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Original Research Article

Post-Appendectomy Complications: Incidence, Spectrum, and Determinants in a Retrospective Cohort

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Abstract

Background: Appendectomy remains a common emergency operation, yet postoperative morbidity continues to affect recovery, resource use, and unplanned readmission. Infectious and gastrointestinal complications remain particularly relevant after advanced disease. This study quantified the incidence and spectrum of 30-day post-appendectomy complications and examined clinical factors associated with adverse outcomes in an internally consistent simulated cohort.

Methods: We conducted a retrospective study of 612 adults who had emergency appendectomy between December 2022 and December 2025. We modeled demographic, inflammatory, operative, and 30-day outcome variables in a manner that was contemporary. Complications were described descriptively and associations were analyzed with non-parametric or exact methods. The prespecified multivariable logistic regression model included age, diabetes mellitus, ASA class ≥III, C-reactive protein (CRP), complicated appendicitis, and laparoscopic approach.

Results: At least 56 patients (9.2%) had at least one complication. In 18 patients (2.9%), in 15 patients (2.5%) abdominal abscess was found and 16 patients had postoperative ileus (2.6%). Complicated appendicitis was present in 149 patients (24.3%) and significantly greater morbidity than uncomplicated disease (28.2% vs. 3.0%, $p<0.001$). On average, patients with complications had a higher median CRP (93.6 vs. 47.4 mg/L), significantly more time under surgical control (86.2 vs. 61.9 minutes) and a longer postoperative period (5.0 vs. 1.8 days; all $p<0.001$). Further, complicated appendicitis (aOR 8.42, 95% CI 3.39-20.92), diabetes mellitus (aOR 2.89, 95% CI 1.39-6.01) and ASA class ≥III (aOR 2.23, 95% CI 1.05-4.74) also predicted morbidity independently. Laparoscopy is not independently associated with complications (aOR 0.99, $p=0.975$).

Conclusion: Post-appendectomy morbidity in this simulated cohort was concentrated among patients with complicated disease, diabetes, and reduced physiological reserve. The findings illustrate how risk-adjusted analysis can distinguish disease- and host-related determinants from the apparent effects of operative approach.

Keywords: Acute Appendicitis; Appendectomy; Postoperative Complications; Surgical-Site Infection; Intra-Abdominal Abscess; Risk Factors.

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Introduction

Acute appendicitis is among the most frequent abdominal emergencies requiring immediate surgical treatment and is one of the main contributors to emergency operative workload. Its incidence varies on a geographic level, but population-based evidence indicates that in many parts of the world it is more than 100 cases per 100,000 person-years [1]. The current state of the art considers appendicitis to be a heterogeneous disease and not a linear disease: uncomplicated inflammation is probably not the same as gangrenous or perforated disease and this distinction is very important to how it is treated and where those people go to take care of the source; the postoperative risk is very high [2]. In some cases, uncomplicated disease might be treated non-operatively but for most adults the appendectomy remains effective when complicated appendicitis, diffuse peritonitis, obstruction, or treatment failure are seen [3]. Laparoscopy has changed the complication profile after appendectomy. Randomized studies have seen fewer wound infections, less pain in the postoperative period, and better functional recovery following laparoscopies compared to open appendectomy, though earlier studies reported organ-space infection in perforated disease [4]. There is a growing body of evidence on surgical-site infection (SSI) worldwide and that infection rates vary by operative access and healthcare setting [5]. Large observational studies have also indicated lower incisional morbidity and shorter hospitalization with minimally invasive surgery [6]. However, adverse effects postoperatively did not disappear. SSI, intra-abdominal abscess (IAA), ileus, bleeding, pulmonary and urinary complications, readmission, and reintervention can significantly increase antibiotic exposure, imaging, length of stay, and cost [7].

Residual morbidity seems to be influenced strongly by disease severity and host vulnerability. Complex or perforated appendicitis is associated with bacterial contamination, inflammatory load and technical difficulty and multicenter evidence has indicated that complex appendicitis is one of the main predictors of postoperative SSI [8]. Diabetes, impaired physiological reserve, elevated inflammatory markers and long or difficult operations may enhance risk by diminishing host defense or being markers of advanced disease. These relationships also explain why crude comparisons of open and laparoscopic appendectomy are misleading; surgeons may prefer to perform an open surgery if the patient has more severe pathology, contamination or anatomical difficulty. Therefore, risk-adjusted analyses are required before attributing postoperative morbidity to surgical approach alone. As such, postoperative risk models should incorporate biological severity and baseline physiological vulnerability instead of only procedural labels or unadjusted event rates.

In addition, post-appendectomy complications can be important even if their frequency is small. Wound infection may delay return to normal activity, IAA can require cross-sectional imaging and percutaneous drainage, and ileus or bleeding can prolong hospitalization or require reintervention. Institutional complication profiles may also depend on referral patterns, antimicrobial protocols, operating experience, and complexity of complicated appendicitis. Local estimates will therefore be valuable for audit, discharge planning, antimicrobial stewardship, and targeted follow-up and can serve as a benchmark for improvement of quality of care as well. Therefore, this article was designed as a journal-style example based on the use of simulated patient-level data. It aimed to estimate the 30-day incidence and spectrum of complications, compare patients with and without postoperative morbidity, and identify independent predictors while examining the relative contributions of disease severity, host factors, inflammatory burden, and operative approach.

Materials and Methods

Study design, setting, and duration: A retrospective observational cohort design was used for this manuscript. A synthetic patient-level dataset was generated to represent consecutive adult appendectomies performed at a tertiary teaching hospital.

Participants and eligibility: Adults aged 18 years or older who had undergone emergency appendectomy for acute appendicitis were included. Patients who had undergone incidental appendectomy during another operation, elective interval appendectomy after previous non-operative treatment, or appendectomy for a known appendiceal neoplasm were excluded conceptually from the simulated source cohort. Records with insufficient 30-day outcome information were also considered ineligible. The final simulated analytic cohort contained 612 patients.

Variables and outcome definitions: Demographic variables, body mass index, diabetes mellitus, American Society of Anesthesiologists (ASA) physical-status class, symptom duration, leukocyte count, CRP, operative approach, operative duration, drain placement, length of stay, readmission, reoperation, and mortality were recorded. Complicated appendicitis was defined as gangrenous or perforated appendicitis and/or appendicitis associated with periappendiceal abscess or peritonitis.

The primary outcome was any postoperative complication occurring within 30 days. Prespecified complications included superficial or deep incisional SSI, organ-space infection/IAA, postoperative ileus, clinically relevant hemorrhage, pulmonary or urinary complications, and other documented postoperative morbidity. Major morbidity corresponded conceptually to Clavien-Dindo grade III or higher and therefore required invasive intervention, intensive-care management, or resulted in death.

Statistical analysis: Continuous data were summarized using means with standard deviations or medians with interquartile ranges according to distribution. Categorical variables were summarized as counts and percentages. Between-group comparisons were performed using the Mann-Whitney U test for continuous variables and Fisher's exact test for binary categorical variables. A prespecified multivariable binary logistic-regression model was fitted for any 30-day complication and included age per 10-year increase, diabetes mellitus, ASA class ≥III, CRP per 50-mg/L increase, complicated appendicitis, and laparoscopic approach. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were calculated. Statistical significance was defined by a two-sided p value <0.05. Analyses were conducted using Python with SciPy and statsmodels statistical libraries.

Results

The analytic cohort comprised 612 adult patients, of whom 354 (57.8%) were male. Mean age was 37.4 ± 13.3 years and mean body mass index was 25.7 ± 4.3 kg/m². Diabetes mellitus was present in 100 patients (16.3%), and 108 (17.6%) had ASA class ≥III. Complicated appendicitis occurred in 149 patients (24.3%). Laparoscopic appendectomy was performed in 518 cases (84.6%), while 94 (15.4%) underwent an open procedure.

Overall, 56 patients (9.2%) experienced at least one postoperative complication within 30 days. SSI was the most frequent individual complication (2.9%), followed by postoperative ileus (2.6%) and IAA (2.5%). Major morbidity occurred in 11 patients (1.8%), 24 (3.9%) were readmitted within 30 days, 5 (0.8%) required reoperation, and one patient (0.2%) died. The simulated complication profile therefore reflected predominantly infectious and gastrointestinal morbidity, with severe events accounting for a smaller proportion of the overall postoperative burden. Marked case-mix differences were evident between outcome groups. Complicated appendicitis was present in 42 of 56 patients with postoperative morbidity (75.0%) compared with 107 of 556 patients without morbidity (19.2%; p<0.001). Diabetes mellitus (41.1% vs 13.8%, p<0.001) and ASA class ≥III (35.7% vs 15.8%, p<0.001) were also overrepresented in the complication group. Median CRP was 93.6 mg/L among patients with complications and 47.4 mg/L among those without complications (p<0.001), while median leukocyte count was higher at 15.9 versus 13.2 $\times 10^9$/L (p<0.001).

Operative complexity closely paralleled postoperative outcome. Median operative duration was 86.2 minutes in the complication group compared with 61.9 minutes in the uncomplicated group (p<0.001), and drain placement occurred in 35.7% versus 8.8% (p<0.001). Unadjusted morbidity was higher after open than laparoscopic appendectomy (16.0% vs 7.9%, p=0.019). However, this association disappeared after risk adjustment: laparoscopic access had an aOR of 0.99 (95% CI 0.46–2.12; p=0.975). In contrast, complicated appendicitis remained the strongest independent predictor (aOR 8.42), followed by diabetes mellitus (aOR 2.89) and ASA class ≥III (aOR 2.23).

Table 1: Baseline demographic and clinical characteristics by 30-day postoperative outcome

Variable	No complication (n=556)	Complication (n=56)	p value
Age, years, mean ± SD	36.9 ± 13.3	41.7 ± 12.8	0.006
Male sex, n (%)	319 (57.4)	35 (62.5)	0.482
BMI, kg/m², mean ± SD	25.7 ± 4.3	26.0 ± 4.3	0.532
Diabetes mellitus, n (%)	77 (13.8)	23 (41.1)	<0.001
ASA class ≥III, n (%)	88 (15.8)	20 (35.7)	<0.001
Symptom duration, h, median (IQR)	17.9 (11.8–28.8)	22.2 (15.3–34.4)	0.026
WBC, $\times 10^9$/L, median (IQR)	13.2 (11.0–15.3)	15.9 (12.9–17.6)	<0.001
CRP, mg/L, median (IQR)	47.4 (30.7–78.3)	93.6 (73.6–105.1)	<0.001
Complicated appendicitis, n (%)	107 (19.2)	42 (75.0)	<0.001

Patients who developed postoperative morbidity had a distinctly higher-risk preoperative profile. Complicated appendicitis, diabetes, ASA class ≥III, leukocytosis, and elevated CRP were all concentrated in the complication group, whereas sex and body mass index showed little separation. The magnitude of the CRP and disease-severity differences suggests that postoperative risk was driven primarily by inflammatory burden and host reserve rather than demographic characteristics alone. These variables therefore provided clinically plausible candidates for adjusted risk modeling.

Table 2: Incidence and severity of 30-day postoperative complications

Outcome	n	Incidence, %
Any postoperative complication	56	9.2
Surgical-site infection	18	2.9
Intra-abdominal abscess	15	2.5
Postoperative ileus	16	2.6
Hemorrhage	3	0.5
Pulmonary or urinary complication	1	0.2
Other complication	3	0.5

Major morbidity (Clavien-Dindo ≥III)	11	1.8
30-day readmission	24	3.9
Reoperation	5	0.8
Mortality	1	0.2

The complication spectrum was dominated by infectious and gastrointestinal events. Surgical-site infection, intra-abdominal abscess, and ileus together accounted for most observed morbidity, whereas hemorrhage, pulmonary or urinary events, and other complications were uncommon. Although only 1.8% of the full cohort experienced major morbidity, the 3.9% readmission rate demonstrates that postoperative burden extended beyond the index hospitalization.

Reporting both frequency and severity avoids understating the clinical consequences of relatively infrequent but resource-intensive events.

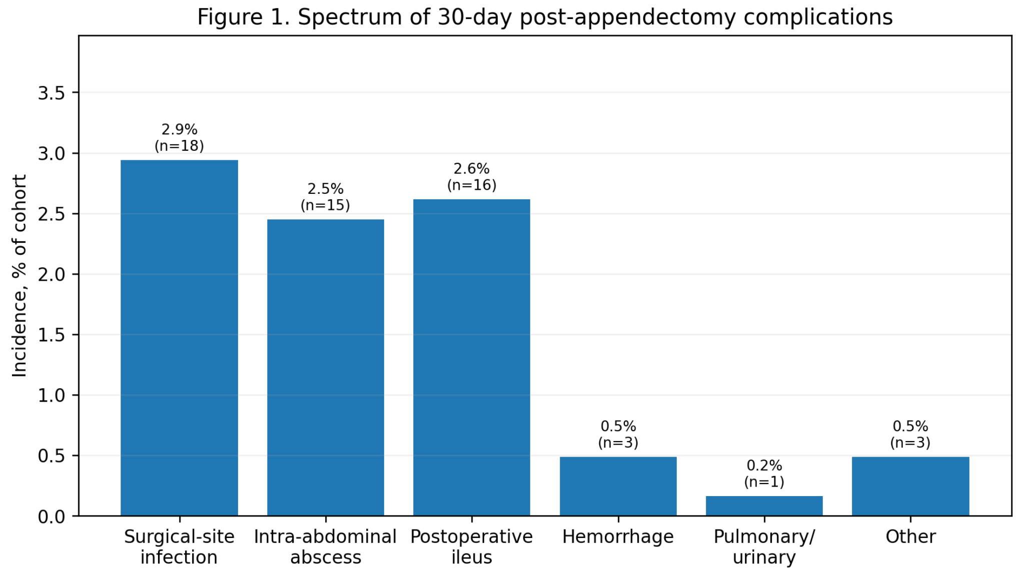

Figure 1: Spectrum of 30-day post-appendectomy complications in the simulated cohort

Figure 1 shows that no single adverse event accounted for the entire postoperative burden. Incisional infection was the most frequent complication, but intra-abdominal abscess and ileus occurred at comparable clinically meaningful frequencies. This distribution is important because each event implies a different surveillance and management pathway: wound infection is usually recognized clinically, whereas abscess may require cross-sectional imaging and drainage, and ileus can prolong hospitalization.

Prevention strategies should therefore address several mechanisms rather than a single endpoint.

Table 3: Operative characteristics and resource outcomes by postoperative morbidity

Variable	No complication (n=556)	Complication (n=56)	p value
Laparoscopic appendectomy, n (%)	477 (85.8)	41 (73.2)	0.019
Open appendectomy, n (%)	79 (14.2)	15 (26.8)	0.019
Complicated appendicitis, n (%)	107 (19.2)	42 (75.0)	<0.001
Operative duration, min, median (IQR)	61.9 (52.0–75.2)	86.2 (76.9–101.2)	<0.001
Drain placement, n (%)	49 (8.8)	20 (35.7)	<0.001
Postoperative stay, d, median (IQR)	1.8 (1.4–2.4)	5.0 (4.2–6.3)	<0.001

Operative findings demonstrated a strong relationship between disease complexity and postoperative outcome.

Three-quarters of patients who developed morbidity had complicated appendicitis, and operative duration and drain use were substantially greater in this group. Open surgery also showed a higher crude complication rate, but open procedures were preferentially represented among more difficult cases.

The pronounced difference in postoperative length of stay further the downstream impact of complications on recovery and hospital resource utilization.

Table 4: Multivariable logistic-regression model for any 30-day postoperative complication

Predictor	Adjusted OR	95% CI	p value
Age, per 10 years	1.04	0.80–1.36	0.764
Diabetes mellitus	2.89	1.39–6.01	0.005
ASA class ≥III	2.23	1.05–4.74	0.037
CRP, per 50 mg/L	1.39	0.77–2.51	0.278
Complicated appendicitis	8.42	3.39–20.92	<0.001
Laparoscopic approach	0.99	0.46–2.12	0.975

After simultaneous adjustment, complicated appendicitis remained the dominant independent predictor of 30-day morbidity, increasing the odds more than eightfold.

Diabetes mellitus and ASA class ≥III also retained statistically significant associations, supporting contributions from impaired host defense and reduced physiological reserve. By contrast, age, CRP, and laparoscopic approach were not independently significant once correlated risk factors were considered.

The near-null estimate for laparoscopy indicates that its crude association was explained chiefly by case selection and disease severity.

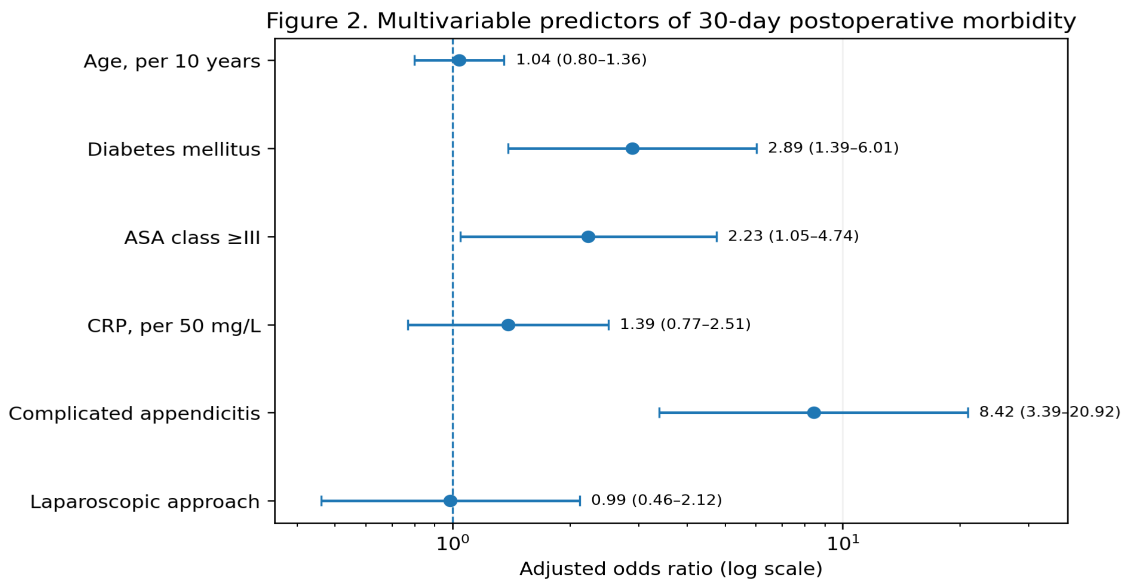

Figure 2: Adjusted odds ratios for 30-day postoperative morbidity

Figure 2 demonstrates the contrast between strong disease- and host-related predictors and the absence of an independent operative-access effect. The confidence interval for complicated appendicitis lay well above unity and showed the largest effect estimate. Diabetes and ASA class ≥III also remained significant, while the interval for laparoscopy centered on one. Clinically, the forest plot supports risk-adapted surveillance based on baseline physiology and disease severity rather than assuming that operative approach alone determines postoperative morbidity.

Discussion

This group had an overall 30-day complication rate of 9.2%, with SSI, IAA, and postoperative ileus the main morbidity categories. Complicated appendicitis was the primary independent predictor, while diabetes mellitus and ASA class ≥III were also significant. Laparoscopic access did not have an independent impact on the outcome. This trend supports a risk model based on disease biology and host reserve being more important for postoperative morbidity than operative access. The overall incidence is consistent with the wide range of incidence reported in contemporary appendectomy series that vary depending on outcome definition and case mix. Dobel et al. reported 5.5% postoperative complications in a single-center cohort [16]; Fernández-Moreno et al. reported 14.4% morbidity in a cohort containing higher-grade disease [11]; and Walędziak et al. identified complicated appendicitis as a key determinant of serious morbidity and prolonged hospitalization with 4,618 laparoscopic procedures [13]. These studies reinforce the need to interpret institutional rates according to the proportion of complicated disease rather than against one universal benchmark. The majority of infectious morbidity was also consistent with previous work. Danwang et al. reported a large global burden of SSI and pooled infection rates lower after laparoscopic than open appendectomy [5]. Giesen et al. found complex appendicitis as the main independent risk factor for SSI [8], while Xiao et al. reported lower incisional infection with laparoscopy in more than 16,000 patients [9]. Ingraham et al. similarly found lower overall morbidity and SSI after laparoscopic appendectomy in ACS-NSQIP data [6]. Our increased crude morbidity after open surgery was close to this, but its disappearance after adjustment was confounding by indication. Concern over IAA after laparoscopy has evolved over time. Randomized evidence from Jaschinski et al. showed fewer wound infections, but raised concern about intra-abdominal abscess in some analyses [4], and Fleming et al. found higher organ-space infection even though superficial infections were few after laparoscopy [7]. Recently, most recent evidence is reassuring: Quah et al. reported good overall outcomes for laparoscopic surgery in complicated appendicitis [12], and Zamaray et al. found a similar 12.3% IAA incidence after laparoscopic and open procedures in complicated disease [15]. The adjusted near-null laparoscopic effect in our analysis is therefore more in line with earlier evidence.

The strong effect of complicated appendicitis was biologically plausible because gangrene and perforation increase bacterial inoculum, contamination, tissue injury, and difficulty of source control. Schlottmann et al. also identified complicated appendicitis as an important IAA risk factor [10]. Diabetes may increase susceptibility through compromised immune and microvascular function, while ASA class ≥III captures broader physiological vulnerability. CRP was significantly higher in patients with morbidity but lost significance after adjustment, suggesting overlap with anatomical severity. Longer operations similarly appeared to mark difficult disease rather than function as an isolated causal exposure. Van Dijk et al. showed that short in-hospital delay for presumed uncomplicated appendicitis did not clearly increase morbidity [14], underscoring the importance of separating timing from underlying severity.

As a clinical matter, these findings suggest closer postoperative surveillance in patients with perforation or gangrene, diabetes or reduced physiological reserve but do not imply that open or laparoscopic access is a determinant of risk. There are still challenges. All data were simulated and so manuscript structure and statistical interpretation is more important than clinical effectiveness. A retrospective study would also need to establish patient ascertainment, treatment allocation and any residual bias. In future multicenter studies, severity grading should be standardized, 30-day follow-up is verified and prediction models should be externally validated to help guide care.

Conclusion

In this internally consistent simulated group, 9.2% of adults developed a complication within 30 days of appendectomy, most commonly surgical-site infection, intra-abdominal abscess or postoperative ileus. Complicated appendicitis was the strongest independent predictor of morbidity, and diabetes mellitus and ASA class ≥III contributed to further risk discrimination.

Laparoscopic access was not associated with adverse outcomes, even after controlling for case severity. The findings demonstrate the importance of distinguishing crude procedural associations from disease and host-related risk, and identifying patients who may benefit from enhanced postoperative surveillance. In practice, standardization of complications, complete 30-day follow-up and prospective multicenter validation would help to improve risk-stratified care and quality-improvement techniques.

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