ORIGINAL ARTICLE

Cardiac arrest during anesthesia at a University Hospital in Nigeria

A Rukewe, A Fatiregun[1], TO Osunlaja

Department of Anesthesia, [1]Faculty of Public Health, Department of Epidemiology and Medical Statistics, College of Medicine, University College Hospital, Ibadan, Oyo State, Nigeria

Abstract

Background: We assessed the incidence and outcomes of cardiac arrest during anesthesia in the operating room at our university hospital. A previous study on intraoperative cardiac arrests covered a period from 1994-1998 and since then; anesthetic personnel, equipment, and workload have increased remarkably.

Materials and Methods: After obtaining institutional ethics approval, we retrospectively reviewed patients' hospital records such as anesthetic charts and register and ICU admission charts between 1st July 2005 and 30th June 2010. The cardiac arrests encountered during anesthesia was identified from anesthetic charts and followed-up in the intensive care unit (ICU) for the first 24 h postoperatively. We consider that cardiac arrest occurred in any patient under anesthesia with asystole or ventricular fibrillation requiring cardiac compression or electrical defibrillation. We define recovery as an alive and non-comatose patient 24-h after the cardiac arrest.

Results: During the study period, a total of 12,143 surgeries were done; the median age of all the patients was 30 years (range: 1 day-119 years). A total of 31 cardiac arrests identified (frequency 25.5:10,000; 95% confidence interval (CI) 17.7-35.8) out of which 17 were nonfatal. Mortality related to anesthesia was 11.5:10,000 (95% CI 6.5-18.9). The median age of patients with cardiac arrests was 39 years (range: 2 months–78 years). Overall, 80.7% cardiac arrests occurred in the American Society of Anesthesiologists' (ASA) physical status 3-5. Cardiothoracic and neurosurgical operations accounted for 54.8% of the total cardiac arrests. The known risk factors identified among those who had cardiac arrest were, ASA physical status 3-5 (80.7%), procedures performed out-of-work hours (60%), and manually ventilating patients during general anesthesia (39%).

Conclusion: Cardiac arrest during anesthesia is higher in poor risk patients (ASA 3-5) who are manually ventilated under general anesthesia and operated during out-of-work hours.

Key words: Anesthesia, cardiac arrest, fatal, nonfatal, outcome

Date of Acceptance: 07-Mar-2013

Introduction

Intraoperative cardiac arrest is not common and it will be difficult to develop preventive measures, if the mechanism of occurrence is not understood. According to Aitkenhead,[1] the state of anesthesia is intrinsically unsafe. Minor complications occur more frequently than major events. In recent decades, there has been a decline in perioperative critical incidents due to new techniques in anesthetic and surgical practices and improved monitoring techniques.[2] A Japanese study of 3,855,384 anesthetics conducted over a 4-year period reported a cardiac arrest incidence of 6.34/10,000 with 7.5% attributable to anesthetic management.[3] Some studies reported a range of 1.10-19.70 per 10,000 anesthetics.[4-6] A previous study on intraoperative cardiac arrests in this hospital covered a period from 1994-1998 and since then; anesthetic personnel, equipment,

Address for correspondence:
Dr. Ambrose Rukewe,
Department of Anesthesia, University College Hospital, Ibadan, Oyo State, Nigeria.
E-mail: ambyrukewe@gmail.com

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/1119-3077.122829

PMID: *******

and workload have increased remarkably.[7] We assessed the incidence and outcomes of cardiac arrests during anesthesia in the operating room at our university hospital.

Materials and Methods

After obtaining institutional ethics approval, we retrospectively reviewed patients' hospital records such as anesthetic charts and register and ICU admission charts between 1st July 2005 and 30th June 2010. The cardiac arrests encountered during anesthesia were identified from the anesthetic charts and followed-up in the intensive care unit (ICU) for the first 24 h postoperatively. Data collected included patient characteristics, age, the American Society of Anesthesiologists' (ASA) physical status, surgical procedure (elective or emergency), type of surgeries, anesthetic agents and techniques, complications encountered during anesthesia, immediate cause of cardiac arrest, and type of monitoring during anesthesia. Excluded are obstetric cases for caesarean delivery.

Every patient had preanesthetic evaluation a day before an elective procedure or immediately before an emergency and urgent surgical operation. The choice of anesthesia is at the discretion of the attending anesthetist. We consider that cardiac arrest occurred in any patient under anesthesia with asystole or ventricular fibrillation requiring cardiac compression or electrical defibrillation. We define recovery as an alive and non-comatose patient 24 h after the cardiac arrest.

Results

During the study period, a total of 12,143 surgeries were done; the median age of all the patients was 30 years (range: 1 day–119 years). There were 31 cardiac arrests identified (frequency 25.5:10,000 [95% confidence interval (CI) 17.7-35.8] out of which 17 were nonfatal. The median age of patients with cardiac arrests was 39 years (range: 2 months–78 years). Table 1 shows the incidence of nonfatal and fatal cardiac arrests during anesthesia according to age. The mean age for nonfatal arrests was 28.2 ± 24.1 years (range: 4 months–58 years) while that for the fatal cardiac arrest was 44.3 ± 22.2 (range: 2-78) years. Of the 17 nonfatal cardiac arrests, 8 (47.1%) were males and 9 (52.9%) were females; while out of 14 fatal cardiac arrests, 6 (42.9%) were males and 8 (57.1%) were females.

Overall, 80.7% cardiac arrests occurred in ASA physical status 3-5; 88.2% nonfatal arrests and 71.4% fatal arrests. The profile of the arrests in relation to the ASA physical status is shown in Figure 1. Mortality related to anesthesia was 11.5:10,000 (95% CI 6.5-18.9). Overall, there was no difference in the frequency of arrests between emergency and elective surgeries but of the fatal arrests, 71.4% had elective procedures and 28.6% were emergent operations. Reverse was the case in the nonfatal arrests, 64.7% were emergent surgeries and 35.3% elective operations [Figure 2]. Cardiothoracic and neurosurgical operations accounted for 54.8% of the total cardiac arrests as shown in Table 2. However, survival rate after cardiopulmonary resuscitation following arrest was worse (25%) with cardiothoracic surgeries compared with neurosurgical operations (56%). The cardiothoracic operations which are noncardiac surgeries included pneumonectomies, Blalock-Taussig (BT) shunt, femoral embolectomy, pacemaker insertion, and modified Heller's operation.

The known risk factors identified among those who had cardiac arrest were, ASA physical status 3-5 (80.7%), procedures performed out-of-work hours (60%), and manually

Table 1: Distribution of nonfatal and fatal cardiac arrests by age during anesthesia

Age group (years)	Nonfatal cardiac arrests; *n*=17 (%)	Fatal cardiac arrests; *n*=14 (%)
≤4	1 (5.9)	2 (14.3)
5-14	1 (5.9)	0
15-34	6 (35.3)	4 (28.6)
35-54	6 (35.3)	5 (35.7)
55-74	3 (17.6)	2 (14.3)
75-84	1 (5.9)	0

Table 2: Distribution of nonfatal and fatal cardiac arrests by surgical specialties during anesthesia

Specialties	Nonfatal cardiac arrests; *n*=17 (%)	Fatal cardiac arrests; *n*=14 (%)
CTSU	2 (11.8)	6 (43.0)
Neurosurgery	5 (29.4)	4 (28.6)
Urology	2 (11.8)	0
Plastic surgery	0	1 (7.1)
Gynecology	2 (11.8)	0
ENT surgery	0	1 (7.1)
Oral maxillofacial surgery	1 (5.8)	0
Orthopedics	2 (11.8)	1 (7.1)
General surgery	3 (17.6)	1 (7.1)

CTSU=Cardiothoracic surgical unit; ENT=Ear, nose, and throat

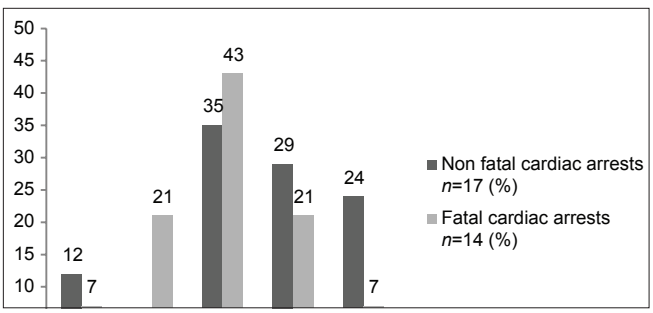

Figure 1: Non fatal and fatal cardiac arrests according to ASA physical status

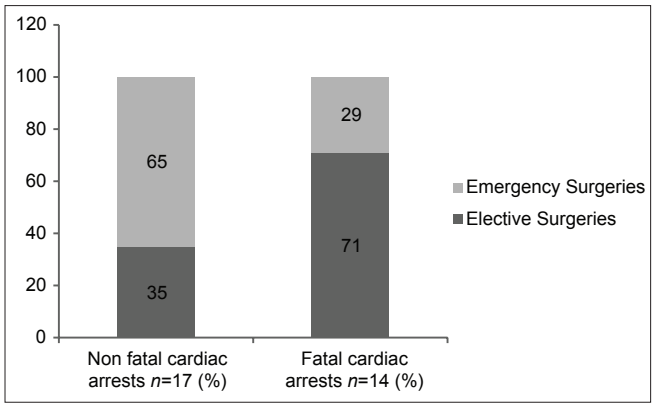

Figure 2: Profile of cardiac arrests according to surgical condition: Emergency versus elective.

ventilating patients during general anesthesia (39%). In the only (nonfatal) case following spinal anesthesia, there was an initial failed block and cardiac arrest that occurred 7 min after the spinal block was repeated. The leading causes of cardiac arrest during anesthesia were hemorrhage and hemorrhagic shock (29%), dysrrhythmias (19%), and hypoxemia due to difficult tracheal intubation (6%). In two cases that had laminectomy, cardiac arrest occurred when they were turned supine from the prone position.

Discussion

Our incidence of cardiac arrests and mortality were found to be 25.5:10,000 and 11.5:10,000, respectively and is higher than the reported incidences of other studies, that is, 1.10-19.70:10,000 and 0.60-2.40:10,000 respectively.[4-6] While not trying to make comparison with these works because our patient populations differ and the different studies employed different methods (prospective versus retrospective), we can infer that this result is a reflection of the poor state of our Medicare. However, our overall incidence was half the figures obtained by other workers in our practice environment over a decade ago, which is a measure of some improvement between the two periods.[7,8] A recent study in a Northern Nigerian teaching hospital reported a higher cardiac arrest incidence (34.6:10,000) and more than two-fold (29.6:10,000) deaths.[9]

In this study, the ASA physical status 3-5 represented a higher risk for cardiac arrest and mortality. This finding is congruous with other workers, who showed that patients with at least ASA physical status 3 have a higher frequency of cardiac arrests and mortality.[4,5,7-11] This subset of patients have severe systemic illnesses which impact on organ function and usually undergo more serious surgical interventions for which invasive monitoring is necessary to improve the outcome. In a low resource center like ours, standard monitoring remains a challenge. Like Olsson and Hallén,[5] we did not find any difference between emergency or elective surgical procedures in our patient population with respect to cardiac arrests, contrary to the report of other workers.[7-9] However, cardiothoracic and neurosurgical operations which are major surgical procedures associated with massive hemorrhage accounted for more than half (54.8%) the total cardiac arrests and 71.4% mortality. Surgical procedures have been known to influence the occurrence of cardiac arrests during anesthesia as well as the outcome following cardiopulmonary resuscitation.[7,8,11] Sprung *et al*.,[11] showed that hemorrhage and hypotension were significant independent predictors of arrests and mortality. Local studies on perioperative cardiac arrests about a decade ago, highlighted the problem of inadequate supply of banked blood and blood substitutes[7,8] and our results revealed that not much has changed between then and now, pertaining to hematologic support to either preventing or managing arrests.

This study showed that arrests were more likely to occur during the conduct of anesthesia out-of-work hours (60%), when less experienced anesthetists are more often involved with anesthesia care and resources for resuscitation are limited.[11] Our result of a higher incidence of arrests following general anesthesia (94%) can be misleading even though regional anesthesia is known to offer a safer technique,[11,12] but these arrests occurred in cases where the surgical procedures were only amenable to general anesthesia (GA) and otherwise, their poor ASA physical status excluded the use of regional techniques. Furthermore, the application of the standards of practice of GA fell short as 39% of these cases were manually ventilated. In the only arrest following spinal block which occurred 7 min after it was repeated; the bradycardia, hypotension, and circulatory collapse that ensued was easily reversed with intravenous crystalloids, ephedrine, and oxygen therapy. There were two fatal arrests following airway management problems. The first was a severely head injured patient who arrested during tracheostomy under local anesthesia, and the other, a 78-year-old hypertensive patient with failed intubation after induction of anesthesia. In those arrests following prolonged prone anesthesia, the hemodynamic compromises, large blood loss from caval obstruction, and inadequate monitoring are recognized.[13]

Cardiac arrest is best prevented than managed; therefore, regular training of anesthetists and anesthetic technical assistants with emphasis on practical application of knowledge is crucial. Close supervision of trainees and the compulsory use of appropriate monitors such as ECG, pulse oximetry, and capnography should be ensured perioperatively.[4] If cardiac arrest occurs during anesthesia, commence cardiopulmonary resuscitation (CPR) to provide circulatory support, followed by defribillation if a shockable rhythm such as ventricular fibrillation (VF) or ventricular tachycardia (VT) is present. The chain of survival has the following links which are crucial: Early recognition of an arrest, early CPR, early defibrillation, and early advanced cardiac life support.[14]

One limitation of this study was poor documentation: The time and duration of cardiac arrest, the ECG rhythm and the use of defibrillation therapy were not stated. Another limitation is that postanesthetic visit by the anesthesia provider is not mandatory after the completion of anesthesia, hence postoperative problems are missed, our database are incomplete, and follow-up remains poor. We recommend that postanesthetic follow-up of patients should be adopted as standard of care, just as preanesthetic visit.

In conclusion, cardiac arrest during anesthesia is higher in poor risk patients (ASA 3-5) who are manually ventilated under general anesthesia and operated during out-of-work hours.

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How to cite this article: Rukewe A, Fatiregun A, Osunlaja TO. Cardiac arrest during anesthesia at a University Hospital in Nigeria. Niger J Clin Pract 2014;17:28-31.

Source of Support: Nil, **Conflict of Interest:** None declared.