 20-30 minutes and costs by approximately 15-20% [13]. A preoperative decision-making framework could mitigate these challenges by identifying patients better suited for primary OA, avoiding the dual burden of laparoscopy followed by conversion.

This study builds on prior research by prospectively analyzing a cohort of 60 patients undergoing LA at a tertiary care center in South India. Unlike retrospective studies, our prospective design allowed real-time data collection on clinical, laboratory, and intraoperative parameters. We evaluated age, sex, comorbidities, previous abdominal surgeries, ASA grading, Tzanaki's score, leukocyte count, and ultrasound findings as potential predictors. Our hypothesis was that a combination of these factors could form a reliable preoperative criterion to predict conversion risk, enabling surgeons to tailor the operative approach.

The broader implications of this research align with global trends in personalized medicine. By reducing conversion rates, we aim to enhance patient outcomes, decrease recovery time, and lower healthcare costs. Comparative studies, such as Garg et al.'s analysis of complicated appendicitis (conversion rate 18%, $p<0.05$ for perforation), highlight the feasibility of this approach [14]. Similarly, Antonacci et al. emphasized preoperative ultrasound in predicting conversion, with a sensitivity of 78% for detecting adhesions [15]. Integrating these insights, our study seeks to establish a practical, evidence-based tool for surgical decision-making in acute appendicitis.

AIMS

The objective of this study was to identify preoperative predictors of conversion from laparoscopic appendicectomy (LA) to open appendicectomy (OA) in patients with acute appendicitis and to develop a preoperative criterion to guide the selection of the optimal surgical approach.

MATERIALS AND METHODS

This prospective study was conducted in the Department of General Surgery at SS Institute of Medical Sciences and Hospital, Davangere, India, from January 2023 to December 2024. Ethical approval was obtained from the institutional review board, and informed consent was secured from all participants.

Study Population and Sample Size

A total of 60 patients diagnosed with acute appendicitis and scheduled for laparoscopic appendicectomy (LA) were enrolled. The sample size was determined based on the expected conversion rate of 15-20%, derived from prior studies [5,9], with a 95% confidence level and 10% margin of error. Patients were selected consecutively based on presentation to the emergency department.

Inclusion and Exclusion Criteria

Inclusion criteria included patients aged >10 years with a clinical diagnosis of acute appendicitis confirmed by history, physical examination, laboratory investigations, and ultrasound of the abdomen and pelvis. Exclusion criteria encompassed patients with contraindications to laparoscopy (e.g., severe cardiopulmonary disease), those opting for primary open appendicectomy (OA), pregnant women, and individuals unable to provide consent.

Study Design and Data Collection
A prospective cohort design was employed. Patients underwent a standardized preoperative assessment, including detailed history (symptoms, duration, prior appendicitis, or abdominal surgeries), clinical examination (right iliac fossa [RIF] tenderness, rebound tenderness), laboratory tests (white blood cell [WBC] count), and ultrasound imaging. The Tzanaki's score was calculated for each patient based on RIF tenderness (4 points), rebound tenderness (3 points), WBC >12,000/mm³ (2 points), and ultrasound evidence of appendicitis (6 points). The American Society of Anesthesiologists (ASA) grading was assigned by the anesthesiologist to assess operative risk.

Surgical Procedure
Laparoscopic appendicectomy was performed by experienced surgeons using a three-port technique under general anesthesia. Conversion to OA was decided intraoperatively by the primary surgeon based on complications such as abnormal appendix position, adhesions, appendicular mass/abscess, perforation, diffuse peritonitis, or technical difficulties (e.g., lack of dissection space). Intraoperative findings were documented meticulously.

Parameters Studied
Data collected included age, sex, comorbidities (e.g., diabetes, hypertension), history of prior abdominal surgeries, symptom duration, clinical signs, WBC count, ultrasound findings (e.g., appendiceal diameter, pericecal fluid), ASA grade, Tzanaki's score, and intraoperative findings. These parameters were analyzed to identify predictors of conversion.

Statistical Analysis
Data were entered into a spreadsheet and analyzed using SPSS version 25. Categorical variables (e.g., age group, sex, ASA grade) were expressed as frequencies and percentages. The association between preoperative factors and conversion to OA was assessed using the chi-square test or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS
Of the 60 patients who underwent LA, 12 (20%) required conversion to OA. The mean age was 34.2 years (range: 10-65 years), with 38 males (63.3%) and 22 females (36.7%). Detailed results are presented in five tables.

Table 1: Patient Demographics and Conversion Rates

Variable	Total Patients (n=60)	Converted to OA (n=12)	P-value
Age <40 years	41 (68.3%)	4 (9.8%)	0.300
Age ≥40 years	19 (31.7%)	8 (42.1%)	0.0001
Male	38 (63.3%)	8 (21.1%)	0.946
Female	22 (36.7%)	4 (18.2%)	0.946

Patients aged ≥40 years had a significantly higher conversion rate (42.1%) compared to those <40 years (9.8%), with a p-value of 0.0001. Sex showed no significant association with conversion (p=0.946).

Table 2: Comorbidities and Conversion

Comorbidities	Total Patients (n=60)	Converted to OA (n=12)	P-value
Present	11 (18.3%)	10 (90.9%)	0.0001
Absent	49 (81.7%)	2 (4.1%)	0.980

Among 11 patients with comorbidities, 10 (90.9%) required conversion, demonstrating a strong association (p=0.0001).

Table 3: ASA Grading and Conversion

ASA Grade	Total Patients (n=60)	Converted to OA (n=12)	P-value
Grade 1	51 (85.0%)	4 (7.8%)	0.940
Grade >2	9 (15.0%)	8 (88.9%)	0.001

Patients with ASA grade >2 had a significantly higher conversion rate (88.9%) compared to those with grade 1 (7.8%), with p=0.001.

Table 4: Tzanaki's Score and Conversion

Tzanaki's Score	Total Patients (n=60)	Converted to OA (n=12)	P-value
≤9	21 (35.0%)	11 (52.4%)	0.020
≥10	39 (65.0%)	1 (2.6%)	0.740

A Tzanaki's score ≤9 was associated with a 52.4% conversion rate, significantly higher than the 2.6% rate for scores ≥10 (p=0.020).

Table 5: Leukocyte Count and Conversion

WBC Count	Total Patients (n=60)	Converted to OA (n=12)	P-value
≤12,000/mm³	35 (58.3%)	3 (8.6%)	0.860
>12,000/mm³	25 (41.7%)	9 (36.0%)	0.021

Leukocytosis (>12,000/mm³) was observed in 25 patients, with 9 (36.0%) requiring conversion (p=0.021), compared to 8.6% in those with normal counts.

Intraoperative findings contributing to conversion included adhesions (6 cases), perforated appendix (4 cases), and abnormal appendix position (2 cases). The mean operative time increased from 45 minutes for LA to 70 minutes when conversion occurred.

DISCUSSION

This study identified several preoperative predictors of conversion from LA to OA, including age ≥40 years, comorbidities, ASA grade >2, Tzanaki's score ≤9, and leukocytosis (>12,000/mm³). These findings align with and expand upon existing literature, offering a framework for preoperative risk stratification.

The 20% conversion rate in our cohort is consistent with reported ranges of 5-20% [5]. Advanced age (≥40 years) emerged as a significant predictor (p=0.0001), corroborating Ricci et al.'s findings, where patients >50 years had a 12.3% conversion rate (p<0.01) due to increased adhesions and comorbidities [9]. Our higher threshold (≥40 years) may reflect a younger population with earlier onset of complicating factors in India.

Comorbidities strongly predicted conversion (90.9%, p=0.0001), echoing Wagner et al.'s study, which reported a 15% conversion rate in patients with diabetes or hypertension (p<0.05) [10]. Systemic diseases likely exacerbate inflammation and adhesion formation, complicating laparoscopy. Similarly, ASA grade >2 was a robust predictor (88.9%, p=0.001), aligning with Antonacci et al.'s observation of a 14% conversion rate in ASA >2 patients (p<0.01) [15]. This reflects the impact of systemic disease on surgical tolerance.

Tzanaki's score ≤9 predicted a 52.4% conversion rate (p=0.020), a novel finding. While typically a diagnostic tool, its inverse relationship with conversion suggests that less definitive preoperative signs (lower scores) may mask severe intraoperative pathology, such as perforation (52% in Garg et al.'s cohort, p<0.05) [14]. Conversely, scores ≥10 correlated with straightforward LA (2.6% conversion), indicating milder disease.

Leukocytosis (>12,000/mm³) increased conversion risk (36%, p=0.021), consistent with Suresh Kumar et al.'s report of 30% conversion in patients with WBC >15,000/mm³ (p<0.05) [6]. Elevated WBC likely signals advanced inflammation or perforation, complicating laparoscopic dissection.

Unlike some studies (e.g., Manuneethimaran et al., 25% conversion in males, p<0.05) [4], sex showed no association (p=0.946), suggesting its limited predictive value. Ultrasound findings, though not quantified statistically due to data constraints, supported conversion in cases of adhesions and perforation, aligning with Antonacci et al.'s 78% sensitivity for preoperative imaging [15].

Our results propose a preoperative scoring system integrating age, comorbidities, ASA grade, Tzanaki's score, and WBC count. Patients with multiple risk factors (e.g., age ≥40, ASA >2, Tzanaki's ≤9) could bypass LA for primary OA, reducing operative time by 20-30 minutes and costs by 15-20% [13]. This contrasts with blanket LA adoption, offering a tailored approach validated by prospective data.

CONCLUSION

This study identified preoperative predictors of conversion from LA to OA, including age ≥40 years, comorbidities, ASA grade >2, Tzanaki's score ≤9, and leukocytosis (>12,000/mm³). These factors, detectable before surgery, enable the development of a criterion to select the optimal operative approach for acute appendicitis. By proceeding directly to OA in high-risk cases, surgeons can minimize conversion-related delays, costs, and complications, enhancing patient outcomes. Future multicenter studies should validate this framework across diverse populations.

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