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Intraoperative cardiac arrest: A retrospective analysis of incidence, etiologies and mortality in a university hospital in Madagascar

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Abstract

Background: Cardiac arrest occurring in the operating room is a rare but severe complication associated with high mortality. Data from Madagascar remain limited. This study aimed to describe the incidence, probable causes, and outcomes of patients who experienced intraoperative cardiac arrest at the University Hospital Center Professor Zafisaona Gabriel of Mahajanga.

Methods: A retrospective descriptive study was conducted from June 1, 2019, to June 30, 2024. All patients who experienced a documented cardiac arrest in the operating room during the study period were included. Data were collected from operating room registers, anesthesia records, operative reports, and intensive care unit files.

Results: Among 8,900 anesthetic procedures, 49 patients experienced cardiac arrest, corresponding to an incidence of 0.55% or 5.5 per 1,000 anesthetics. The mean age was 24.7 years, and females accounted for 73.5% of cases. Most patients were classified as American Society of Anesthesiologists physical status III and underwent emergency surgery. The main identified causes were hemorrhagic shock (38.8%) and hypoxia (30.6%). Return of spontaneous circulation was achieved in 83.7% of patients. Overall in-hospital mortality was 59.2%.

Conclusion: Intraoperative cardiac arrest mainly occurred in high-risk patients undergoing emergency surgery. Hemorrhagic shock and hypoxia were the leading causes. Despite a high rate of return of spontaneous circulation, hospital mortality remained substantial.

Keywords: Anesthesia; Emergency surgery; Intraoperative cardiac arrest; Hemorrhagic shock; Hypoxia; Mortality

1. Introduction

Perioperative cardiac arrest is one of the most feared complications in anesthesiology and critical care. Although relatively uncommon, it remains associated with high mortality and is considered a major indicator of the quality and safety of perioperative care (1). Its occurrence often results from a complex interaction between the patient's clinical condition, the underlying surgical pathology, anesthetic factors, and the resources available for managing critical events. Over the past decades, advances in anesthesia, patient monitoring, and critical care have led to a significant reduction

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in the incidence of perioperative cardiac arrest in high-income countries. Nevertheless, this complication continues to represent a major challenge in low-resource settings (2). Indeed, studies conducted in low- and middle-income countries have reported substantially higher rates of perioperative cardiac arrest than those observed in developed countries (3,4). Several factors have been identified as being associated with the occurrence of cardiac arrest in the operating room. In Madagascar, data regarding perioperative cardiac arrest remain limited. The lack of local information on its incidence, circumstances of occurrence, etiologies, and outcomes constitutes an obstacle to the development of appropriate strategies aimed at preventing such events and improving anesthesia safety. The present study aimed to describe the incidence of perioperative cardiac arrests occurring in the operating rooms of the Professor Zafisaona Gabriel University Hospital Center of Mahajanga, as well as their probable etiologies and patient outcomes.

2. Materials and methods

2.1. Study Setting

This study was conducted in the central operating theater, the Mother and Child Complex (MCC) operating rooms, and the surgical intensive care unit of the Professor Zafisaona Gabriel University Hospital Center (CHU PZaGa) in Mahajanga, Madagascar. This institution is the main medical and surgical referral center in the northwestern region of Madagascar. The central operating theater provides surgical care for both adult and pediatric patients. Surgical specialties performed in this center include general surgery, visceral surgery, urology, otorhinolaryngology, maxillofacial surgery, neurosurgery, and trauma surgery. The Mother and Child Complex has two operating rooms dedicated to obstetric and gynecological procedures. Each operating room is equipped with standard multiparameter monitoring. However, no defibrillator was available in the operating theaters during the study period. The surgical intensive care unit provides postoperative patient management and follow-up.

2.2. Study design and period

This was a retrospective, descriptive, observational study conducted over a five-year period from June 1, 2019, to June 30, 2024.

2.3. Study population

The source population consisted of all patients who underwent surgery under general or regional anesthesia during the study period. The target population included all patients who experienced cardiac arrest in the operating room. These patients were subsequently followed in the post-anesthesia care unit and the intensive care unit to assess their outcomes. In this study, cardiac arrest was defined as the absence of a central pulse and cessation of effective ventilation requiring the initiation of cardiopulmonary resuscitation (CPR).

2.3.1. Inclusion criteria

All complete and exploitable medical records of patients, regardless of age, who experienced a documented perioperative cardiac arrest in the operating room during the study period were included, irrespective of the timing of occurrence within the perioperative period.

2.3.2. Exclusion criteria

Incomplete or non-exploitable medical records were excluded, particularly those lacking sufficient information regarding the circumstances of cardiac arrest, its management, or patient outcomes. Cardiac arrests occurring before the induction of anesthesia or in the post-anesthesia care unit, as well as patients transferred after experiencing a cardiac arrest in another healthcare facility, were also excluded.

2.4. Sampling

An exhaustive sampling method was used, including all cases meeting the selection criteria during the study period.

2.5. Study variables

2.5.1. Sociodemographic variables

- Age;
- Sex.

2.5.2. Preoperative and pre-anesthetic variables

- American Society of Anesthesiologists (ASA) physical status classification;
- Pre-existing comorbidities;
- Preoperative clinical severity signs, including: hemodynamic (shock, hypotension, or hypertension), respiratory (dyspnea), neurological (altered Glasgow Coma Scale score or seizures), and infectious (sepsis or septic shock).

2.5.3. Procedure-related variables

- Surgical specialty;
- Type of anesthesia.

2.5.4. Cardiac arrest-related variables

- Timing of cardiac arrest occurrence;
- Presumed etiology of cardiac arrest.

2.5.5. Management-related variables

- Duration of cardiopulmonary resuscitation.

2.5.6. Outcome variables

- Return of spontaneous circulation (ROSC);
- Survival at discharge from the operating room;
- Postoperative survival until hospital discharge when information was available.

2.6. Data collection

Data were collected from operating room registers, anesthesia records, operative reports, patients' medical records, and intensive care unit registers for transferred patients. A standardized data collection form was developed to ensure consistency and quality of data collection.

2.7. Statistical analysis

Data were entered and analyzed using Microsoft Excel® and RStudio® software. A descriptive analysis was performed. Categorical variables were expressed as frequencies and percentages. Continuous variables were summarized as means and standard deviations when normally distributed, or as medians and interquartile ranges when non-normally distributed.

The incidence of perioperative cardiac arrest was calculated by dividing the number of observed cardiac arrests by the total number of anesthetic procedures performed during the study period.

2.8. Ethical considerations

The study was conducted after obtaining administrative authorization from the Director of CHU PZaGa and the heads of the operating theaters involved. Data confidentiality was strictly maintained throughout the study. All collected information was anonymized, coded, and stored in a secure location accessible only to the investigators. No patient-identifying information was collected or disclosed. Due to its retrospective and non-interventional nature, the study posed no additional risk to patients.

2.9. Study limitations

This single-center study was conducted exclusively at CHU PZaGa. Therefore, the generalizability of the findings to other healthcare institutions should be interpreted with caution. Furthermore, the retrospective design may have resulted in missing or incomplete data, potentially affecting the completeness of certain analyses. In addition, some information regarding the circumstances surrounding cardiac arrest events or specific resuscitation procedures may not have been systematically documented in the medical records.

3. Results

3.1. Incidence of perioperative cardiac arrest

During the study period, a total of 8,900 anesthetic procedures were performed in the operating rooms of CHU PZaGa. Among these, 49 patients experienced a perioperative cardiac arrest, corresponding to an incidence of 0.55%, or 5.5 cardiac arrests per 1,000 anesthetic procedures (Figure 1).

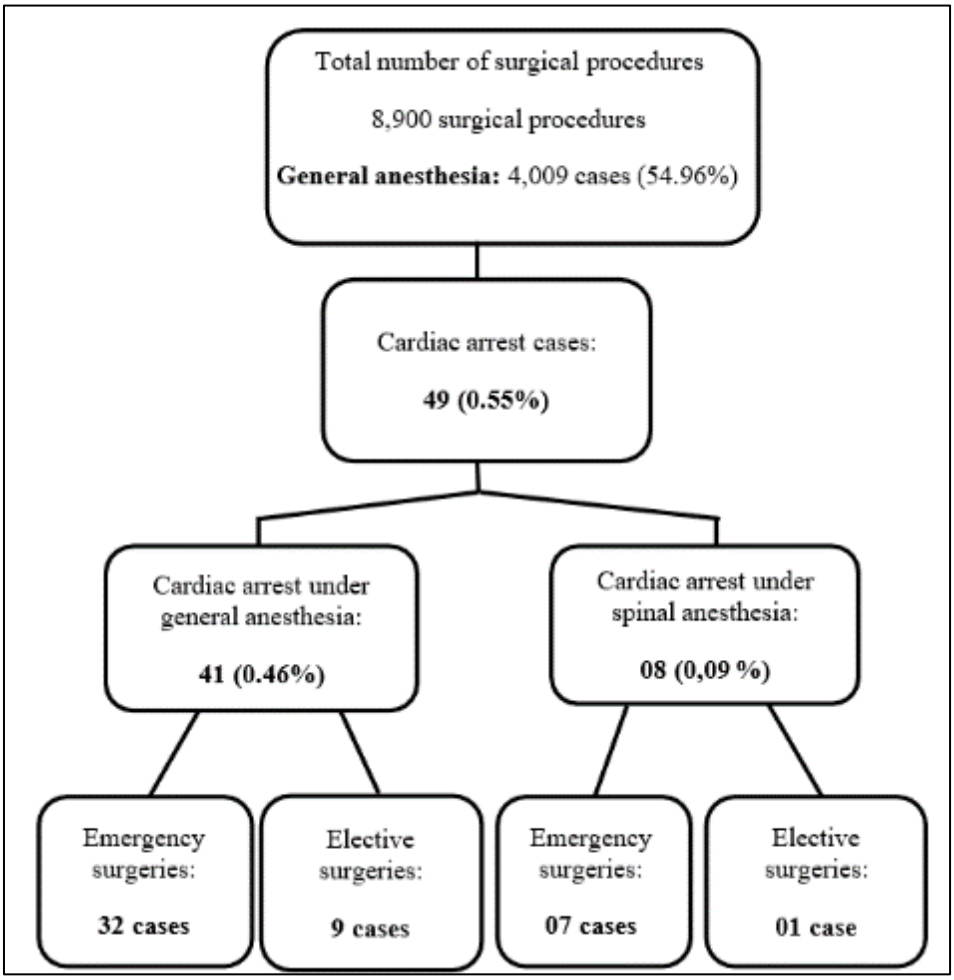

Figure 1 Flow diagram of study cases

3.2. Patient and procedure characteristics

Patient and procedure characteristics are summarized in Table 1.

The patients were predominantly young, with a mean age of 24.7 ± 14.2 years, and were mainly female (73.5%), yielding a male-to-female sex ratio of 0.36. Most patients had an impaired preoperative physical status, with a predominance of ASA III patients (61.2%). The procedures were mainly performed in emergency settings (79.6%) and were predominantly obstetric surgeries (51.0%). General anesthesia was the most frequently used anesthetic technique.

Table 1 Patient and procedure characteristics

	Number (n=49)	**Percentage (%)**
Antécédents		
Hypertension	4	8.2
Diabete	1	2.0

Heart failure	1	2.0
Chronic kidney disease	1	2.0
Asthma	1	2.0
ASA class		
ASA I	8	16.3
ASA II	9	18.4
ASA III	30	61.2
ASA IV	2	4.1
Type of anesthesia		
General anesthesia	41	83.7
Spinal anesthesia	8	16.3
Type of surgery		
Obstetric	25	51.0
Visceral	8	16.3
Neurosurgery	4	8.2
Urology	4	8.2
Gynecology	3	6.1
Otorhinolaryngology	3	6.1
Maxillofacial	2	4.1

3.3. Patients' clinical status before surgery

A substantial proportion of patients presented with preoperative signs of clinical severity. The most frequently observed abnormalities were hypotension (34.7%), sepsis (32.6%), a Glasgow Coma Scale score between 3 and 9 (30.6%), and dyspnea (26.5%) (Table 2).

Table 2 Preoperative clinical severity signs

	Number (n)	**Percentage (%)**
Hemodynamic signs		
Shock	9	18.4
Hypotension	17	34.7
Hypertension	10	20.4
Respiratory signs		
Dyspnea	13	26.5
Acute pulmonary edema	4	8.2
Neurological signs		
Glasgow coma scale (10 – 14)	2	4.1
Glasgow coma scale (3 – 9)	15	30.6
Seizure	10	20.4

Infectious signs		
Sepsis	16	32.6

Note: A single patient could present one or more preoperative clinical abnormalities.

3.4. Circumstances and causes of perioperative cardiac arrests

The circumstances of occurrence and the probable causes of cardiac arrests are presented in Table 3. The majority of events occurred during the maintenance phase of anesthesia (61.2%). Hemorrhagic shock (38.8%) and hypoxia related to difficult ventilation or intubation (30.6%) were the two main identified causes, together accounting for nearly 70% of observed cardiac arrests.

Table 3 Circumstances and causes of perioperative cardiac arrests

	Number (n)	**Percentage (%)**
Timing of occurrence		
Anesthetic induction phase	19	38.8
Anesthetic maintenance phase	30	61.2
Probable cause		
Hemorrhagic shock	19	38.8
Hypoxia	15	30.6
Septic shock	5	10.2
Intracranial hypertension	4	8.2
Cardiac decompensation	3	6.1
Acute pulmonary edema	2	4.1
Myocardial infarction	1	2

3.5. Duration of resuscitation

The mean duration of cardiopulmonary resuscitation was 14.1 ± 13.3 minutes. The median duration was 10 minutes, with a range from 1 to 40 minutes.

3.6. Patient outcomes

The management modalities and patient outcomes are summarized in Table 4.

Despite a high rate of return of spontaneous circulation after resuscitation, postoperative mortality remained high. Overall, 29 patients died during hospitalization, corresponding to a global mortality rate of 59.2%.

Table 4 Outcomes of patients following perioperative cardiac arrest

	Number (n)	**Percentage (%)**
Return of spontaneous circulation (ROSC)	41	83.7
No return of spontaneous circulation (no ROSC)	8	16.3
Death within 24 hours postoperatively	17	34.7
Death after 24 hours postoperatively	4	8.2
Survival to hospital discharge	20	40.8
Overall mortality	29	59.2

A total of 29 patients died, including 8 who did not achieve return of spontaneous circulation, 17 who died within the first 24 postoperative hours, and 4 who died beyond 24 hours postoperatively.

4. Discussion

In our study, the incidence of perioperative cardiac arrest was 0.55%, corresponding to 5.5 cases per 1,000 anesthetic procedures. This incidence is higher than those reported in high-income countries, where the observed rates are generally much lower (3–6). An international meta-analysis showed that perioperative cardiac arrests remain more frequent in low- and middle-income countries than in high-income countries (7). The mean age of our patients was 24.7 years, and women accounted for 73.5% of cases. This female predominance is mainly explained by the high proportion of obstetric surgery. Similar findings have been reported in several african studies, where obstetric emergencies contribute substantially to perioperative morbidity and mortality (8,9).

Most patients were classified as ASA III or ASA IV and frequently presented with preoperative signs of severity, including hypotension, sepsis, shock, or neurological impairment. A high ASA physical status is recognized as one of the major independent risk factors for perioperative cardiac arrest (6,10–12). In our series, most patients who experienced cardiac arrest were either ASA III or underwent emergency surgery. This observation is consistent with previous reports showing that emergency surgery is associated with a significantly increased risk of perioperative cardiac arrest and death (11,13–15).

Hemorrhagic shock was the leading cause of cardiac arrest (38.8%). This finding may be explained by the predominance of obstetric surgery and emergency procedures. Several studies conducted in resource-limited settings have similarly identified hemorrhage as a major cause of perioperative cardiac arrest and mortality (7,16,17). Hypoxia was the second most common cause of cardiac arrest in our study (30.6%). Respiratory complications, particularly difficulties with ventilation and tracheal intubation, remain among the most frequently reported causes of anesthesia-related cardiac arrest (5,18,19).

Most events occurred during the maintenance phase of anesthesia. This observation differs from some reports in which anesthetic induction is considered the period of highest risk, particularly for respiratory complications (5,18).

The mean duration of cardiopulmonary resuscitation was 14.1 ± 13.3 minutes. Several studies have demonstrated that prolonged resuscitation is associated with progressively lower survival rates, although return of spontaneous circulation may still be achieved after extended resuscitation efforts (20,21). Despite a high rate of return of spontaneous circulation (83.7%), in-hospital mortality remained substantial (59.2%). This discrepancy between initial resuscitation success and long-term survival has been reported in previous studies and reflects the impact of persistent organ dysfunction and the severity of underlying diseases (6,10,20).

The absence of a defibrillator in the operating rooms represents an organizational limitation that may compromise the optimal management of cardiac arrests presenting with a shockable rhythm. International guidelines emphasize the importance of immediate availability of resuscitation equipment in preventing avoidable anesthesia- and surgery-related deaths (22).

5. Conclusion

In this hospital-based series, perioperative cardiac arrests occurred predominantly in patients undergoing emergency surgery, presenting with severely impaired preoperative clinical status and mostly classified as ASA III. Hemorrhagic shock and hypoxia were the main identified etiologies. Although return of spontaneous circulation was achieved in more than four out of five patients, in-hospital mortality remained high, highlighting the major influence of patients' initial severity and underlying diseases on final outcomes. These findings suggest that early identification of high-risk patients, optimization of their hemodynamic and respiratory status, and prompt management of hemorrhagic emergencies could help reduce the occurrence and consequences of perioperative cardiac arrest. Improvements in perioperative monitoring and resuscitation resources may contribute to reducing mortality associated with this major complication in resource-limited settings. Prospective multicenter studies are needed to better characterize the factors associated with the occurrence and prognosis of perioperative cardiac arrest in Madagascar.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

This retrospective study was based exclusively on anonymized medical records collected during routine clinical care. No interventions involving human participants or animals were performed by the authors.

Statement of informed consent

Due to the retrospective nature of the study and the use of anonymized medical records collected during routine clinical care, informed consent from individual patients was waived.

References

[1] Botney R. Improving patient safety in anesthesia: a success story? Int J Radiat Oncol Biol Phys. 2008;71(1 Suppl):S182-S186.

[2] Walker IA, Wilson IH. Anaesthesia in developing countries-a risk for patients. Lancet. 2008;371(9617):968-969.

[3] Newland Myrna C; Ellis SJ; Lydiatt CA; Peters K R; Tinker JH; Romberger DJ. et al. Anesthestic-related cardiac arrest and mortality: a report covering 72,959 anesthetics over 10 years from a US teaching hospital. Anesthesiology. 2002. 97(1): 108-15.

[4] Braz LG, Braz JR, Módolo NS, et al. Cardiac arrest during anesthesia at a tertiary teaching hospital: prospective survey from 1996 to 2002. Rev Bras Anestesiol. 2004;54(6):755-68.

[5] Ellis SJ, Newland MC, Simonson JA, Peters KR, Romberger DJ, Mercer DW, et al. Anesthesia-related cardiac arrest. Anesthesiology. 2014;120(4):829-38.

[6] Nunnally ME, O'Connor MF, Kordylewski H, Westlake B, Dutton RP. The incidence and risk factors for perioperative cardiac arrest observed in the national anesthesia clinical outcomes registry. Anesth and Analg. 2015;120(2):364-70.

[7] Koga FA, El Dib E, Wakasugui W, Roça CT, Corrente JE, Braz MG, et al. Anesthesia-related and perioperative cardiac arrest in low- and high-income countries: a systematic review with meta-regression and proportional meta-analysis. Medicine (Baltimore). 2015;94(36) : e1465.

[8] Aloweidi A, Alghanem S, Bsisu I, Ababneh O, Alrabayah M, Al-Zaben K, et al. Perioperative cardiac arrest: a 3-year prospective study from a tertiary care university hospital. Drug Healthc Patient Saf. 2022;10;14:1-8.

[9] Maeda, M., Hirata, N., Chaki, T. *et al.* Risk factors of cardiac arrest and failure to achieve return of spontaneous circulation during anesthesia: a 20-year retrospective observational study from a tertiary care university hospital. J Anesth. 2022;36; 221-29.

[10] Gong CL, Hu JP, Qiu ZL, Zhu QQ, Hei ZQ, Zhou SL, Li X. A study of anaesthesia-related cardiac arrest from a Chinese tertiary hospital. BMC Anesthesiol.2018;18(1):127.

[11] Siriphuwanun V, Punjasawadwong Y, Lapisatepun W, Charuluxananan S, Uerpairojkit K. Incidence of and factors associated with perioperative cardiac arrest within 24 hours of anesthesia for emergency surgery. Risk Manag Healthc Policy.2014;4;7:155-62.

[12] Flick RP, Sprung J, Harrison TE, et al. Perioperative cardiac arrests in children between 1988 and 2005 at a tertiary referral center: a study of 92,881 patients. Anesthesiology. 2007;106(2):226-37.

[13] Weiser TG, Regenbogen S, Thompson K et al. An estimation of the global volume of surgery: a modelling strategy based on available data. Lancet. 2008;372(9633):139-44.

[14] Bainbridge D, Martin J, Arango M, Cheng D; Evidence-based Peri-
operative Clinical Outcomes Research (EPiCOR) Group. Perioperative and anaesthetic related mortality in developed and developing countries : a systematic and meta-analysis. Lancet. 2012; 380(9847) :1075-81.

[15] Lagasse, Robert S. Anesthesia Safety: Model or Myth?: A Review of the Published Literature and Analysis of Current Original Data. Anesthesiology. 2002 ;97(6):1609-17.

[16] Morray JP, Geiduschek JM, Ramamoorthy CMB, Haberkern, Charles M, Hackel A et al. Anesthesia-related Cardiac Arrest in Children: Initial Findings of the Pediatric Perioperative Cardiac Arrest (POCA) Registry. Anesthesiology. 2000 ;93(1):6-14.

[17] Cheney, Frederick W. The American Society of Anesthesiologists closed claims project : what have we learned, how has it affected practice, and how will it affect practice in the future?. Anesthesiology. 1999. 91(2):p 552-56.

[18] Sprung J, Flick RP, Gleich SJ, Weingarten TN. Perioperative cardiac arrests. Signa Vitae. 2008;3(2):8-12.

[19] Pearse RM, Moreno RP, Bauer P, Pelosi P, Metnitz P, Spies C et al. European Surgical Outcomes Study (EuSOS) group for the Trials groups of the European Society of Intensive Care Medicine and the European Society of Anaesthesiology. Mortality after surgery in Europe: a 7 day cohort study. Lancet. 2012;380(9847):1059-65.

[20] Schiff JH, Wagner S. Anesthesia related mortality? A national and international overview. Trends Anaest Crit Care.2016 (9) :43-48.

[21] Li G, Warner M, Lang BH, Huang L, Sun LS. Epidemiology of anesthesia-related mortality in the United States, 1999-2005. Anesthesiology. 2009;110(4):759-65.

[22] Armstrong RA, Soar J, Kane AD, Kursumovic E, Nolan JP, Oglesby FC, et al. Peri-operative cardiac arrest: epidemiology and clinical features of patients analysed in the 7th National Audit Project of the Royal College of Anaesthetists. Anaesthesia. 2023 ;79: 18-30.