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Research Article

CAO Recovered in the General Intensive Care Unit: Epidemioclinical Characteristics and Mortality Factors in a Sub-Saharan African Country

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ABSTRACT

Background: Cardiac arrest in the operating room (CAO) is a serious accident of often rare epidemiology.
Methods: Retrospective, descriptive and analytical study from 2012 to 2021 in the multipurpose intensive care unit of the Cocody University Hospital in Abidjan, including all patients who presented a recovered CAO.
Results: The prevalence was 1.5% (89 out of 5730 admissions). The mean age was 33.5 ± 26 years (13-81). The sex ratio was 0.1. The medical history was mostly hypertension (22.5%). Patients were classified ASA ≥ III (52.8%) for urgent surgery (52.8%) under spinal anesthesia (56.6%). CAO occurred mostly at anesthetic induction (44.3%). The causes were mainly persistent arterial hypotension (54.7%) and hemorrhagic shock (30.2%). Medical CPR was performed in 94.8% of cases in the operating room before transfer to the intensive care unit. The mean duration of LowFlow was 4.5±1.8 minutes (3-12). On admission, the mean Glasgow score was 6.3±4.4 (3-11). Treatment consisted of continued CPR. The mean stay was 3.1±2.9 minutes (1-12). The death rate was 60.4%. ASA class >3, urgent procedure, general anesthesia, presence of NA alone, Gl score ≤ 7, and Low Flow duration> 5 minutes were predictive of mortality ($p < 0.05$).
Conclusion: strengthening of material resources and continuous training in extreme emergency situations for anesthesia personnel could optimize the prognosis of CAO.

Introduction

Cardiac arrest (CA) is the most acute, severe, and demonstrative form of life-threatening distress, subject to recommendations and updates, most recently updated in 2021 [1]. In the specialized context of anesthesia, cardiac arrest in the operating room (CAO) is a serious accident, often with a fatal outcome. It represents a unique entity, due to its epidemiological, pathophysiological, etiological and diagnostic specificities, and its management methods. In sub-Saharan Africa, particularly in Côte d'Ivoire, very few studies have been performed on recovered CAO. Management methods are far from meeting the 2021 guidelines of the European Resuscitation Council and the European Society of Intensive Care Medicine [2]. To improve the survival of CAO in our setting, the aim of our study is to describe the epidemioclinical characteristics and mortality factors of recovered CAO in the multipurpose intensive care unit.

Methods

This was a retrospective study with descriptive and analytical aims from January 1, 2012 to December 31, 2021 in the intensive care unit of the Cocody University

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Hospital in Abidjan (Ivory Coast). The study population consisted of patients who presented a recovered CAO and were admitted to the intensive care unit. All patients who presented with an CAO recovered from any operating room, regardless of age or sex, and admitted to the intensive care unit within 24 hours of the incident were included. Inadequately completed charts and deaths during transfer to the intensive care were excluded from this study. The variables studied were epidemiological (age, sex, profession, place of origin), anesthetic (medical history, ASA class (American Society of Anesthesiologists) expressing the preoperative health of the patient by evaluating the anesthetic risk in order to obtain a predictive parameter of perioperative morbidity and mortality, type of operation, anesthetic technique, quality of the anesthetic personnel, time of the CAO, The data were collected on the following parameters: perioperative morbidity and mortality, type of procedure, anesthetic technique, quality of anesthesia staff, time of CAO, duration of low flow during CPR, cause of CAO, clinical admission (vitals, Glasgow score, motor deficit, pupil status, trunk reflex), therapeutic (CPR, ventilatory assistance, sedation, hemodynamic support), evolution (length of stay, vital outcome, neurological sequelae) and prognosis (mortality factors). Hospitalization records, medical records, and anesthesia charts were used to complete the predefined survey form. The results in qualitative values were expressed as frequencies and percentages; those in quantitative values as means with their dispersion index. The result of the Mantel-Haenszel chi-square statistical test was considered significant for a p value of less than 0.05. According to the ethical recommendations of the Declaration of Helsinki, we declare no conflict of interest.

Results

We identified 89 records out of 5730 admissions over a 10-year period, representing a prevalence of 1.5%. Eighty-two cases were included in the study.

Socio-epidemiological data

The mean age was 33.5 ± 26 years with extremes of 13 and 81 years. There was a high frequency of patients in the 20-40 age group (56.5%). The sex ratio was 0.1 with a female predominance (90.6%). The majority of patients were working in the informal sector (73.6%). About 43.4% of the patients were referred from other hospital structures (Table 1).

The most frequent medical history was hypertension (22.5%) and 59% of the patients did not have any. The patients, mainly classified as ASA III or IV (52.8%), underwent urgent surgery (52.8%), mainly in gyneco-obstetrics (86.8%). Spinal anaesthesia was the most common anaesthetic technique used (56.6%). CAO occurred mainly during anesthetic induction (44.3%), in the presence of a resuscitating anesthesiologist and a registered nurse anesthetist in more than half the cases (52.8%) (Table 2).

Thecauses found for CAO were predominantly persistent arterial hypotension (54.7%) and hemorrhagic shock (30.2%) (Figure 1).

Clinical data on admission to the intensive care unit

The mean systolic blood pressure was 113.7±28.2 mmHg with extremes of 60 and 90 mmHg. For 47.2% of patients, it was between 110 and 140 mmHg. The mean diastolic blood pressure was 63.7±20.1 mmHg with extremes of 34 and 140 mmHg. For 49.1% of patients, it was below 60 mmHg. Heart rate was 50 to 90 beats per minute in 47.2% of patients and temperature was normal in 88.7%. The average Glasgow score was 6.36 +/- 4.41 with extremes of 3 and 11; 56.6% of patients had a Glasgow score higher than 8. The neurological examination also noted concentric and reactive equal pupils (37.7%), the presence of the trunk reflex in 64.1% of cases and the absence of motor deficits for 96.3% of patients (Table 3).

Therapeutic data

Medical CPR was performed in 94.8% (all patients received external cardiac massage, tracheal intubation, administration of adrenaline associated with vascular filling, and 79.2% received atropine) in the operating room before transfer to the intensie care. The mean duration of low flow was 4.5 ± 1.8 minutes, with extremes of 3 and 12 minutes. For 81.7% of the patients, the Low Flow was less than or equal to 5 minutes. Treatment in the intensive care unit consisted of continued CPR, ventilatory support, sedation (82.9%) and hemodynamic support with noradrenaline (82.9%). It also included symptomatic treatment and nursing.

Evolutionary and prognostic data

The mean length of stay was 3.1 ± 2.9 minutes with extremes of 1 and 12 days. For 64.6% of patients, the length of stay was less than or equal to 3 days. The outcome was 39.6% favorable with 77.9% of neurological sequelae (60% motor deficit, 20% psychomotor agitation and 20% temporo-spatial disorentation). At the end of their stay, the patients were transferred to neurology or to the referral service. The death rate was 60.4%. The mortality factors of the CAO recovered in the intensive care unit were analyzed in (Table 4).

According to the statistical analysis, age, medical history, origin and length of stay did not influence the prognosis of patients admitted for CAO recovered in the intensive care unit. On the other hand, the ASA class higher than 3, the urgent intervention, the general anesthesia type, the presence of an anesthesiologist as a nurse anesthsist, the Glasgow score lower than or equal to 7 and the duration of Low Flow higher than 5 minutes were prognostic factors, significantly related to the mortality of patients admitted for CAO recovered in the intensive care.

Table 1- Distribution of patients according to socio-epidemiological data

Socio-epidemiological data		Number	Percentage (%)
Age (years)	< 20	17	21.0
	[20 – 40[	46	56.8
	[40 – 60[	13	16.3
	≥ 60	5	5.9
Gender	male	8	9.4
	female	74	90.6
Profession	informal sector	60	73.6
	salaried employee	8	9.4
	pupil/student	12	15.1
	retired	2	1.9
Origin	operating room	46	56.6
	other hospital structure	36	43.4

Table 2- Distribution of patients according to anesthetic data

Anesthetic data		Number	Percentage (%)
Medical history	high blood pressure	18	22.5
	diabetes	9	11.3
	asthma	1	1.8
	heart disease	1	1.8
	neoplasia	1	1.8
	renal insufficiency	1	1.8
	none	48	59.0
ASA Classe	I, II	39	47.2
	III, IV	43	52.8
Type of procedure	urgent	43	52.8
	scheduled	39	47.2
Surgical specialty	gyneco-obstétrics	71	86.8
	digestive surgery	5	5.7
	traumatology	3	3.7
	ENT	3	3.7
Anaesthetic technique	GA	36	43.4
	spinal anaesthesia	46	56.6
	induction	36	44.3
Time of CAOR	intraoperative	12	14.5
	immédiat postoperative	34	41.2
Quality of anesthesiologist present in the operating room	anesthsiologist and NA	43	52.8
	NA	39	47.2

GA = general anaesthesia, ENT = ear, nose and throat, NA = nurse anesthetist state graduate

Table 3- Distribution of patients according to clinical data on admission to the intensive care unit

Clinical data on admission to the intensive care unit							
Consistencies		**n**	**%**	**Neurological examination findings**		**n**	**%**
SBP	< 110	36	43.4	Glasgow Score	3 -7	36	43.4
(mmHg)	110 – 140	39	47.2		≥ 8	46	56.6
	> 140	8	9.4	Pupil status	RCT	31	37.7
DBP	< 60	40	49.1		mydriasis	23	28.4
(mmHg)	60 – 90	37	45.3		miosis	28	33.9
	> 90	5	5.6	Trunk reflex	present	53	64.1
HR	[30 – 50[	20	24.5		absent	29	35.9
	[50 – 90[	39	47.2	Motor deficit	absent	79	96.3
	≥ 90	23	28.3		present	3	3.7
T° C	< 36	4	4.8	n = number, % = percentage, SBP = systolic blood pressure, DBP = diastolic blood pressure, HR = heart rate in beats per minute, T°C = temperature in degrees Celsius, RCT = concentric and reactive equals			
	36 – 37,5	73	88.7				
	> 37,5	5	6.5				

Table 4- Analysis of mortality factors for CAO recovered in intensive care

Mortality factors		Patient outcomes Favourable	Death	RR	P
Age	≤ 40 years	26	38	1.21	0.29
	> 40 years	06	12		
Medical history	yes	13	21	0.96	0.45
	no	19	29		
origin	Operating room CHUC	18	28	1.00	0.49
	Othe hospital structure	14	22		
ASA Classe	< III	10	29	0.50	0.01
	≥ III	22	21		
Type of procedure	urgent	22	21	1.99	0.01
	non-urgente	10	29		
Type of anesthesia	GA	14	32	0.60	0.03
	spinal anesthesia	18	18		
Quality of anesthesiologist present in the operating room	NA	12	31	0.54	0.01
	anesthsiologist and NA	20	19		
Glasgow score on admission	< 7	26	10	5.53	0.00
	≥ 8	06	40		
Duration of Low Flow	≤ 5 minutes	22	45	0.49	0.01
	> 5 minutes	10	05		
Length of stay	≤ 3 days	23	30	1.39	0.14
	> 3 days	09	20		

RR: relative risk, p: probality, BO-CHUC: teatching hospital of Cocody, GA: general anesthesia, NA: nurse anesthetist state graduate

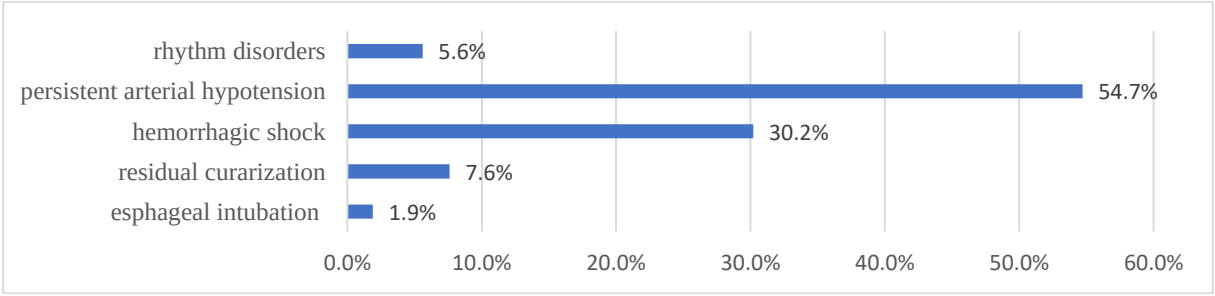

Figure 1- Distribution of patients according to the causes of CAO

Discussion

The occurrence of cardiac arrest in the operating room is a rare event requiring a pre-established organization and a team organization in order to optimize the chances of success. The prevalence in our series was 1.5%. Perioperative cardiopulmonary arrest represents about 2% of intra-hospital cardiopulmonary arrests [3].

Socio-demographic data

The mean age was 30.9+/-14.0 years. The peak frequency was between 20 and 40 years of age. Our figures were contrary to those of developed countries. Indeed, data from a study by Luc et al [4] in France showed a mean age of 68 years. This difference could be explained by the broad-based age pyramid of the Ivorian population. Indeed, according to the 2021 general population and housing census [5], the average age was 18.5 years and more than 75.6% of the population was under 35 years old. Statistically, we did not find a significant association between age and the fate of recovered CAO. Our female population was the most represented, as in the work of Brouh et al [6]. However, the series of Lai et al [7] in Singapore found respectively 56.4% and 65.7% of men. This difference with our work would be related to the important activity of the obstetrical unit of the Cocody university hospital and the referral of parturients from surrounding health structures.

Anesthetic data

In our study, the CAO that occurred under general anesthesia had an unfavorable evolution compared to the patients who presented CAO under locoregional anesthesia. Our results were in accordance with those found in the literature where general anesthesia appeared to be a little more at risk of CAO [8-9] and of a worse prognosis according to a meta-analysis, showing a 30% reduction in mortality in favor of loco-regional anesthesia [10]. This would be related to the emergency and precarious state of patients operated on under general anaesthesia. Also, an ASA class greater than or equal to

3 in an emergency context was a factor of mortality of CAO in our series. This could be explained by an insufficient preanesthetic preparation of precarious patients who arrived in an emergency context. In the last decades, many investigations carried out in Europe had tried to evaluate the frequency and causes of anesthetic deaths, in order to propose preventive measures. These studies were, however, made difficult by practical constraints (absence of data in certain files, reluctance of the anesthetists to report the accidents that occurred, conditions of activity of the anesthetist: fatigue, stress, various solicitations) and constraints related to the "sensitive" character of the information and its medicolegal environment [10]. The etiologies of the recovered CAO, in our series, were dominated by persistent arterial hypotension and hemorrhagic shock in the data of the literature, hemorrhagic shock occupied the first ranks [11-12]. This would be related to the insufficiency or unavailability of blood products, necessary for the transfusion of patients with acute anemia by blood spoliation. Also, CAO occurred most often during induction and in the immediate postoperative period in the recovery room, as in the study by Brouh et al [6]. This could be explained by the decompensation of pre-existing defects and the inadequacy of the nurse anesthesit and material resources, not allowing a good distribution of the insufficient qualified personnel, hence the increased workload.

Clinical data at admission to the intensive care unit

On the neurological level, we found a statistically significant relationship between the Glasgow score and the outcome of the recovered CAO. Several studies confirmed this, such as the one carried out by Wijdicks et al [13] in patients not treated by hypothermia, which found that a motor response lower than or equal to 2 according to the Glasgow score, associated with the absence of brainstem reflexes at 72 hours, was associated with a poor prognosis, with a zero false positive rate. Tachon al [14] made the same observation in the work in 2015. Regarding vitals, 93.5% of patients had a temperature between 35 and 37.5°C. Our results were contrary to those of the literature, which recommended hypothermia between 32 and 36°C. Indeed, patients with a temperature below 36°C and above 37.5°C had a severe prognosis [15].

Therapeutic data

The CPR performed in our series consisted of tracheal intubation with ventilatory assistance associated with external cardiac massage. The use of the defibrillator was not included in our study, due to the absence of AEDs/AEDs in the operating rooms. The duration of NoFlow (duration during which the cardiac output is zero before any CPR is performed) was not specified in any of the files. In our series, the average duration of LowFlow was 4.5 ± 1.8 minutes. According to the literature [16], an assessment of the quality of the cardiac output generated during the Low-Flow period should be made to judge the vital prognosis.

Evolutionary and prognostic data

In our study, the overall survival of recovered cardiac arrests admitted to the intensive care unit was 39.6%. These results were consistent with those found in the literature, in which the in-hospital survival of recovered OHCAs varied, in general, from 30% [17] to 65% [7]. Also, Ramachandran et al [17] described a favorable functional evolution in 32% of the patients with a recovered CAO and whose basal functional status was previously satisfactory. The limitations of our study were the retrospective nature, including the lack of accurate data on medical CPR in the operating room, means of transport and incomplete records.

Conclusion

Despite the progress made, CAO remains a condition with a very high in-hospital mortality. Our study confirmed that the prolongation of the duration of LowFlow and a nurse not assisted by an anesthesiologist were among the factors of poor prognosis. It is difficult for developing countries to meet international recommendations for the management of CAO. Improving the prognosis of patients would require advocacy involving the strengthening of material resources and continuing education of anesthesia personnel in extreme emergency situations

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