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Associated Factors and Outcomes of Cardiopulmonary Resuscitation of Intrahospital Cardiorespiratory Arrests in Adults of North-Kivu in a Resource-Limited Setting: A Cohort Study

Jean-Pierre Mumbere Kigayi[1,2*], John Marshall[3], Celine Kavira[4], Hadassa Kyakimwa Anuarite[5], Alfred Chasumba Murhula[6], Augustin Kambale Sivihwa[7], Tresor Benda Masehi[7], Jeannette Kahindo Kasomo[7], Cedric Kambale Tsongo[2], Jonas Ngaruye[2], Peter Trallagan[8], Théophile Amani Kabesha[9], Edwin Lugazia[10], Bronwyn Rae[11], Zacharie Kibendelwa Tsongo[12]

[1]Department of Anesthesiology, Faculty of Medicine, University of Goma, Goma, Democratic Republic of Congo (DRC)
[2]Department of Anesthesiology-Resuscitation and Intensive Care, HEAL Africa Hospital, Goma, DRC
[3]World Federation of Intensive and Critical Care Research Academy, Toronto, Canada
[4]School of Public Health, University of Goma, Goma, DRC
[5]Laboratory Department, HEAL Africa Hospital, Goma, DRC
[6]Department of Surgery, Faculty of Medicine, University of Goma, Goma, DRC
[7]Kyondo General Referral Hospital, Kyondo Health Zone, Nord-Kivu, DRC
[8]Department of Anesthesiology and Physiology, Faculty of Medicine, Notre Dame University of Australia, Sydney, Australia
[9]Department of Ophthalmology, Faculty of Medicine, Official University of Bukavu, Bukavu, DRC
[10]Department of Anesthesiology, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania
[11]Department of Anesthesiology, Northwestern University, Evanston, IL, USA
[12]Department of Internal Medicine, Faculty of Medicine, University of Kisangani, Kisangani, DRC
Email: jpmkigayi@gmail.com

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Abstract

Introduction: Intrahospital Cardiopulmonary Arrest (IHCA) is a common critical event with high morbidity and mortality in resource-limited settings. This study examines the outcomes of Cardiopulmonary Resuscitation (CPR) for IHCA and their associated factors in North-Kivu in the Democratic Republic of Congo. **Methods:** This is an 18-month prospective cohort study conducted in two hospitals located in North-Kivu Province: HEAL Africa and Kyondo General Reference Hospital. Data were analyzed using Fisher's exact test for categorical data and multinomial regression. A p-value < 0.05 was considered statistically significant. **Results:** We included 84 patients, 58.3% men, with a mean (SD) age of 57.7 years (±17.1). IHCA was due to a combination

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of causes in 39.3% and isolated hypoxia in 33.3%. Metabolic acidosis was observed in 50%. Hyponatremia and hyperkalemia were the most common electrolyte disturbances in patients with IHCA (52.8% and 44.4%, respectively). In 41.6% of cases, the alert was launched after CA, and 47.6% of CPR was initiated within 4 minutes of CA. Most resuscitations were led by residents. Asystole was noted in 83.3% of monitored patients. Advanced resuscitation with intubation was performed in 45.2% of patients. The rate of Return of Spontaneous Cardiac Activity (ROSC) after IHCA was 42.9%. The factors associated with ROSC were CPR initiated by doctors and nurses, and a history of cardiovascular diseases. The survival rate on the seventh and thirtieth day after ROSC was 8.3% and 6%, respectively. Three out of five patients had a complete recovery on the thirtieth day. **Conclusion:** IHCA in North-Kivu is due to multiple reversible causes and often occurs in patients with multiple combined illnesses and cardiovascular disease. Early detection and prevention measures for IHCA are still very limited. The ROSC rate for IHCA is high, contrasting with a very low survival rate at day 30 of IHCA.

Keywords

Intrahospital Cardiopulmonary Arrest, Cardiopulmonary Resuscitation, Outcomes, Return of Spontaneous Cardiac Activity

1. Introduction

Cardiopulmonary Arrest (CA) is defined as a sudden cessation of the mechanical activity of the heart pump. It manifests clinically by the absence of a central pulse, absence of breathing or agonal breathing, and loss of consciousness [1]. Intrahospital CA (IHCA) occurs in a hospital setting. One to five out of 1000 hospitalized patients experience CA [2]. The incidence of IHCA constitutes a burden on the healthcare system worldwide. Most studies come from developed countries, and there is little data from developing countries. The survival rate after IHCA is highly variable worldwide and between institutions; it ranges from 0% to 36.6% [1]. The lowest survival rates are documented in developing countries. Fifty to sixty percent of IHCA occur in hospitals compared to 40% to 50% which occur in intensive care or in the operating room where monitoring is, in principle continuous [3]. In countries with limited resources, both the rate of Return of Spontaneous Cardiac Activity (ROSC) and ultimate survival are low. In Africa, the few studies carried out suggest low rates of ROSC in Uganda (7.4%) [4], Democratic Republic of Congo (DRC) (0%), and Kenya (4.2%) [5] [6]. These studies are often carried out in capital cities and not in peripheral provinces in African countries where knowledge of Cardiopulmonary Resuscitation (CPR) by healthcare staff is low [7]. We therefore want to study the sociodemographic and clinical aspects and the outcomes of CPR in IHCA in the East of the DRC, particularly in North-Kivu province in both urban and rural areas.

2. Materials and Methods

This is a prospective cohort study conducted in the North-Kivu province of the DRC. We selected HEAL Africa Hospital in an urban area and Kyondo General Referral Hospital in a rural area. Both have intensive care units, including six beds equipped to a level II standard for HEAL Africa and eight underequipped beds for Kyondo Hospital. All are highly utilized health facilities. HEAL Africa has a capacity of 300 beds, while Kyondo Hospital has 500. Our study population consisted of adult patients who experienced IHCA. Data were collected between July 1, 2023, and December 31, 2024. During day shifts (7:30 a.m. to 3:30 p.m.), data collection was conducted during a life-threatening emergency alert or a CA concluded among hospitalized patients. For data collection during night shifts (3:30 p.m. to 7:30 a.m.), investigators collected data from patient records and obtained additional information from the resuscitation team leader. Data from patients brought in deceased or with suspected brain death, either with a Glasgow score of 3/15 despite immediate emergency care on admission, and patients who had an Out-of-Hospital Cardiac Arrest (OHCA) 48 hours ago were excluded from the study. The independent variables consist of patients' sociodemographic data: age, gender, occupation, marital status, urban or rural location, and method of payment for care; clinical data, namely: medical history, reason for admission to hospital, diagnosis on admission, hospitalization department, reason for alerting the resuscitation team, National Emergency Warning Score (NEWS) 2 at alert, cause of CA, Emergency Point Of Care (EPOC) result, time interval between arrest and initiation of CPR, qualification of the initiator of CPR, number in resuscitation team, team leader qualification, duration of resuscitation, days of resuscitation (weekend or not), time of CPR, types of resuscitation (basic or specialized), duration of CPR, drugs administered during CPR, cause of CA, and cause of death. The dependent variables were CPR outcomes: the primary outcome is the ROSC. The secondary outcome is patient survival after 24 hours, 7 days, and 30 days. The tertiary outcome is neurological status on day 30 after CPR for survivors. This status was assessed using the Glasgow Outcome Score (GOS), which classifies patients into five grades: Grade 1 is death, Grade 2 is neurovegetative status, Grade 3 is severe disability, Grade 4 is moderate disability, and Grade 5 is good neurological recovery. The collected data were processed and analyzed using IBM SPSS version 26 software. Categorical variables were presented as number and percentage. Continuous variables were presented as mean with standard deviation. The association between independent categorical variables was measured using Pearson's chi-square test or approximated by Fisher's exact test when indicated. Variables deemed clinically relevant were subjected to logistic regression to verify whether they constitute a determining factor for ROSC or survival after an IHCA. The result was considered statistically significant if the p-value was less than 0.05.

3. Results & Discussion

This study allowed us to identify IHCA patients' sociodemographic characteristics

(Table 1) and the distribution of clinical aspects of IHCA patients (Table 2). Also, it determines the direct and indirect causes of IHCA, the most commonly used type of resuscitation (Table 3), the outcomes of IHCA CPR (Table 4 and Figure 1), and its associated factors (Table 5) in a resource-limited setting in North-Kivu province, located in the east of DRC.

Table 1. Sociodemographics of patients' distribution.

Variables		Total	
		Number	Percentage (%)
Sex	Male	49	58.3
	Female	35	41.7
Age (years)	18 - 49	23	27.4
	≥50	61	72.6
	Mean (±SD)	57.2 (±17.2)	
Location	Rural	41	48.8
	Urban	43	51.2
Marital status	Single	10	11.9
	Married	65	77.4
	Widowed	9	10.7
Profession	Public servant	13	15.5
	Traders	8	9.5
	Agriculture	37	44
	Housekeeper	8	9.5
	Other	8	9.5
	None	10	11.9
Payment mode	Assurance	28	33.3
	Cash	35	41.7
	Debt	21	25.0
Total		84	100.0

SD: Standard Deviation.

Table 2. Distribution of patients with IHCA according to clinical aspects.

Variables		Number	Percentage
Main complaint	Dyspnea	20	23.8
	Loss or deterioration of conscience level	13	15.5
	Physical weakness	10	11.9
	Epigastric pain	6	7.1
	Others	35	41.7

Continued

Diagnostics at admission	Stroke & severe HBP	13	15.5
	Other cardiopathies	11	13.1
	Pulmonary diseases	11	13.1
	Surgical diseases	11	13.1
	Other diseases	38	45.2
Warning reason	Cardiac arrest	35	41.6
	Bradycardia	16	19
	Apnea or bradypnia + hypoxia	24	28.5
	Others	18	21.4
NEWS 2	1	1	1.2
	5	2	2.4
	≥7	41	48.8
	Not done	36	48.6
IHCA witness	Health personnel	71	84.5
	Patient guardian	4	4.8
	None	9	10.7

HBP: High Blood Pressure.

Table 3. Cardiopulmonary resuscitation of IHCA.

Variables		Number	Percentage
CPR initiator	Doctor and nurse	45	53.6
	Nurse	16	19.0
	Doctor	12	14.3
	Nurse anesthetist	5	6.0
	None	6	7.1
CPR initiation time	Less than 1 minute	27	32.1
	1 - 4 minutes	40	47.6
	≥5 minutes	8	9.5
	Not applicable	9	10.7
Clinical judgment on IHCA reversibility	Reversible	26	31.0
	None reversible	58	69.0
Monitoring	Without MPM	42	50
	With MPM	42	50
Types of rhythm on MPM	Asystoly	35	83.3
	Pulseless Electrical Activity	4	9.6
	Shockable rhythm	3	7.1

Continued

Direct causes of IHCA	Hypoxia	28	33.3
	Many associated causes	33	39.3
	Other causes	23	27.4
Number of health personnel in CPR team	0 - 2	19	22.6
	≥3	65	77.4
	Mean (±SD)	3.14 (±1.17)	
Number of trained health personnel in CPR team	0 - 1	35	41.7
	≥2	49	58.3
	Mean (±SD)	2.13 (±1.46)	
Resuscitation Team Leader	Anesthesiologist	9	10.7
	Resident	40	47.6
	Nurse Anesthetist	5	6.0
	Others	30	35.7
Resuscitation duration	1 - 5 minutes	16	19.0
	6 - 10 minutes	20	23.8
	11 - 20 minutes	6	7.1
	21 - 30 minutes	6	7.1
	≥30 minutes	26	31.0
	Not applicable	10	11.9
CPR types	Not applicable	10	11.9
	Advanced plus intubation	38	45.2
	Advanced without intubation	5	6.0
	Basic without defibrillator	31	36.9
CPR Medication	Adrenaline	11	13.1
	Adrenaline + oxygen	47	56.0
	Oxygen	13	15.5
	Others	13	15.5
Weekend	Yes	22	26.2
	No	62	73.8
Times of arrest	Days shift	33	39.3
	Night shift	51	60.7
Unit/Ward before IHCA	Intensive Care Unity	48	57.1
	Internal Medicine	21	25.0
	Others	15	17.9
ICU follow up after IHCA	ICU	54	94.7
	Others units	3	5.2

MPM: Multiparameter Monitor. CPR: Cardiopulmonary Resuscitation. ICU: Intensive Care Unity.

Table 4. CPR outcomes of IHCA.

Variables		Rural	Urbain	Total (N = 84)	%	p
ROSC	No	25	23	48	57.1	0.515**
	Yes	16	20	36	42.9	
Global CPR outcome	Survival less than 24 hours	7	13	20	23.8	0.222*
	Survival of 1 day - 7 days	4	3	7	8.3	
	Survival ≥ 14 days	1	4	5	6.0	
	Deaths	29	23	52	61.9	
CPR outcome on 30th day	Deaths	40	39	79	94.0	0.360**
	Survival	1	4	5	6.0	
Glasgow Out Come Score	Grade 1	30	34	64	76.2	0.205*
	Grade 2	9	4	13	15.5	
	Grade 3	0	1	1	1.2	
	Grade 4	1	0	1	1.2	
	Grade 5	1	4	5	6.0	
Total		41	43	84	100	
Percentage		48.8	51.2	100	100	

ROSC: Return of Spontaneous Cardiac Activity. "*": Pearson Chi-square, "**": Fisher's exact test.

Table 5. Associated factors of ROSC.

	Total	ROSC	No ROSC	p-value	Exp B	Confidence Interval	
						Low limit	Upper limit
Gender							
Female	35 (41.7)	18 (47.2)	17 (37.5)	0.109	0.351	0.097	1.265
Male	49 (58.3)	19 (52.8)	30 (62.5)				
Area							
Rural	41 (48.8)	16 (44.4)	25 (52.1)	0.348	2.348	0.394	13.978
Urban	43 (51.2)	20 (55.6)	23 (47.9)				
Number of comorbidities							
0 - 1	56 (66.7)	23 (63.9)	33 (68.8)	0.707	1.798	0.084	38.427
≥2	28 (33.3)	13 (36.1)	15 (31.3)				
Types of comorbidities							
Cardiovascular diseases	17 (20.2)	7 (19.4)	10 (20.8)	0.031	18.225	1.306	254.228
Melitus diabetes	7 (8.30)	1 (2.8)	6 (12.5)	0.174	9.690	0.366	256.290
Many associated diseases	25 (29.8)	12 (33.3)	13 (27.1)	0.355	4.093	0.207	81.102
None	23 (27.4)	11 (30.6)	12 (25.0)	0.241	3.775	0.409	34.840
Other diseases	12 (14.3)	5 (13.9)	7 (14.6)				

Continued

Direct cause of IHCA							
Hypoxia	28 (33.3)	13 (36.1)	15 (31.3)	0.414	0.486	0.086	2.746
Association of many causes	33 (39.3)	15 (41.7)	18 (37.5)	0.819	0.821	0.152	4.439
Other causes	23 (27.4)	8 (22.2)	15 (31.3)				
Number of trained personnel in CPR team							
0 - 1	35 (41.7)	11 (30.6)	24 (50.0)	0.132	3.035	0.716	12.871
≥2	49 (58.3)	25 (69.4)	24 (50.0)				
CPR team leader							
Anesthesiologist	9 (10.7)	6 (16.7)	3 (6.3)	0.832	0.769	0.068	8.730
Resident	40 (47.6)	13 (36.1)	27 (56.3)	0.171	3.888	0.557	27.161
Nurse Anesthetist	5 (6.0	3 (8.30)	2 (4.20)	0.598	2.385	0.094	60.355
Others	30 (35.7)	14 (38.9)	16 (33.3)				
CPR initiator							
Medical Doctor	12 (14.3)	4 (11.1)	8 (16.7)	0.000	4098617743.122	556663639.164	30177410957.638
Medical Doctor + Nurse	45 (53.6)	21 (58.3)	24 (50.0)	0.000	454832508.824	78810042.564	2624952408.997
Nurse	16 (19.0	6 (16.7)	10 (20.8)		1779267577.200	1779267577.200	1779267577.200
Nurse Anesthetist	5 (6.0)	5 (13.9)	0 (00.0)				
None	6 (7.1)	0 (00.0)	6 (12.5)	0.994	262023173244070816	0.000	.[c]
Occurrence of CPR							
Weekend days	22 (26.2)	12 (33.3)	10 (20.8)	0.253	0.468	0.127	1.721
Working days	62 (73.8)	24 (72.7)	38 (79.2)				

ROSC: Return of Spontaneous Cardiac Activity; Reference category is: ROSC. Age classes 18 years - 49 years and ≥50 years were considered as covariables. C: value is defined on missing data in the system.

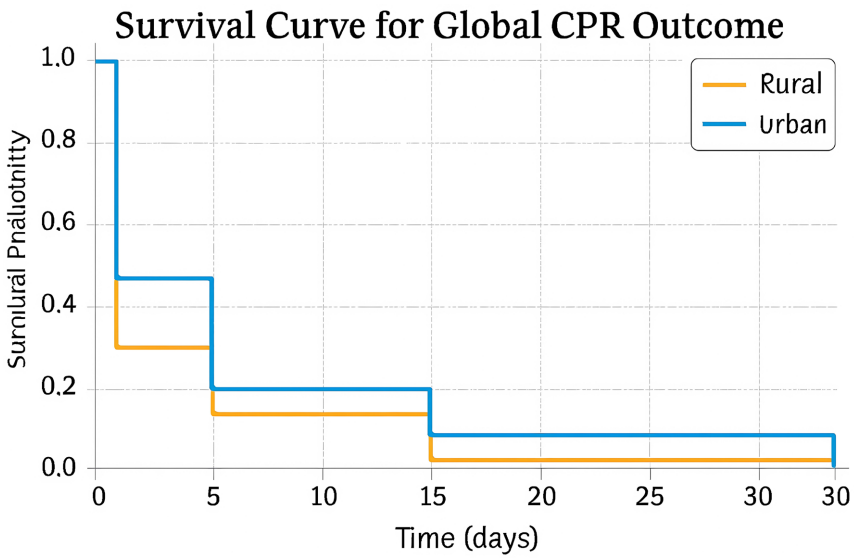

Figure 1. Survival curve for global outcomes among rural and urban patients.

ROSC of 42.9% in our study is elevated compared to that observed by NGUNGA in Kenya in 2016, where it was 23.2%, and that of Davidson Ocen in Uganda, which was 7.4%. This rate even exceeds that of some advanced countries such as Korea and Great Britain, which had 5.3% and 16.9%, respectively [4] [6]. We cannot compare it with KITSHIABI's study in Kinshasa/DRC, which found a ROSC of 26.7%; this is the sustained ROSC of 20 minutes of spontaneous cardiac activity, while ours refers to a spontaneous cardiac activity of 2 minutes [5]. Nevertheless, this rate of ROSC is lower than that found in certain studies like that of Sun, with 54% of ROSC [8]. The difference observed in Nordic countries would be linked to the fact that the population is elderly with serious comorbidities at the terminal stage. The Hessulf study showed that 48% of patients who presented IHCA were over 75 years old, 65.1% of whom had kidney disease [9]. As for African countries, the observed difference is not justified by age because the population is often young. In Uganda, most patients (66.5%) were between 18 and 44 years old. Moreover, the average ages of patients in Kenya and our study were not different; 61.46 years (±19.7) and 57.2 years (±17.2), respectively. The low rate of ROSC would be justified by the inadequacy of the health system and the causes of IHCA. In addition, there was a shortage of staff; 63.2% of IHCAs were not witnessed compared to 84.5% of IHCAs witnessed by health personnel in our study [4]. There is an undeniable link between the time between the start of CPR and the chance of ROSC; the earlier the CPR, the better the outcome. Regarding the comorbidities of patients, 45% of patients in Uganda had HIV infection and most of the IHCA was related to trauma patients with severe traumatic brain injuries. The ROSC of 23.2% in Kenya also remains low, but this result hides a great discrepancy between public health facilities, whose ROSC was 1%, compared to 40% for private ones. The ROSC rate of private facilities is close to that which we found in the two facilities where we conducted the study. These facilities are also under private management, by the Non-Governmental Organization for Development for HEAL Africa and the Catholic denomination for Kyondo Hospital, which corroborates with the organizational aspects in the success of the CPR of IHCA [6]. The same reasons may also explain the difference observed for the 24-hour survival rate of IHCA, which turns out to be relatively high with 8.3% (7/84) in our study compared to 5.6% (5/90) observed at Kinshasa University Clinic in 2018 and 5.7% (11/190) in Uganda in 2014. In addition to the above, we can add the low rate of follow-up in ICU after IHCA, which was 50% at the Makerere University Clinic and 94.7% in North-Kivu. This increase would also be due to the high rate of admission in intensive care before CA (57.1%) of patients, similar to that observed at the Kinshasa University Clinics (56.7%) [5]. We noted a non-significant difference between survival from 24 hours to 7 days between rural and urban areas (**Figure 1** and **Table 5**). However, we cannot ignore the fact that rural areas are often disadvantaged in terms of human resources and biomedical equipment. We had 50% of patients (42/84) who were not monitored on a multiparameter monitor before IHCA. Among these patients, 90.5% were from a rural hospital. As for 30-day survival and neurological status after IHCA, our result is very low

(6%) compared to that observed in some countries in Europe or the USA, where this rate is more than 20% with a higher functional recovery rate. However, it is better than that of Kinshasa, where it was zero at discharge, or even that found in Uganda and Arabia [4]-[6] [9] [10]. This disparity is linked to the more improved healthcare system in more advanced countries compared to resource-limited countries and also to the lack of resuscitation research in developing countries [1]. We should therefore adopt specific strategies for our environment to increase the survival rate at discharge after ROSC or at the thirtieth day of IHCA and somewhat reduce this accusatory paradox of a mismatch between high ROSC and low survival rate after IHCA in our African countries, noting our province of North-Kivu.

The heart rhythm observed during IHCA is dominated by asystole (83.3%) in our study. This result is similar to that noted in other African countries with limited resources, such as Uganda, Kenya, and Ethiopia. This results from low multiparameter monitoring rates before IHCA, low index of suspicion of IHCA, and the virtual non-existence of continuous monitoring services for patients in vital distress. Shockable rhythms were rare, with a rate of 7.1% in our study, whereas at the Kinshasa University Clinics, its frequency was 10% [5]. This result is slightly higher compared to that of Uganda and Korea, where researchers found the shockable rhythm frequency of 5.4% and 5.3%, respectively. This result is lower than that found in the United Kingdom of England and Arabia, where researchers found the shockable rhythm frequency at 16.9% and 37.3%, respectively. In countries where this dysfunction has already been resolved, shockable rhythms are around 20% before IHCA. This rate sometimes reaches 84% in patients monitored on Holter. Moreover, it should be noted that IHCA preceded by a shockable rhythm is easily reversible and increases the ROSC rate if defibrillation is done early and effectively [1] [6] [9] [11]. To solve the problem of low survival rate after IHCA, prevention and early detection of patients at risk of CA will be among the fundamental bases. CA was the main reason for alerting the resuscitation team (41.6%). This result is not very different from that obtained by Fuchs A. in 2021 in Switzerland (46.6%) [10]. It was the CPR team to improve the outcome of IHCA. This team is not yet formally constituted in the two structures of our study. It was therefore an isolated call for help to participate in CPR. The implantation and training of this team remains a need to be met in North-Kivu. The rapid emergency response team must be trained in the two health facilities in order to activate the alert early for patients in life-threatening conditions or at high risk of IHCA to measure its effects on improving IHCA prevention. Thus, we could therefore come closer to the adage which says: "prevention is better than massage" [5]. Apart from various ungrouped diseases (45.2%), the causes of IHCA in this study are predominated by cardiovascular diseases with 28.6%, of which HBP represents 15.5%, followed by respiratory and surgical diseases with a frequency of 13.1% each. This result reflects that of other research carried out in developing countries, with the exception of the Ocen study, where HIV predominated in Uganda (45%), and contrasts with those of developed countries where the main causes are cardiac

and pulmonary [1] [4] [12]. For our study, hypoxia is the second reversible cause of IHCA, which is explained by the complaints on admission; dyspnea having been the second complaint in our study (23.8%) preceded by the other non-grouped complaints (41.7%). This fact shows the importance of every symptom on admission and especially the NEWS 2 score. This predominance of several causes of IHCA was also mentioned by Pierre Michelet and François Kerbaul in 2013 [2]. In this study, 77.4% of patients were resuscitated by at least three caregivers, the majority of whom were resident doctors, who led 47.6% of CPRs. Contrary to the observation made by Ocen, who reported that CPRs performed on weekends were performed by a single person and had a low ROSC rate. In North-Kivu, the weekend is not a day off for health personnel. Most IHCAs occurred during working hours, which is similar to Ocen's study. The times of occurrence of IHCA did not have a significant influence on ROSC [4]. We did not find a correlation between the immediate or global outcome and the CPR team leader. However, we found that ROSC occurred most frequently when the CPR was initiated either by a medical doctor or by a medical doctor plus nurse. Normally, knowledge should be related to education and experience [13]. Most CPRs were performed by residents. Residents should not be forgotten in CPR training because of their direct involvement in resuscitation and the low level of knowledge of CPR among healthcare personnel of all professional categories found in our previous study conducted in North-Kivu [7]. We agree with Michelet and Kerbaul, who stated: "training all hospital staff in alerting and first aid appears essential and largely determines the efficiency of the chain of survival" [2]. 45.2% of patients received specialized CPR with Oro-Tracheal Intubation. This rate is low compared to the study conducted at Kinshasa, where 86.6% were intubated, including 58.9% before CA [5]. Our study did not specify the frequency of patients previously intubated before CA, which limits the comparison.

We observed a low rate of use of adrenaline and oxygen in North-Kivu in CPR of IHCA compared to the ideal and the results of Kinshasa, where adrenaline was administered in 87.8% of patients and oxygen in 85.6%. Our result remains low compared to the use of adrenaline in Kenyan hospitals, which was 73.1% and 92.8%, respectively in public and private hospitals in urban areas [5] [6]. The use of adrenaline and oxygen is particularly low in rural areas, where only 51.2% of patients received adrenaline or oxygen during CPR. This low rate can be explained by the lack of oxygen sources in rural areas, where the ICU is less equipped, but also by the lack of awareness of epinephrine as a first-line drug in CPR of CA. In a survey on CPR of CA in North-Kivu, we found that 72.4% of caregivers did not classify epinephrine as a first-line drug in CPR of IHCA [7]. The use of epinephrine combined with effective chest compression is a contributing factor to ROSC and survival of IHCA [14]. Blood gas and ionogram were performed only in 42.7% (36/84), all of whom proved pathological in the peri-IHCA period. These disorders are predominated by metabolic acidosis, hyponatremia, hyperkalemia, and hyperglycemia in the current study. The rate of acid-base and electrolyte imbalances is higher than that found by Kim (7.1%). This is similar to most studies that

have focused much more on OHCA [11] [15]. As for hyperglycemia, it remains low compared to that described in the literature. These disorders have proven to be independent factors of ROSC in OHCA and some IHCA. Our study is limited by a small number of patients who had blood gases and ionograms. Apart from the disorders mentioned, other studies have mentioned the importance of ionized calcium and dysmagnesemia observed after CA. Our study did not focus on other ions [8] [16]. Systematic screening for acid-base and electrolyte disorders in critically ill patients should be studied on a large number of patients to assess its effect on the prevention and management of IHCA.

Our study has certain limitations: first, the study was conducted over 18 months in two facilities in North-Kivu, which may not represent all healthcare facilities in North-Kivu. However, the inclusion of an urban and a rural facility brings us closer to the reality of healthcare facilities in North-Kivu province. Secondly, it did not take into account certain variables such as the Glasgow Coma Scale score at admission, the patients' echocardiogram, and the post-IHCA outcome in the medium and long term, which would better explain the outcomes of survivors. Thirdly, the study did not assess CPR quality such as chest compression fraction and depth, which are critical determinants of both ROSC and neurological survival. In addition, we did not assess the physiological parameters, which would add some precision regarding the nature of the intervention to be considered. The strength of the study is that it followed up survivors for up to 30 days. Finally, the observations made are essentially clinical and paraclinical; no autopsy results were available. The promotion of autopsy must be initiated to understand the underlying causes of certain deaths.

4. Conclusion

In North-Kivu, the rate of ROSC after IHCA is 42.9% and is associated with cardiovascular comorbidity and CPR initiated by medical doctors and nurses. This rate of ROSC contrasts with a very low survival rate (6%) and functional recovery rate at discharge or on the 30th day of IHCA. The CPR alert is issued late. Most IHCAs occur during working days and on-call hours, and CPR is often led by residents within 1 to 4 minutes of the CA. Half of critically ill patients are not monitored on a multiparameter monitor. Asystole is the most frequently observed cardiac rhythm during CA. Advanced life support with intubation is commonly performed but has a low completion rate. The combination of several reversible causes and hypoxia is the main direct cause of IHCAs. IHCAs are due to diverse causes and cardiovascular diseases. EPOC is not often performed. Metabolic acidosis, hyponatremia, and hyperkalemia are the most common metabolic disorders observed.

Authors' Contributions

JP Kigayi Mumbere is the principal investigator and corresponding author of the study. Trésor Benda Mahesi, Kahindo Kasomo, Kambale Tsongo, and Jonas

Ngaruye are secondary investigators. The other authors reviewed the research protocol, read and edited the manuscript, and approved the final version for publication.

Ethics Approval

The study was authorized by the University of Goma Ethics Committee through its approval letter UNIGOM/CEM/012/2022. Helsinki Principles for human research were respected.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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