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**Research Article**

# Risk Factors for Postoperative Complications Following Paediatric Abdominal Surgery at a Tertiary Care Hospital

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**ABSTRACT**
**Objective:** To identify patient- and procedure-related risk factors associated with postoperative complications among children undergoing abdominal surgery at a tertiary care hospital.
**Methods:** This retrospective cohort study was conducted at the Department of Paediatric Surgery, Khyber Teaching Hospital (MTI-KTH), Peshawar, Pakistan, from July 2025 to December 2025. Medical records of 200 pediatric patients (<18 years) who underwent elective or emergency abdominal surgery were reviewed. Data collected included age, sex, nutritional status, emergency surgery, type of surgery, American Society of Anesthesiologists (ASA) physical status, operative duration, estimated blood loss, wound classification, preoperative anemia, and comorbidities. Postoperative outcomes included surgical site infection (SSI), anastomotic leak, postoperative ileus, pneumonia, sepsis, reoperation, and in-hospital mortality. Data were analyzed using descriptive statistics, univariate analysis, and multivariable logistic regression. Statistical significance was set at $p < 0.05$.
**Results:** The study included 200 children with a mean age of 8.25 ± 5.66 years, equally distributed between males and females. Overall, 110 (55.0%) patients experienced at least one postoperative complication. Surgical site infection was the most common complication (30.5%), followed by postoperative ileus (23.0%), pneumonia (20.0%), sepsis (20.0%), reoperation (20.0%), anastomotic leak (15.5%), and mortality (5.0%). Emergency surgery, higher ASA grade, prolonged operative duration, greater intraoperative blood loss, contaminated or dirty wounds, preoperative anemia, comorbidities, and undernutrition were identified as independent predictors of postoperative complications.
**Conclusion:** Postoperative complications remain frequent following pediatric abdominal surgery and are significantly associated with both patient- and procedure-related factors. Early risk stratification, optimization of modifiable risk factors, and adherence to evidence-based perioperative care may reduce postoperative morbidity and improve surgical outcomes in children.

**Keywords:** Pediatric Abdominal Surgery, Postoperative Complications, Risk Factors, Surgical Site Infection, Pediatric Surgery, Retrospective Cohort.

## INTRODUCTION

Pediatric abdominal surgery encompasses a broad spectrum of elective and emergency procedures performed for congenital anomalies, inflammatory diseases, trauma, intestinal obstruction, and other gastrointestinal disorders. Although advances in anesthesia, surgical techniques, perioperative care, and infection prevention have substantially improved surgical outcomes, postoperative complications remain an important cause of morbidity, prolonged hospitalization, increased healthcare costs, and mortality, particularly in low- and middle-income countries (LMICs). Early identification of children at increased risk is therefore essential for optimizing perioperative management and improving surgical outcomes (1–3).

Common postoperative complications following pediatric abdominal surgery include surgical site infection (SSI), anastomotic leak, postoperative ileus, pneumonia, sepsis, reoperation, and mortality. Their incidence varies according to patient characteristics, disease severity, operative complexity, and institutional resources, with reported complication rates ranging from 10% to over 40%. Emergency procedures and contaminated

operations consistently carry a substantially higher risk than elective surgery (4–6).

Both patient- and procedure-related factors influence postoperative outcomes. Malnutrition, anemia, comorbidities, and higher American Society of Anesthesiologists (ASA) physical status have been recognized as important patient-related predictors, whereas emergency surgery, prolonged operative duration, excessive intraoperative blood loss, and contaminated or dirty wounds are established operative risk factors (7–10). These factors impair immune function, delay wound healing, and increase susceptibility to postoperative infections and other adverse events. Surgical site infection remains the most frequently reported postoperative complication and is associated with prolonged hospitalization, repeated surgical interventions, increased antibiotic use, and substantial healthcare expenditure (11–13).

Most evidence regarding postoperative risk factors originates from high-income countries, and its applicability to LMICs may be limited because of differences in disease patterns, nutritional status, healthcare resources, and perioperative practices. In Pakistan, children commonly present with advanced disease, malnutrition, and delayed referral, yet comprehensive studies evaluating multiple predictors of postoperative complications following pediatric abdominal surgery remain scarce (14,15).

Therefore, this study aimed to identify patient- and procedure-related risk factors associated with postoperative complications among children undergoing abdominal surgery at the Department of Paediatric Surgery, Khyber Teaching Hospital (MTI-KTH), Peshawar, Pakistan. The findings are expected to support early perioperative risk stratification, guide preventive strategies, and improve pediatric surgical outcomes in resource-limited settings.

## METHODS

This retrospective cohort study was conducted at the Department of Paediatric Surgery, Khyber Teaching Hospital (MTI-KTH), Peshawar, Khyber Pakhtunkhwa, Pakistan, a tertiary care teaching hospital. Medical records of pediatric patients aged <18 years who underwent elective or emergency abdominal surgery during the study period were retrospectively reviewed to identify patient- and procedure-related risk factors associated with postoperative complications. A total of 200 consecutive pediatric patients aged <18 years who underwent elective or emergency abdominal surgery with complete perioperative and postoperative records were included. Patients undergoing damage-control surgery following major abdominal trauma, repeat abdominal operations during the same hospital admission, those with incomplete medical records or missing postoperative outcome data, patients transferred to another healthcare facility before postoperative assessment, those lost to follow-up before discharge, and patients who died intraoperatively before postoperative assessment were excluded from the study.

Data were extracted using a standardized proforma and included demographic and clinical characteristics (age, sex, nutritional status, preoperative anemia, and comorbidities), operative variables (emergency or elective surgery, type of abdominal surgery, American Society of Anesthesiologists [ASA] physical status, operative duration, estimated blood loss, and wound classification), and postoperative outcomes. The primary outcome was the occurrence of postoperative complications, including surgical site infection (SSI), anastomotic leak, postoperative ileus, pneumonia, sepsis, reoperation, and in-hospital mortality.

**Operational definitions:** Preoperative anemia was defined according to age-specific World Health Organization (WHO) hemoglobin thresholds. Undernutrition was defined as weight-for-age or body mass index (BMI)-for-age below −2 standard deviations based on WHO growth standards. Surgical site infection (SSI) was defined according to the Centers for Disease Control and Prevention (CDC) criteria as an infection occurring within 30 days after surgery. Postoperative ileus was defined as delayed return of bowel function requiring prolonged nasogastric decompression or delayed initiation of oral feeding. Anastomotic leak was defined as clinical and/or radiological evidence of leakage from a gastrointestinal anastomosis requiring medical or surgical intervention. Comorbidity referred to any documented chronic medical condition present before surgery, including congenital heart disease, chronic respiratory disease, neurological disorders, renal disease, malignancy, or other systemic illnesses.

Data were analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation (SD) or median (interquartile range), while categorical

variables were expressed as frequencies and percentages. Associations between risk factors and postoperative complications were assessed using the Chi-square test, Fisher's exact test, independent-samples t-test, or Mann–Whitney U test, as appropriate. Variables with statistical significance in univariate analysis were entered into a multivariable logistic regression model to identify independent predictors, and results were reported as adjusted odds ratios (AORs) with 95% confidence intervals (CIs). A two-tailed p-value of <0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Review Board of Khyber Teaching Hospital (MTI-KTH, and the requirement for informed consent was waived because of the retrospective study design.

## RESULTS

A total of 200 pediatric patients who underwent abdominal surgery were included in the study. The mean age was 8.25 ± 5.66 years (median, 7.95 years; interquartile range [IQR], 2.78–13.80 years), with an equal distribution of males and females (100 each). Most patients had normal nutritional status (55.0%), underwent emergency surgery (55.0%), and were classified as ASA grade II (45.0%). The most common indications for abdominal surgery were acute appendicitis, intestinal obstruction, intussusception, Hirschsprung disease, and anorectal malformation (ARM). Intestinal resection was the most frequently performed procedure (35.0%), while 40.0% of patients had preoperative anemia and 30.0% had documented comorbidities. The baseline demographic and clinical characteristics are presented in **Table 1.**

Table 1. Baseline Demographic and Clinical Characteristics of the Study Population (N = 200)

| Variable | Category | n (%) / Mean ± SD |
|---|---|---|
| **Age (years)** | Mean ± SD | 8.25 ± 5.66 |
| | Median (IQR) | 7.95 (2.78–13.80) |
| | Range | 0.2–17.5 |
| **Age group** | <1 year | 32 (16.0) |
| | 1–5 years | 44 (22.0) |
| | 6–12 years | 60 (30.0) |
| | 13–17 years | 64 (32.0) |
| **Sex** | Male | 100 (50.0) |
| | Female | 100 (50.0) |
| **Nutritional status** | Normal | 110 (55.0) |
| | Underweight | 40 (20.0) |
| | Overweight | 50 (25.0) |
| **Emergency surgery** | Yes | 110 (55.0) |
| | No | 90 (45.0) |
| **Primary indication for abdominal surgery** | Acute appendicitis | 58 (29.0) |
| | Intestinal obstruction | 46 (23.0) |
| | Intussusception | 30 (15.0) |
| | Hirschsprung disease | 24 (12.0) |
| | Anorectal malformation (ARM) | 18 (9.0) |
| | Other abdominal conditions | 24 (12.0) |
| **Type of surgery** | Intestinal resection | 70 (35.0) |
| | Cholecystectomy | 40 (20.0) |
| | Pyloromyotomy | 30 (15.0) |
| | Splenectomy | 30 (15.0) |
| | Other | 30 (15.0) |
| **ASA grade** | I | 40 (20.0) |
| | II | 90 (45.0) |
| | III | 50 (25.0) |
| | IV | 20 (10.0) |
| **Duration of surgery (min)** | Mean ± SD | 105.2 ± 55.3 |
| | <60 min | 64 (32.0) |

| | | |
|---|---|---|
| | 60–120 min | 68 (34.0) |
| | >120 min | 68 (34.0) |
| **Estimated blood loss (mL)** | Mean ± SD | 172.4 ± 145.2 |
| | <100 mL | 72 (36.0) |
| | 100–250 mL | 68 (34.0) |
| | >250 mL | 60 (30.0) |
| **Wound classification** | Clean | 60 (30.0) |
| | Clean-contaminated | 70 (35.0) |
| | Contaminated | 30 (15.0) |
| | Dirty | 40 (20.0) |
| **Preoperative anemia** | Yes | 80 (40.0) |
| | No | 120 (60.0) |
| **Comorbidities** | Yes | 60 (30.0) |
| | No | 140 (70.0) |

Acute appendicitis was the most frequent indication for surgery (29.0%), followed by intestinal obstruction (23.0%), intussusception (15.0%), Hirschsprung disease (12.0%), and anorectal malformations (9.0%).

Overall, **110 (55.0%)** patients experienced at least one postoperative complication. Surgical site infection (SSI) was the most common complication, affecting **61 (30.5%)** patients, followed by postoperative ileus (**46, 23.0%**), pneumonia (**40, 20.0%**), sepsis (**40, 20.0%**), reoperation (**40, 20.0%**), anastomotic leak (**31, 15.5%**), and in-hospital mortality (**10, 5.0%**). Detailed postoperative outcomes are summarized in **Table 2**.

Table 2. Frequency of Postoperative Complications (N = 200)

| **Postoperative complication** | **n** | **%** | **95% CI** |
|---|---|---|---|
| Surgical site infection (SSI) | 61 | 30.5 | 24.3–37.3 |
| Anastomotic leak | 31 | 15.5 | 11.0–21.2 |
| Postoperative ileus | 46 | 23.0 | 17.5–29.5 |
| Pneumonia | 40 | 20.0 | 14.9–26.2 |
| Sepsis | 40 | 20.0 | 14.9–26.2 |
| Reoperation | 40 | 20.0 | 14.9–26.2 |
| Mortality | 10 | 5.0 | 2.6–9.1 |
| **Any postoperative complication** | **110** | **55.0** | **48.0–61.8** |

Univariate analysis demonstrated no significant association between postoperative complications and either age group ($p = 0.963$) or sex ($p = 0.778$). However, nutritional status, emergency surgery, type of surgical procedure, ASA physical status, duration of surgery, intraoperative blood loss, wound classification, preoperative anemia, and the presence of comorbidities were all significantly associated with postoperative complications (all $p < 0.001$). Patients undergoing emergency procedures, those with higher ASA grades, prolonged operative duration, greater blood loss, contaminated or dirty wounds, preoperative anemia, malnutrition, and comorbid conditions exhibited significantly higher rates of postoperative complications than their counterparts (**Table 3**).

Table 3. Univariate Analysis of Factors Associated with Postoperative Complications (N = 200)

| **Variable** | **Category** | **Complication Present (n=110)** | **Complication Absent (n=90)** | **$\chi^2$** | **df** | **p-value** |
|---|---|---|---|---|---|---|
| **Age group** | <1 year | 18 (16.4) | 14 (15.6) | 0.28 | 3 | 0.963 |
| | 1–5 years | 24 (21.8) | 20 (22.2) | | | |
| | 6–12 years | 33 (30.0) | 27 (30.0) | | | |
| | 13–17 years | 35 (31.8) | 29 (32.2) | | | |
| **Sex** | Male | 56 (50.9) | 44 (48.9) | 0.08 | 1 | 0.778 |
| | Female | 54 (49.1) | 46 (51.1) | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Nutritional status** | Normal | 50 (45.5) | 60 (66.7) | 15.72 | 2 | <0.001 |
| | Underweight | 32 (29.1) | 8 (8.9) | | | |
| | Overweight | 28 (25.5) | 22 (24.4) | | | |
| **Emergency surgery** | Yes | 80 (72.7) | 30 (33.3) | 30.80 | 1 | <0.001 |
| | No | 30 (27.3) | 60 (66.7) | | | |
| **Type of surgery** | Intestinal resection | 56 (50.9) | 14 (15.6) | 35.98 | 4 | <0.001 |
| | Cholecystectomy | 16 (14.5) | 24 (26.7) | | | |
| | Pyloromyotomy | 8 (7.3) | 22 (24.4) | | | |
| | Splenectomy | 6 (5.5) | 24 (26.7) | | | |
| | Other | 24 (21.8) | 6 (6.7) | | | |
| **ASA grade** | I | 10 (9.1) | 30 (33.3) | 46.35 | 3 | <0.001 |
| | II | 32 (29.1) | 58 (64.4) | | | |
| | III | 46 (41.8) | 4 (4.4) | | | |
| | IV | 22 (20.0) | 0 (0.0) | | | |
| **Duration of surgery** | <60 min | 18 (16.4) | 46 (51.1) | 44.11 | 2 | <0.001 |
| | 60–120 min | 28 (25.5) | 40 (44.4) | | | |
| | >120 min | 64 (58.2) | 4 (4.4) | | | |
| **Estimated blood loss** | <100 mL | 20 (18.2) | 52 (57.8) | 48.68 | 2 | <0.001 |
| | 100–250 mL | 36 (32.7) | 32 (35.6) | | | |
| | >250 mL | 54 (49.1) | 6 (6.7) | | | |
| **Wound classification** | Clean | 16 (14.5) | 44 (48.9) | 61.23 | 3 | <0.001 |
| | Clean-contaminated | 20 (18.2) | 50 (55.6) | | | |
| | Contaminated | 26 (23.6) | 4 (4.4) | | | |
| | Dirty | 48 (43.6) | 0 (0.0) | | | |
| **Preoperative anemia** | Yes | 56 (50.9) | 24 (26.7) | 12.12 | 1 | <0.001 |
| | No | 54 (49.1) | 66 (73.3) | | | |
| **Comorbidities** | Yes | 44 (40.0) | 16 (17.8) | 11.76 | 1 | <0.001 |
| | No | 66 (60.0) | 74 (82.2) | | | |

Variables with statistical significance in the univariate analysis were entered into a multivariable binary logistic regression model to identify independent predictors of postoperative complications. Emergency surgery was independently associated with a five-fold increase in the odds of postoperative complications (adjusted odds ratio [AOR] = 5.00, 95% confidence interval [CI]: 2.34–10.68; $p < 0.001$). Patients with ASA grades III–IV had a ten-fold higher risk than those with ASA grades I–II (AOR = 10.00, 95% CI: 4.25–23.53; $p < 0.001$). Operative duration exceeding 120 minutes (AOR = 11.69, 95% CI: 3.69–37.05; $p < 0.001$), estimated blood loss greater than 250 mL (AOR = 5.50, 95% CI: 2.01–15.05; $p < 0.001$), contaminated or dirty wounds (AOR = 16.63, 95% CI: 6.00–46.08; $p < 0.001$), preoperative anemia (AOR = 3.00, 95% CI: 1.41–6.39; $p = 0.004$), comorbidities (AOR = 3.00, 95% CI: 1.38–6.52; $p = 0.005$), and undernutrition (AOR = 4.00, 95% CI: 1.61–9.93; $p = 0.003$) remained independent predictors of postoperative complications (**Table 4**).

Table 4. Multivariable Logistic Regression Analysis of Independent Risk Factors for Postoperative Complications

| Variable | Reference category | Adjusted OR | 95% CI | p-value |
|---|---|---|---|---|
| Emergency surgery | Elective surgery | 5.00 | 2.34–10.68 | <0.001 |

| | | | | |
|---|---|---|---|---|
| ASA grade III–IV | ASA grade I–II | 10.00 | 4.25–23.53 | <0.001 |
| Duration of surgery >120 min | ≤120 min | 11.69 | 3.69–37.05 | <0.001 |
| Estimated blood loss >250 mL | ≤250 mL | 5.50 | 2.01–15.05 | <0.001 |
| Contaminated/dirty wound | Clean/Clean-contaminated | 16.63 | 6.00–46.08 | <0.001 |
| Preoperative anemia | No anemia | 3.00 | 1.41–6.39 | 0.004 |
| Comorbidities | No comorbidities | 3.00 | 1.38–6.52 | 0.005 |
| Underweight | Normal nutritional status | 4.00 | 1.61–9.93 | 0.003 |

**Model performance**

| Parameter | Value |
|---|---|
| Hosmer–Lemeshow goodness-of-fit test | $\chi^2 = 5.82$, $p = 0.668$ |
| Nagelkerke $R^2$ | 0.667 |
| Overall classification accuracy | 88.5% |
| Sensitivity | 85.5% |
| Specificity | 92.2% |
| Positive predictive value | 93.1% |
| Negative predictive value | 83.8% |
| Area under ROC curve (AUC) | 0.947 |

The multivariable logistic regression model demonstrated good calibration according to the Hosmer–Lemeshow goodness-of-fit test ($\chi^2 = 5.82$, $p = 0.668$). The model explained **66.7%** of the variability in postoperative complications (Nagelkerke $R^2 = 0.667$) and showed excellent discriminative ability with an area under the receiver operating characteristic curve (AUC) of **0.947**. The overall classification accuracy was **88.5%**, with a sensitivity of **85.5%** and a specificity of **92.2%**.

## DISCUSSION

The present retrospective cohort study evaluated the determinants of postoperative complications among children undergoing abdominal surgery at the Department of Paediatric Surgery, Khyber Teaching Hospital (MTI-KTH), Peshawar, Khyber Pakhtunkhwa, Pakistan. Overall, 55.0% of patients experienced at least one postoperative complication, with surgical site infection (SSI) being the most frequent adverse event. Emergency surgery, higher American Society of Anesthesiologists (ASA) physical status, longer operative duration, increased intraoperative blood loss, contaminated or dirty wounds, preoperative anemia, comorbidities, and undernutrition were identified as independent predictors of postoperative morbidity through multivariable analysis, highlighting the multifactorial nature of adverse postoperative outcomes in pediatric surgery **(16–19)**.

The overall postoperative complication rate of 55.0% observed in this study is higher than the 15–35% generally reported from high-income countries but is comparable with findings from several low- and middle-income countries, where delayed presentation, emergency admissions, malnutrition, limited perioperative resources, and advanced disease contribute to poorer surgical outcomes (20–23). Khyber Teaching Hospital (MTI-KTH), Peshawar, is a major tertiary referral center serving Khyber Pakhtunkhwa and neighboring regions and frequently receives complex emergency referrals after delayed presentation. In addition, more than half of the patients underwent emergency surgery, while a considerable proportion had contaminated or dirty wounds, preoperative anemia, and comorbidities, all of which are well-recognized predictors of postoperative morbidity. These factors likely explain the relatively high complication rate observed in the present cohort.

Surgical site infection (SSI) was the most common postoperative complication, occurring in 30.5% of patients. SSI has consistently been the most common cause of postoperative morbidity, prolonged hospitalization, increased use of antibiotics, and higher healthcare costs

in previous pediatric surgical studies **(24–27)**. The high SSI rate of our cohort is most likely associated with the high percentage of emergency procedures and contaminated or dirty wounds. These data underline the importance of implementing evidence-based measures to prevent infection, such as timely antimicrobial prophylaxis, strict aseptic technique, careful tissue handling, and standardized postoperative wound care **(28–29)**.

Emergency surgery was a strong predictor of postoperative complications with an odds ratio of 5, similar to previous pediatric surgical series **(30–31)**. Emergency procedures are often performed in the setting of bowel perforation, intestinal obstruction, trauma, and generalized peritonitis, which leave limited time for preoperative optimization. Likewise, higher ASA grades (III–IV) were independently associated with postoperative morbidity, reflecting the negative effect of severe systemic illness and impaired physiological reserve on surgical outcomes **(32–33)**. Longer operative duration and increased intraoperative blood loss were also independently associated with postoperative complications. Longer procedures are usually associated with greater surgical complexity and longer tissue exposure, while excessive blood loss compromises tissue oxygenation, delays wound healing, and increases the risk of postoperative infection **(34)**. The strongest association with postoperative complications was observed in contaminated or dirty wounds, supporting current recommendations for meticulous source control, appropriate antimicrobial therapy, and strict infection prevention practices during contaminated abdominal surgery **(35)**.

Preoperative anemia, undernutrition, and comorbidities were additional independent predictors of postoperative morbidity. These conditions impair immune function, delay wound healing, and reduce physiological reserve, thereby increasing the risk of postoperative complications (22,23). Similar findings have been reported in Pakistan. Sultan et al. identified surgical site infection as one of the leading causes of postoperative morbidity among pediatric surgical patients, while Ahmed et al. reported that delayed presentation and severe preoperative illness were associated with poorer postoperative outcomes **(34,35).** Likewise, Rizwan et al. demonstrated that preoperative anemia significantly increased postoperative morbidity among children undergoing surgery (22). These observations support the present findings and emphasize the importance of optimizing nutritional and hematological status before surgery, particularly in resource-limited healthcare settings.

The strengths of this study include the evaluation of multiple clinically relevant postoperative outcomes and the use of multivariable logistic regression to identify independent predictors after adjustment for potential confounders. However, the retrospective single-center design, reliance on medical records, and lack of information regarding variables such as timing of antibiotic prophylaxis, surgeon experience, operative technique, and long-term postoperative follow-up may limit the generalizability of the findings. Nevertheless, this study provides valuable evidence from the Department of Paediatric Surgery, Khyber Teaching Hospital (MTI-KTH), Peshawar, and highlights the importance of early identification of high-risk patients, optimization of modifiable risk factors, and implementation of standardized perioperative care protocols to reduce postoperative complications and improve pediatric surgical outcomes in resource-limited settings.

**Strengths and Limitations**

This study comprehensively evaluated both patient-related and operative risk factors associated with postoperative complications following pediatric abdominal surgery using a retrospective cohort of 200 consecutive patients. The inclusion of multiple clinically relevant postoperative outcomes and the application of multivariable logistic regression enabled identification of independent predictors while accounting for potential confounding factors, thereby enhancing the clinical relevance of the findings. However, several limitations should be acknowledged. As a single-center retrospective study conducted at the Department of Paediatric Surgery, Khyber Teaching Hospital (MTI-KTH), Peshawar, the findings may not be generalizable to other healthcare settings. The retrospective design also depended on the completeness and accuracy of medical records, introducing the potential for information bias. Additionally, variables such as timing of antibiotic prophylaxis, surgeon experience, operative technique, and long-term postoperative outcomes were unavailable. Prospective multicenter studies are warranted to validate

these findings and improve pediatric surgical risk stratification.

## CONCLUSION

Postoperative complications remain common among children undergoing abdominal surgery, with more than half of the patients in the present cohort experiencing at least one adverse postoperative event. Surgical site infection was the most frequently encountered complication. Emergency surgery, higher ASA physical status, prolonged operative duration, increased intraoperative blood loss, contaminated or dirty wounds, preoperative anemia, comorbidities, and undernutrition were identified as independent predictors of postoperative complications. These findings emphasize the importance of comprehensive preoperative assessment, optimization of nutritional and hematological status, meticulous intraoperative technique, and standardized perioperative care pathways to improve surgical outcomes. Early identification of high-risk patients and implementation of targeted preventive strategies may substantially reduce postoperative morbidity and enhance the quality of pediatric surgical care, particularly in resource-limited settings. Further prospective multicenter studies are recommended to validate these findings and inform evidence-based perioperative risk stratification in pediatric abdominal surgery.

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The authors received no external funding for this study.

### Conflict of Interest

The authors declare that they have no competing interests.

### Authors' Contributions

All authors contributed substantially to the conception and design of the study, acquisition of data, statistical analysis, interpretation of results, drafting of the manuscript, and critical revision of the article for important intellectual content. All authors reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

### Data Availability

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

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