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Morbidity and Mortality Associated with General Anesthesia Practices in Dentistry at the University Clinics of Kinshasa

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ABSTRACT

Introduction

General anesthesia in oral and maxillofacial surgery is essential for the management of complex or non-cooperative patients. However, it remains associated with significant morbidity and mortality, particularly in resource-limited settings.

Purpose

This study aimed to assess morbidity and mortality related to general anesthesia in odontostomatological surgery at the University Clinics of Kinshasa and to identify associated risk factors.

Methods

A retrospective analytical study was conducted among 418 patients who underwent odontostomatological surgery under general anesthesia. Sociodemographic, anesthetic, intraoperative, and postoperative data were collected and analyzed. Factors associated with mortality were identified using multivariate logistic regression analysis.

Results

The majority of patients were male (55.3%), and 30.6% were younger than 15 years. Patients classified as ASA III–IV accounted for 24.6% of cases. The most frequent intraoperative complications were hypoxemia (12.4%) and hypotension (10.5%). Postoperative complications included severe pain (23.4%) and postoperative nausea and vomiting (16.3%). The overall mortality rate was 5.0% (n = 21 deaths), including 2.15% anesthesia-related deaths, 1.44% deaths within the first 24 postoperative hours, and 1.44% between postoperative days 1 and 7. Seven-day survival was estimated at 95%. Independent predictors of mortality were ASA class ≥III (adjusted odds ratio [aOR] = 2.87, 95% confidence interval [CI] [1.62, 5.09], $p < 0.001$), difficult intubation (aOR = 3.41, 95% CI [1.78, 6.52], $p < 0.001$), emergency surgery (aOR = 2.11, 95% CI [1.18, 3.77], $p = 0.011$), and intraoperative hypoxemia (aOR = 2.95, 95% CI [1.71, 5.08], $p < 0.001$).

Conclusion

General anesthesia in odontostomatological surgery in Kinshasa is associated with high morbidity and considerable mortality, mainly related to respiratory complications and airway management difficulties. Strengthening perioperative monitoring and implementing standardized safety protocols are essential to improve patient outcomes.

INTRODUCTION

General anesthesia (GA) in oral and maxillofacial surgery constitutes an essential component of the management of patients requiring complex, urgent, or non-feasible procedures under local anesthesia. Despite major advances in anesthetic safety worldwide, the perioperative period remains associated with significant morbidity and variable mortality depending on healthcare settings.

Globally, substantial disparities persist in perioperative safety outcomes. In high-income countries, improvements in perioperative monitoring, standardization of anesthetic practices, and specialized training have reduced anesthesia-related mortality to extremely low levels, estimated at fewer than 1 death per 100,000 to 1,000,000 procedures (Bainbridge et al., 2012; World Health Organization [WHO], 2018). Conversely, in low- and middle-income countries (LMICs), perioperative mortality remains considerably higher, often several-fold greater than rates reported in high-resource settings, largely because of structural, human-resource, and technical limitations (Biccard et al., 2018; WHO, 2021).

Oral and maxillofacial surgery presents specific anesthetic challenges related to airway management, proximity of the surgical field to the respiratory tract, and the frequent occurrence of emergency situations. Respiratory complications, particularly hypoxemia and difficult intubation, remain the most commonly reported adverse events during general anesthesia in this field (Apfelbaum et al., 2022; Cook & MacDougall-Davis, 2021). Without early recognition and adequate monitoring, these complications may rapidly progress to severe or fatal outcomes.

In resource-limited environments, these risks are further amplified by inadequate monitoring equipment, shortages of specialized anesthesia personnel, and limited access to intensive care services. Several African studies have reported a higher incidence of critical perioperative events and anesthesia-related mortality, particularly in emergency and high-complexity surgical procedures (Makembi et al., 2025; Ponthus et al., 2024).

Furthermore, patients undergoing GA for oral and maxillofacial surgery frequently belong to vulnerable populations, including children, individuals with significant comorbidities, and patients presenting with maxillofacial trauma. These groups are associated with increased anesthetic risk, often compounded by delayed presentation and advanced American Society of Anesthesiologists (ASA) physical status at the time of surgery (Mbombo et al., 2024).

In this context, the Democratic Republic of Congo (DRC) represents a particularly relevant setting for investigating perioperative anesthesia safety. Local data remain scarce; however, available hospital-based studies suggest a substantial burden of perioperative complications and mortality exceeding international standards, especially in referral centers managing complex and emergency cases (Makembi et al., 2025; Pascal et al., 2021). In addition, organizational and material constraints continue to limit consistent implementation of international perioperative safety recommendations, including those promoted by the World Health Organization (WHO, 2016).

Despite the clinical importance of this issue, few studies have specifically evaluated morbidity and mortality associated with general anesthesia in oral and maxillofacial surgery within university hospitals in the DRC. This lack of robust local evidence represents an important scientific gap that limits the development of context-adapted preventive strategies and quality-improvement interventions.

Therefore, this study aimed to evaluate perioperative morbidity and mortality associated with general anesthesia for oral and maxillofacial surgery at the University Clinics of Kinshasa and to identify factors independently associated with perioperative complications and mortality. We hypothesized that perioperative morbidity and mortality in oral and maxillofacial anesthesia are significantly associated with both clinical factors, including elevated ASA status, hypoxemia, and difficult intubation, and organizational factors such as emergency surgery in a resource-limited setting.

METHODS

Study Design, Setting, and Period

This was a retrospective analytical observational cohort study conducted at the University Clinics of Kinshasa (UCK), Democratic Republic of Congo. This tertiary university hospital serves as a national referral center for

complex oral and maxillofacial surgical cases. The study included medical records of patients who underwent general anesthesia for oral and maxillofacial surgical procedures between January 2022 and December 2025.

The retrospective cohort design was selected because it allowed assessment of the occurrence of perioperative complications and mortality following exposure to different anesthetic and surgical factors during the perioperative period. This design is particularly appropriate for evaluating factors associated with perioperative morbidity and mortality in hospital settings where data are available from medical records. The manuscript was prepared according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational studies.

Study Population

The source population consisted of all patients who underwent oral and maxillofacial surgery under general anesthesia during the study period.

- **Inclusion Criteria:** Patients who received general anesthesia for oral and maxillofacial surgery; availability of complete anesthetic and surgical records; documented intraoperative and immediate postoperative follow-up.
- **Exclusion Criteria:** Procedures performed under local anesthesia or sedation alone; incomplete or unusable medical records; absence of data regarding immediate postoperative outcomes.
- **Management of Exclusions:** Records containing more than 20% missing data for the main exposure or outcome variables were excluded in order to minimize information bias and improve statistical reliability.

Sampling Procedure and Study Size

A consecutive exhaustive sampling approach was used, including all eligible records available during the study period. A total of 418 patients were included in the final analysis. Because of the exhaustive nature of the study, no *a priori* sample size calculation was performed. Nevertheless, the final sample size was considered sufficient to explore associations between anesthetic complications and perioperative mortality. However, given the relatively limited number of mortality events observed, the findings of multivariable analyses should be interpreted cautiously because of the potential risk of statistical instability and widening confidence intervals.

Study Variables

The variables analyzed were grouped into four categories:

- **Sociodemographic Variables:** Age and sex.
- **Pre-anesthetic Variables:** ASA physical status classification (I–V), surgical indication, emergency or elective nature of surgery, and presence of comorbidities.
- **Intraoperative Variables:** Anesthetic technique (intravenous or inhalational anesthesia), type of intubation (orotracheal or nasotracheal), difficult intubation, duration of surgery, episodes of hypoxemia, and respiratory and hemodynamic complications.
- **Postoperative Variables:** Severe postoperative pain, postoperative nausea and vomiting, surgical site infection, delayed desaturation, intensive care unit admission, and postoperative death.

Outcome Measures

- **Primary Outcome:** Overall perioperative mortality, defined as any death occurring during anesthesia, within the first 24 postoperative hours, or between postoperative day 1 and postoperative day 7.
- **Secondary Outcomes:** Intraoperative morbidity, postoperative morbidity, and 7-day survival.

Operational Definitions and Complication Grading

Anesthetic complications were defined according to international perioperative safety standards:

- **Difficult intubation:** Difficult glottic exposure or requirement for multiple intubation attempts according to American Society of Anesthesiologists criteria.
- **Hypoxemia:** Peripheral oxygen saturation (SpO_2) < 90% for more than one minute.
- **Intraoperative hypotension:** Reduction in systolic blood pressure ≥20% from baseline value.

- **Complication Severity Classification:** Minor complications (events without immediate life-threatening consequences) and major complications (events threatening vital prognosis, requiring resuscitation or intensive care admission, or resulting in death).

Data Collection Procedures

Data were extracted from anesthetic records, operative reports, intraoperative monitoring sheets, and hospitalization registers. A pretested standardized data collection form was used to ensure uniformity and reproducibility of collected information.

Statistical Analysis

Data entry and analysis were performed using Jamovi statistical software. A data quality control procedure was conducted before analysis, including verification of completeness, consistency, and plausibility of recorded variables. Categorical variables were summarized using frequencies and percentages. Associations between explanatory variables and perioperative mortality were first evaluated using univariable logistic regression analysis.

Variables with a p-value < 0.20 in univariable analysis, as well as variables considered clinically relevant, were included in a multivariable logistic regression model to identify factors independently associated with mortality. Potential confounding variables considered in the multivariable model included age, sex, ASA physical status, emergency surgery, difficult intubation, intraoperative hypoxemia, and duration of surgery. Results were expressed as crude odds ratios (ORs) and adjusted odds ratios (aORs) with their corresponding 95% confidence intervals (95% CIs). Statistical significance was set at $p < 0.05$. Given the limited number of mortality events observed, multivariable results were interpreted cautiously to minimize the risk of overfitting and unstable estimates.

Ethical Considerations

This study was approved by the Ethics Committee of the School of Public Health of the University of Kinshasa under approval number 29/CE/2025. All data were anonymized to ensure patient confidentiality. Because of the retrospective nature of the study, individual informed consent was waived.

Methodological Limitations

This study has several limitations inherent to its retrospective design, including potential information bias related to the quality of medical records, inter-provider variability in documentation of anesthetic events, absence of follow-up beyond postoperative day 7, and a limited number of mortality events, which may reduce the stability of multivariable models and widen confidence intervals. Nevertheless, this study provides important data regarding anesthetic safety in oral and maxillofacial surgery within a resource-limited African setting.

RESULTS

Table 1:
Sociodemographic and Clinical Characteristics of Participants (N = 418)

Variable	Subcategory	n	%
Age (years)	< 15	128	30.6
	15–24	101	24.2
	25–34	77	18.4
	35–44	60	14.4
	≥45	52	12.4
Sex	Male	231	55.3
	Female	187	44.7
ASA Physical Status	ASA I	150	35.9
	ASA II	165	39.5
	ASA III	82	19.6
	ASA IV–V	21	5.0

Note. ASA = American Society of Anesthesiologists.

The study included 418 patients. Most participants were younger than 25 years (54.8%). Males represented 55.3% of the study population (sex ratio = 1.24). According to the ASA classification, ASA II (39.5%) and ASA I (35.9%) were the most frequent categories, whereas ASA IV–V accounted for only 5.0% of cases **(Table 1)**.

Table 2:
Distribution of Patients According to Surgical Indications

Indication	n	%
Complex oral surgery	118	28.2
Impacted teeth / multiple extractions	95	22.7
Maxillofacial trauma	70	16.7
Severe orofacial infection	55	13.2
Non-cooperation (child / disability)	72	17.2
Others	8	1.9

The most common indication for surgery was complex oral surgery (28.2%), followed by impacted teeth or multiple extractions (22.7%). Non-cooperative patients (children or patients with disabilities) accounted for 17.2%. Maxillofacial trauma (16.7%) and severe orofacial infections (13.2%) were also frequent indications, while other indications remained marginal (1.9%) **(Table 2)**.

Table 3:
Distribution of Anesthetic Techniques and Airway Management

Technique / Airway Management	n	%
Inhalational general anesthesia	238	56.9
Intravenous general anesthesia	180	43.1
Orotracheal intubation	298	71.3
Nasotracheal intubation	103	24.6
Spontaneous ventilation	17	4.1

Inhalational general anesthesia was the most frequently used technique (56.9%), compared with intravenous general anesthesia (43.1%). Orotracheal intubation was the predominant airway management technique (71.3%), followed by nasotracheal intubation (24.6%). Spontaneous ventilation was rarely used (4.1%) **(Table 3)**.

Table 4:
Intraoperative Complications

Complication	n	%
Hypoxemia	52	12.4
Hypotension	44	10.5
Rhythm disorders (Arrhythmias)	33	7.9
Laryngospasm	24	5.7
Difficult intubation	22	5.3
Bronchospasm	12	2.9
Vomiting / aspiration	11	2.6
Cardiorespiratory arrest	5	1.2

The most frequent intraoperative complications were hypoxemia (12.4%) and hypotension (10.5%). Cardiac arrhythmias occurred in 7.9% of cases. Airway-related complications included laryngospasm (5.7%) and difficult intubation (5.3%). Bronchospasm (2.9%) and vomiting/aspiration (2.6%) were less frequent. Cardiorespiratory arrest was rare but severe, occurring in 1.2% of cases. Overall, respiratory and hemodynamic complications were predominant **(Table 4)**.

Table 5:
Postoperative Complications

Complication	n	%
Severe pain	98	23.4
Nausea / vomiting	68	16.3
Surgical site infection	39	9.3
Secondary hemorrhage	31	7.4
Delayed desaturation	18	4.3
Admission to intensive care unit	10	2.4

Severe postoperative pain was the most frequent complication (23.4%), followed by postoperative nausea and vomiting (16.3%). Surgical site infection occurred in 9.3% of patients, while secondary hemorrhage was observed in 7.4%. Delayed desaturation (4.3%) and ICU admission (2.4%) were less frequent but reflected severe postoperative outcomes **(Table 5)**.

Table 6:
Perioperative Mortality

Timing of Death	n	%
Per-anesthetic death	9	2.15
Postoperative death (≤24 h)	6	1.44
Postoperative death (1–7 days)	6	1.44
Overall mortality	**21**	**5.0**

Peri-anesthetic mortality was 2.15% (n = 9). Postoperative deaths occurred in 1.44% of patients within the first 24 hours and in 1.44% between postoperative days 1 and 7. Overall mortality was 5.0% (n = 21). These findings indicate a non-negligible perioperative mortality burden in this population **(Table 6)**.

Table 7:
Factors Associated with Anesthetic Complications (Univariable Analysis)

Variable	Crude Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
ASA class ≥III	3.21	[2.01, 5.12]	< 0.001
Surgical emergency	2.54	[1.61, 4.01]	< 0.001
Duration > 2 hours	2.18	[1.39, 3.41]	0.001
Difficulty with intubation	3.89	[2.12, 7.13]	< 0.001
Extreme ages	1.92	[1.18, 3.12]	0.008

Note. ASA = American Society of Anesthesiologists.

An ASA status ≥III was significantly associated with anesthetic complications (OR= 3.21, 95% CI [2.01, 5.12], p < 0.001). Emergency surgery also increased the risk (OR= 2.54, 95% CI [1.61, 4.01], p < 0.001), as did surgical duration > 2 hours (OR= 2.18, 95% CI [1.39, 3.41], p = 0.001). Difficult intubation was the strongest associated factor (OR= 3.89, 95% CI [2.12, 7.13], p < 0.001). Extreme age groups were also significantly associated with complications (OR= 1.92, 95% CI [1.18, 3.12], p = 0.008) **(Table 7)**.

Table 8:
Independent Predictors of Anesthetic Complications (Multivariable Analysis)

Variable	Adjusted Odds Ratio (aOR)	95% Confidence Interval (CI)	p-value
ASA class ≥III	2.87	[1.62, 5.09]	< 0.001
Surgical emergency	2.11	[1.18, 3.77]	0.011
Difficulty with intubation	3.41	[1.78, 6.52]	< 0.001
Intraoperative hypoxemia	2.95	[1.71, 5.08]	< 0.001

Note. ASA = American Society of Anesthesiologists.

In multivariable logistic regression analysis, ASA ≥III (aOR = 2.87, 95% CI [1.62, 5.09], p < 0.001), emergency surgery (aOR = 2.11, 95% CI [1.18, 3.77], p = 0.011), difficult intubation (aOR = 3.41, 95% CI [1.78, 6.52], p < 0.001), and intraoperative hypoxemia (aOR = 2.95, 95% CI [1.71, 5.08], p < 0.001) remained independently associated with anesthetic complications. Difficult intubation emerged as the strongest independent predictor **(Table 8)**.

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DISCUSSION

Principal Findings and Interpretation

This study provides one of the first hospital-based analyses from the Democratic Republic of the Congo focusing specifically on perioperative morbidity and mortality associated with general anesthesia in oral and maxillofacial surgery. The findings reveal a high burden of anesthetic complications and a global perioperative mortality rate of 5.0%, highlighting persistent challenges in the delivery of safe anesthesia in low-resource settings.

Beyond the numerical results, the present study underscores the close relationship between perioperative mortality and systemic limitations in anesthesia safety infrastructure. The predominance of respiratory complications, particularly hypoxemia (12.4%), and hemodynamic instability reflects the vulnerability of shared-airway procedures in oral surgery, where airway access is technically challenging and interruption of ventilation may rapidly occur. Similar observations have been reported in African perioperative cohorts, where respiratory adverse events remain among the leading preventable causes of anesthesia-related mortality (Biccard et al., 2018; Ponthus et al., 2024).

The overall mortality rate observed in this series is substantially higher than figures reported in high-income countries, where anesthesia-related mortality in oral surgery is estimated at fewer than 1 death per 100,000 procedures. This discrepancy illustrates persistent global inequities in perioperative safety. In high-resource environments, reductions in anesthesia mortality have been achieved through systematic monitoring, continuous capnography, standardized airway algorithms, simulation-based training, and availability of intensive care resources. In contrast, many low- and middle-income countries continue to face deficiencies in monitoring equipment, workforce density, emergency preparedness, and postoperative critical care capacity (Atanda et al., 2023; Bainbridge et al., 2012).

The mortality rate observed in our study should therefore not be interpreted solely as a reflection of anesthetic practice, but rather as the consequence of interacting patient-, procedure-, and health-system-related factors. A substantial proportion of patients presented with ASA ≥III status and underwent urgent or complex procedures, suggesting delayed presentation and advanced disease severity at admission. Such late-stage presentations are frequently reported in sub-Saharan African surgical settings due to socioeconomic barriers, delayed referral systems, and limited access to specialized care (Kintieti et al., 2025; Walker et al., 2013).

Respiratory Complications and Airway Management Challenges

Respiratory complications represented the dominant perioperative events in this cohort. Hypoxemia emerged as an independent predictor of mortality (aOR = 2.95), confirming its central role in perioperative deterioration. This finding is consistent with contemporary evidence indicating that preventable hypoxic events remain a major contributor to anesthesia-related cardiac arrest in low-resource settings (Ponthus et al., 2024).

The high incidence of difficult intubation and airway-related complications deserves particular attention. Oral and maxillofacial procedures inherently expose patients to elevated airway risks because the surgical field overlaps with the anesthetic airway. Blood, secretions, facial deformities, infection, or trauma may further complicate airway control. In our study, difficult intubation was the strongest independent determinant of mortality (aOR = 3.41), emphasizing the importance of airway preparedness and advanced airway management competencies.

International guidelines from the American Society of Anesthesiologists emphasize that anticipation of difficult airway situations, access to advanced airway devices, and use of structured algorithms significantly reduce severe hypoxic complications and avoidable deaths (Apfelbaum et al., 2022). However, implementation of these recommendations remains difficult in many African hospitals because of limited access to videolaryngoscopy, fiberoptic equipment, capnography, and difficult-airway carts.

Influence of Patient Severity and Emergency Surgery

Patients with ASA physical status ≥III had nearly threefold increased odds of mortality. Although ASA classification primarily reflects baseline physiological vulnerability and comorbid disease burden, in low-resource settings it may also indirectly reflect delayed healthcare access and poor optimization before surgery. Similar associations between

elevated ASA status and perioperative mortality have been reported across African surgical cohorts (Biccard et al., 2018; Kintieti et al., 2025).

Emergency surgery was also independently associated with mortality. Urgent procedures often limit adequate preoperative evaluation, optimization of comorbidities, and airway planning. Moreover, emergency cases are frequently performed under organizational pressure and resource constraints, conditions that may compromise adherence to safety standards. Previous studies in sub-Saharan Africa have consistently shown higher perioperative mortality among emergency surgical patients due to delayed presentation, sepsis, trauma, and limited postoperative intensive care availability (Walker et al., 2013).

Postoperative Morbidity and Continuity of Perioperative Care

Postoperative morbidity remained considerable, particularly severe pain (23.4%) and postoperative nausea and vomiting (16.3%). These findings likely indicate insufficient implementation of multimodal analgesia and antiemetic protocols. In many low-resource settings, limited access to opioid-sparing medications, regional anesthesia techniques, and standardized recovery pathways contributes to avoidable postoperative suffering and delayed recovery (Kaye et al., 2019).

Additionally, the occurrence of delayed desaturation and intensive care admissions suggests that postoperative surveillance capacity may be insufficient for high-risk patients. Perioperative safety extends beyond intraoperative management and requires continuity of monitoring during the immediate postoperative period, especially after airway or respiratory complications.

Health-System Implications and Comparison with International Literature

The present findings highlight major disparities between perioperative outcomes in low-income settings and those reported internationally. While anesthesia safety has significantly improved worldwide, progress remains uneven because many African institutions continue to face structural limitations, including:

- Inadequate monitoring equipment availability;
- Inconsistent access to pulse oximetry and capnography;
- Shortage of trained anesthesia providers;
- Absence of simulation-based crisis training;
- Insufficient postoperative critical care capacity.

These systemic deficiencies contribute directly to delayed recognition and treatment of respiratory and hemodynamic deterioration. The World Health Organization and the Lancet Commission on Global Surgery have emphasized that strengthening perioperative systems is essential to reducing preventable surgical mortality worldwide. Implementation of standardized perioperative safety strategies could substantially improve outcomes in our setting. These include routine use of the WHO Surgical Safety Checklist, systematic capnography monitoring, difficult-airway protocols, continuing professional education, and strengthening postoperative recovery and critical care services.

Methodological Limitations

Several limitations should be considered when interpreting these findings. First, the retrospective design exposed the study to risks of incomplete documentation, missing data, and information bias. Although records with more than 20% missing data were excluded and quality control procedures were performed, underreporting of minor complications remains possible.

Second, the relatively small number of deaths may have limited the stability of multivariable regression estimates, potentially contributing to wide confidence intervals for some predictors. Consequently, associations identified in this study should be interpreted cautiously.

Third, the single-center design may limit external validity and generalizability to other healthcare settings in the Democratic Republic of Congo or sub-Saharan Africa.

Fourth, the absence of long-term postoperative follow-up beyond 7 days may have underestimated delayed morbidity and mortality outcomes.

Finally, variability in clinical practice and documentation between anesthetic providers could have introduced

measurement bias, particularly regarding the reporting of intraoperative complications.

Strengths of the Study

Despite these limitations, this study has several important strengths. It represents one of the first Congolese investigations specifically addressing anesthesia-related morbidity and mortality in oral and maxillofacial surgery. The inclusion of 418 patients provides meaningful insight into perioperative outcomes in a real-world African university hospital setting. Furthermore, the use of multivariable logistic regression enabled identification of independent mortality predictors, including hypoxemia, difficult intubation, elevated ASA status, and emergency surgery. These findings may contribute to the development of locally adapted perioperative safety strategies and future multicenter research initiatives.

Clinical Implications and Recommendations

The findings of this study emphasize the urgent need to strengthen perioperative safety systems in university hospitals in the Democratic Republic of Congo. Priority interventions should include:

- Systematic availability of continuous capnography and pulse oximetry;
- Implementation of WHO Surgical Safety Checklist protocols;
- Establishment of standardized difficult-airway management algorithms;
- Development of simulation-based anesthesia training programs;
- Reinforcement of postoperative recovery and intensive care capacity.

In addition, creation of a national perioperative complications registry could facilitate continuous quality improvement, benchmarking, and surveillance of anesthesia-related outcomes.

CONCLUSION

This study suggests that general anesthesia for oral and maxillofacial surgery at the University Clinics of Kinshasa is associated with a considerable burden of perioperative morbidity and a relatively high mortality rate compared with reports from high-income settings. Perioperative hypoxemia, difficult intubation, elevated ASA status, and emergency surgery were identified as factors significantly associated with mortality.

These findings highlight the potential contribution of respiratory complications, airway management challenges, and perioperative system constraints to adverse anesthetic outcomes in low-resource environments. However, interpretation of these associations should remain cautious given the retrospective single-center design, the limited number of mortality events, and the possibility of incomplete documentation and residual confounding. The study nevertheless underlines the importance of strengthening perioperative safety through improved monitoring capacity, enhanced airway management preparedness, implementation of standardized perioperative safety protocols, and reinforcement of postoperative critical care services. In addition, continuous professional training and wider adoption of the WHO Surgical Safety Checklist may contribute to reducing preventable perioperative complications. Further prospective multicenter studies with larger sample sizes and longer postoperative follow-up are needed to better characterize anesthesia-related outcomes and guide evidence-based perioperative safety strategies in the Democratic Republic of Congo and similar low-resource settings.

Use of Artificial Intelligence (AI) Declaration: The authors declare that artificial intelligence (AI) tools were used solely to assist with language editing and improving the clarity of the manuscript. All scientific content, data analysis, interpretation of results, and conclusions were reviewed and validated by the authors, who take full responsibility for the content of this publication.

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i. **Conceptualization:** DK, EK, TB, BB, NF, BM, AK
ii. **Formal analysis:** TB, DK, EK, BB, NF, BM
iii. **Investigation:** TB, DK, EK, LK
iv. **Writing – original draft:** EK, LK, MM, BB, NF
v. **Writing – review & editing:** All authors

Data Availability Statement: The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

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Informed Consent and Anonymity: All data were anonymized to ensure patient confidentiality. Because of the retrospective nature of the study, individual informed consent was waived.

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