

Risk Factors and Outcomes of Postoperative Complications in Digestive Surgery: A Prospective Study from a Tertiary Hospital in Burundi

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Abstract

Background: Postoperative complications (POCs) after gastrointestinal surgery are a major cause of morbidity and mortality, especially in low-resource settings. This study assessed their incidence, risk factors, and outcomes at a tertiary hospital in Burundi. **Materials and Methods:** A prospective observational cohort study was conducted over 12 months (October 2024-September 2025) at Kamenge University Teaching Hospital, Bujumbura. All patients undergoing gastrointestinal surgery were included and monitored for POCs during hospitalization. Data were collected using a standardized form and analyzed with SPSS version 26. Logistic regression identified independent risk factors. **Results:** Of 416 patients, 71 developed POCs, yielding an incidence of 17.06%. Mean age was 28.2 ± 23.9 years. Among the 71 patients who developed postoperative complications, 42 (59.15%) were male, yielding a male-to-female ratio of 1.44. Among these patients, 60 (84.51%) belonged to ASA classes III - IV. Emergency surgery accounted for 83.09% of complicated cases. Infectious complications predominated (43.66%), with surgical site infection most frequent. Mortality among patients with complications was 31.00%. Multivariate analysis identified emergency surgery (OR = 3.5; 95% CI: 1.8 - 6.7; $p = 0.001$), ASA III - V (OR = 2.8; 95% CI: 1.3 - 5.9; $p = 0.006$), operative duration > 120 minutes (OR = 2.2; 95% CI: 1.1 - 4.3; $p = 0.02$), contaminated/dirty

wounds (OR = 3.1; 95% CI: 1.5 - 6.2; $p = 0.002$), and prolonged antibiotic use (OR = 1.9; 95% CI: 1.0 - 3.5; $p = 0.04$) as independent predictors. **Conclusion:** POCs remain frequent and severe in this setting, with high mortality. Emergency surgery, poor preoperative condition, prolonged operative time, and inappropriate antibiotic use are key modifiable risk factors. These findings should be interpreted as associations rather than causal relationships. Prospective studies are required to confirm these observations and identify modifiable perioperative interventions to reduce postoperative complications.

Keywords

Gastrointestinal Surgery, Postoperative Complications, Risk Factors, Surgical Site Infection, Low-Resource Settings, Emergency Surgery

1. Introduction

Postoperative complications (POCs) in gastrointestinal surgery remain a major contributor to morbidity and mortality worldwide, particularly in low-resource settings where access to timely care and perioperative optimization is limited [1]-[3]. These complications, ranging from surgical site infections to organ dysfunction, significantly affect patient outcomes and increase healthcare costs through prolonged hospital stays and complex management [4]. Despite advances in surgical techniques and perioperative care, the burden of postoperative complications remains high in sub-Saharan Africa, where emergency surgeries, delayed presentation, and limited resources are common [5] [6]. Several studies have shown that POCs are influenced by a combination of patient-related factors (e.g., physiological status), procedure-related factors (e.g., operative duration, wound contamination), and system-level constraints [6]-[8]. In Burundi, available data on postoperative complications in gastrointestinal surgery are scarce and outdated. Given the evolving surgical practices and changing patient profiles, updated prospective data are needed to better understand current trends and identify modifiable risk factors. Therefore, this study aimed to identify risk factors and assess outcomes of postoperative complications following digestive surgery at Kamenge University Teaching Hospital.

2. Materials and Methods

We conducted a prospective observational analytic cohort study over a 12-month period from 1 October 2024 to 30 September 2025 in the Department of General and Gastrointestinal Surgery at Kamenge University Teaching Hospital (KUTH), Burundi.

All consecutive patients of any age who underwent gastrointestinal surgery during the study period were included and prospectively followed until hospital discharge for the occurrence of postoperative complications.

We included all operated patients who provided informed consent. Patients with

incomplete medical records or those who refused participation were excluded.

The primary outcome was the occurrence of at least one postoperative complication, defined as any deviation from the normal postoperative course during hospitalization. Postoperative complications were diagnosed based on predefined clinical, biological, microbiological, and imaging criteria according to routine institutional practice. Surgical site infection was diagnosed in patients presenting with purulent wound discharge, wound dehiscence associated with local inflammatory signs, or positive bacteriological culture when available. Postoperative peritonitis was diagnosed based on abdominal pain, fever, generalized abdominal tenderness or guarding, supported by imaging findings and confirmed during reoperation when applicable. Septic shock was defined by persistent hypotension requiring resuscitation in association with clinical evidence of severe infection. Anastomotic leakage was diagnosed in patients with digestive fluid leakage through surgical drains or wounds, radiological evidence of leakage, or confirmation during reoperation. Pulmonary infections were diagnosed using compatible clinical findings associated with chest radiography whenever available. Renal failure was defined by elevated serum creatinine associated with oliguria. Malnutrition was diagnosed during postoperative follow-up based on clinically significant weight loss requiring nutritional support.

Malnutrition was considered a postoperative complication only when it developed after surgery during hospitalization in patients who had no documented severe malnutrition before the operation. Diagnosis was based on clinically significant postoperative nutritional deterioration requiring nutritional support such as therapeutic feeding or parenteral nutrition. Pre-existing nutritional disorders were not classified as postoperative complications.

Perioperative antibiotic prophylaxis was defined as administration within 60 minutes before incision and discontinued within 24 hours postoperatively. Antibiotic administration beyond 24 hours was considered therapeutic use.

Data were collected using a standardized pre-designed form and included sociodemographic characteristics, comorbidities, ASA classification, surgical indication, type of surgery, urgency (emergency vs elective), operative duration, wound classification (Altemeier), antibiotic use, and postoperative outcomes.

Information regarding the primary surgical procedure was prospectively collected, including the surgical indication, urgency (elective or emergency), type of procedure performed, operative duration, wound classification according to the Altemeier classification, type of digestive surgery, and surgical approach (open or minimally invasive).

For the primary analysis, each patient was counted only once regardless of the number of postoperative complications experienced. Patients presenting with more than one complication were classified according to the coexistence of infectious and non-infectious complications, while each specific complication was described separately in the descriptive analysis.

Data were analyzed using SPSS version 26. Categorical variables were compared

using the chi-square test. Continuous variables were summarized as means $\pm$ standard deviation. Univariate logistic regression analysis was performed to identify factors associated with postoperative complications. Variables with a p-value < 0.20 in the univariable analysis, together with clinically relevant variables identified from the literature, were considered for inclusion in the multivariable logistic regression model. A backward stepwise selection procedure was then applied to identify independent predictors of postoperative complications. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported. Statistical significance was set at $p < 0.05$. The tables were created in Microsoft Excel 2016. The text was written using Microsoft Word 2016 and the references were managed using Zotero.

3. Results

A total of 416 patients underwent gastrointestinal surgery during the study period of whom 71 developed postoperative complications, yielding an incidence of 17.06%. The mean age was 28.2 ± 23.9 years. Among the 71 patients who developed postoperative complications, 42 (59.15%) were male, yielding a male-to-female ratio of 1.44. Most patients were from rural areas (78.87%). Acute peritonitis was the most common surgical indication (38.02%), followed by intestinal obstruction (29.57%), strangulated hernia (7.04%), and digestive tumors (7.04%). Most patients underwent emergency surgery (83.09%), while only 16.90% had elective procedures. Among the 71 patients who developed postoperative complications, 60 (84.51%) belonged to ASA physical status classes III or IV.

In the overall cohort, ASA classes III - IV accounted for 240 of 416 patients (57.69%). Exploratory laparotomy was the most frequently performed procedure, followed by laparotomy with ileostomy and laparotomy with colostomy. Lower gastrointestinal surgery accounted for 80.28% of procedures. According to the Altemeier classification, 45.07% of procedures were classified as dirty surgery and 26.76% as contaminated surgery. Operative duration ranged from less than 60 minutes to more than 180 minutes, with nearly half of procedures lasting between 120 and 180 minutes (49.29%). Infectious complications were the most frequent (43.66%), with surgical site infections predominating (38.88%), followed by postoperative peritonitis and septic shock. *Escherichia coli* was the most commonly isolated pathogen. Non-infectious complications included malnutrition (27.5%), anastomotic leakage (20%), and multi-organ failure (17.5%). Most complications occurred within the first postoperative week (mean delay: 3.7 days). According to the Clavien-Dindo classification, severe complications (grades IIIb and V) were predominant. The mortality rate among patients with complications was 30.98%.

Variables entered into the multivariable logistic regression model included age, sex, ASA physical status, emergency surgery, operative duration, Altemeier wound classification, type of digestive surgery, and nutritional status. In univariate analysis, emergency surgery, higher ASA score, operative duration greater than 120 minutes, contaminated or dirty surgical wounds, and prolonged antibiotic expo-

sure (>24 hours) were significantly associated with postoperative complications. In multivariate logistic regression analysis, several independent predictors of postoperative complications were identified. Emergency surgery was associated with a significantly increased risk of complications (AOR = 3.5; 95% CI: 1.8 - 6.7; $p = 0.001$). Patients with ASA class III - V had a higher likelihood of developing complications compared to those with ASA I - II (AOR = 2.8; 95% CI: 1.3 - 5.9; $p = 0.006$). Operative duration greater than 120 minutes was also independently associated with complications (AOR = 2.2; 95% CI: 1.1 - 4.3; $p = 0.02$). Similarly, contaminated or dirty wounds (Altemeier III - IV) were strongly associated with postoperative complications (AOR = 3.1; 95% CI: 1.5 - 6.2; $p = 0.002$).

Prolonged antibiotic use (>24 hours) is associated with complications, likely reflecting severity rather than causality (AOR = 1.9; 95% CI: 1.0 - 3.5; $p = 0.04$). No statistically significant association was found between age, sex, or comorbidities and the occurrence of postoperative complications (**Table 1**).

Table 1. Risk factors for postoperative complications.

Variable	Complication n (%)	No complication n (%)	Univariate OR (95% CI)	p-value
Emergency surgery	59 (83.1)	210 (60.9)	3.5 [1.8 - 6.7]	0.001
ASA III - V	60 (84.5)	180 (52.2)	2.8 [1.3 - 5.9]	0.006
Duration > 120 min	35 (49.3)	120 (34.8)	2.2 [1.1 - 4.3]	0.02
Altemeier III - IV	50 (70.4)	140 (40.6)	3.1 [1.5 - 6.2]	0.002
Antibiotics > 24 h	48 (67.6)	180 (52.2)	1.9 [1.0 - 3.5]	0.04
Age			1.01 [0.99 - 1.02]	0.21
Male sex	42 (59.1)	200 (58.0)	1.0 [0.6 - 1.7]	0.89
Comorbidity	7 (9.8)	40 (11.6)	0.8 (0.3 - 1.9)	0.62

4. Discussion

This study provides updated prospective data on postoperative complications following gastrointestinal surgery in a low-resource setting. The incidence of complications (17.06%) observed in our study is consistent with reports from similar settings, where rates range between 10% and 30% [9]. However, the mortality among patients with complications (30.98%) remains markedly higher than that reported in high-income countries, where it is generally below 5% [10] [11]. Emergency surgery emerged as the strongest independent predictor of postoperative complications. This finding is consistent with existing literature, as emergency procedures are often associated with delayed presentation, advanced disease, and limited preoperative optimization [12]. In our setting, the high proportion of emergency surgeries likely reflects barriers in access to timely surgical care, as highlighted in global surgery reports [12].

Preoperative physiological status, assessed by the ASA classification, was also

significantly associated with postoperative complications. Patients with ASA III - V had a higher risk, highlighting the importance of preoperative optimization and risk stratification. This association has been consistently demonstrated in large cohort studies and meta-analyses [13]. Operative duration greater than 120 minutes was independently associated with complications. This likely reflects procedural complexity and intraoperative challenges, which have been widely reported as contributors to postoperative morbidity [14]. Infectious complications, particularly surgical site infections, were the most common. This finding is consistent with global literature, which identifies surgical site infection as the leading postoperative complication in gastrointestinal surgery, especially in low- and middle-income countries [15]. The predominance of *Escherichia coli* is expected given its origin from the intestinal microbiota [16]. The low rate of microbiological sampling observed in our study likely reflects limited access to routine bacteriological investigations in our setting, which may have led to an underestimation of the true microbiological profile of postoperative infections.

Emergency surgery was highly prevalent among patients with postoperative complications in this cohort. This likely reflects delayed presentation and limited preoperative optimization, which are common challenges in low-resource settings. Similarly, prolonged antibiotic exposure was observed among patients with complications. However, this finding should be interpreted cautiously, as prolonged antibiotic use may reflect the severity of postoperative infections rather than a causal relationship. Overall, these findings highlight associations rather than causal relationships, given the descriptive design of the study.

Non-infectious complications such as malnutrition, anastomotic leakage, and multi-organ failure were also frequent. Malnutrition, in particular, is a well-recognized risk factor for poor surgical outcomes and is highly prevalent in low-resource settings. Anastomotic leakage remains one of the most feared complications in digestive surgery, associated with high morbidity and mortality [17]. Most complications were diagnosed within the first postoperative week, with an average delay of 3.7 days, highlighting the importance of early postoperative monitoring. As in other low-resource settings, diagnosis in our study was primarily clinical, relying on signs such as tachycardia, fever, and hypotension.

According to the Clavien-Dindo classification, a high proportion of complications were severe (grades IIIb and V). The mortality rate (30.98%) is particularly high compared to reports from high-income countries, where postoperative mortality is generally below 5% [10] [11] [16]. This discrepancy may be explained by delayed presentation, the high rate of emergency surgeries, limited access to intensive care, and challenges in timely management of complications [18].

The prolonged hospital stays (mean 41 days) observed in our study reflect the severity of complications and have important implications for healthcare costs and resource utilization. Similar findings have been reported in other African studies, where complications significantly increase hospital stay and economic burden. Similarly, contaminated and dirty surgical wounds were strongly associated with

postoperative complications. This finding is in line with well-established evidence linking wound contamination to infectious complications, particularly in gastrointestinal surgery. A prolonged duration of postoperative antibiotic therapy was frequently observed in our cohort. However, this finding should be interpreted with caution. In routine clinical practice, antibiotic treatment was commonly extended after the diagnosis of postoperative infectious complications, reflecting therapeutic management rather than perioperative prophylaxis. Therefore, postoperative antibiotic duration cannot be interpreted as an independent predictor or modifiable determinant of postoperative complications because of the possibility of reverse causation inherent to retrospective studies. In many cases, prolonged antibiotic use likely represents a response to established postoperative infections rather than a causal factor. Current international guidelines recommend limiting prophylactic antibiotic administration to the perioperative period for most digestive surgical procedures, whereas prolonged antibiotic treatment should be reserved for established postoperative infections or specific clinical indications. Consequently, future prospective studies should distinguish perioperative prophylaxis from therapeutic postoperative antibiotic administration when evaluating the effect of antibiotics on postoperative outcomes [19].

Despite advances in surgical techniques, our findings suggest that postoperative complications remain a major challenge in our setting. There is a need to strengthen perioperative care through improved preoperative optimization, adherence to evidence-based antibiotic protocols, enhanced infection prevention measures, and early detection of complications.

No significant association was found between age, sex, or comorbidities and postoperative complications. This may be explained by the relatively young population and the limited number of patients with documented comorbidities. Similar findings have been reported in other sub-Saharan African studies [17]. Overall, these findings highlight that modifiable perioperative factors, particularly surgical timing, infection control, and adherence to antibiotic stewardship principles, represent key targets for improving surgical outcomes in low-resource settings [15] [19].

This study identified several key determinants of postoperative complications in gastrointestinal surgery within a low-resource setting. Emergency surgery was the strongest independent predictor of postoperative complications. This finding is consistent with global surgical literature, where emergency procedures are associated with delayed presentation, limited preoperative optimization, and increased physiological stress. In our setting, the high proportion of emergency surgeries likely reflects barriers in access to care and late referral patterns.

These findings are in line with the Global Surgery 2030 report and more recent analyses showing significantly higher morbidity and mortality following emergency procedures compared to elective surgery [12].

5. Limitations

This study has some limitations. As a single-center study, its findings may not be

generalizable. Additionally, some variables, such as intraoperative technical details and long-term outcomes, were not assessed. Nevertheless, this prospective study provides updated and valuable data on postoperative complications in gastrointestinal surgery in our context.

Another limitation is that postoperative antibiotic exposure was recorded after surgery and frequently after complication onset. Consequently, the temporal relationship between antibiotic administration and postoperative complications could not be established, precluding any causal interpretation.

6. Conclusion

Postoperative complications affected nearly one in six patients undergoing digestive surgery and were associated with substantial in-hospital mortality in our institution. Emergency surgery, poor preoperative physical status, prolonged operative duration, and contaminated or dirty procedures were associated with a greater burden of postoperative complications. These characteristics should primarily be considered markers for perioperative risk stratification rather than direct therapeutic targets. Because postoperative antibiotic therapy frequently represented treatment initiated after complication onset, it should not be interpreted as an independent modifiable risk factor. Strengthening perioperative care, early recognition of complications, and conducting prospective studies focusing on truly modifiable perioperative factors may contribute to improving surgical outcomes in low-resource settings.

Author Contributions

JCM conceptualized, designed and supervised the study. SN contributed to data analysis and manuscript drafting. AI participated in data collection and interpretation. DK and FN critically revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Considerations

Ethical approval was obtained from the relevant institutional authorities of Kamenge University Teaching Hospital. Informed consent was obtained from all participants or their legal guardians prior to inclusion in the study. Confidentiality and anonymity were strictly maintained throughout the research process in accordance with ethical standards.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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