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Comparison of presumed cardiac and respiratory causes of out-of-hospital cardiac arrest ☆

Jean-Christophe Orban[a],[*], Mathieu Truc[a], Sébastien Kerever[b], Michaël Novain[a], Florian Cattet[a], Rémi Plattier[a], Mohamed Nefzaoui[a], Hervé Hyvernat[c], Olivier Raguin[d], Michel Kaidomar[e], Nicolas Mongardon[f],[g],[h], Carole Ichai[a]

[a] Medical surgical ICU, Pasteur 2 Hospital, Nice University Hospital, 30 Voie Romaine, 06001 Nice, France
[b] Departments of Anesthesiology and Critical Care, Lariboisière University Hospital, 2 rue Ambroise Paré, 75010 Paris, France
[c] Medical ICU, Archet Hospital, Nice University Hospital, 151 route de Saint-Antoine, 06200 Nice, France
[d] Intensive Care Unit, Antibes General Hospital, 107 avenue de Nice, 06600 Antibes, France
[e] Intensive Care Unit, Fréjus Saint-Raphaël General Hospital, 240 avenue de Saint-Lambert, 83600 Fréjus, France
[f] Anesthesia and surgical ICU, Henri Mondor University Hospital, 31 rue du Parc, 94000 Créteil, France
[g] School of Medicine, Paris Est University, 61 avenue du Général De Gaulle, 94000 Créteil, France
[h] Inserm U955, équipe 3, "Stratégies pharmacologiques et thérapeutiques expérimentales des insuffisances cardiaques et coronaires", 8 rue du Général Sarrail, 94010 Créteil, France

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ABSTRACT

Aims of the study: Most interventional and observational studies include cardiac arrest from cardiac origin. However, an increasing proportion of cardiac arrest results from an extra-cardiac origin, mainly respiratory. The aim of our study was to compare the characteristics and outcome of cardiac arrest patients according to the presumed cardiac or respiratory causes.

Methods: This retrospective multicenter observational study included out-of-hospital cardiac arrest patients from presumed cardiac and respiratory origin treated with therapeutic hypothermia. Demographic data (age, sex, initial rhythm as shockable or non-shockable, durations of no-flow and low-flow), clinical evolution in ICU, lactate and outcome (CPC scale at ICU discharge) were compared between patients according to the presumed cardiac or respiratory origin of the cardiac arrest.

Results: Two hundred and fifty-one cardiac arrest patients were included, 156 from presumed cardiac origin (62%) and 95 from presumed respiratory origin (38%). Patients with presumed cardiac cause presented more frequently a shockable rhythm (68% vs. 5%, p < 0.001), received more defibrillations attempts (2 [1–5] vs. 0 [0-0], < 0.001) and needed less adrenaline (3 mg [0–5] vs. 4 mg [2–7], p = 0.01). The arterial lactate concentration on admission was higher in patients with presumed respiratory causes (6.3 mmol/L [4.2–9.8] vs. 3.2 mmol/L [1.6–5.0], p < 0.001). The proportion of patients presenting a favorable outcome was higher in the population with presumed cardiac causes, compared to its respiratory counterpart (42% vs. 19%, p < 0.001).

Conclusions: Compared to presumed cardiac origin, a worse outcome and a different mode of death are associated with the presumed respiratory origin, resulting from a greater insult preceding cardiac arrest. The presumed cause of cardiac arrest could be integrated in the multimodal prognostication process.

Introduction

Out-of-hospital cardiac arrest (OHCA) is a major public health issue in Western countries, as it represents for instance more than 300,000 cases per year in United States of America [1]. Despite improvement in the process of care, the survival at hospital discharge remains very low. Several characteristics influence the outcome, such as the presence of a bystander, the location or the initial rhythm [2]. Though poorly studied, the underlying cause of cardiac arrest (CA) might also modify the prognosis. Most observational and interventional studies on OHCA included only patients presenting a cardiac arrest from presumed or confirmed cardiac aetiology [3,4]. However the proportion of extra-cardiac causes ranges from 9 to 50% according to the case-mix [5] and this percentage seems to increase over time [6]. The respiratory causes

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are considered as the most frequent extra-cardiac causes of OHCA [6,7]. The characteristics of these patients differ widely from whom undergoing CA of cardiac cause. First, the pathophysiology implies a prolonged period of ischemic/anoxic insult preceding the cessation of flow [8,9]. Second, asystole represent the most frequent initial rhythm, which is a poor prognosis factor [10]. Finally, in the prehospital setting, a suspected respiratory cause of cardiac arrest leads less frequently to a decision of initiating medical CPR, probably due to a presumed worse prognosis [11]. Improved knowledge of OHCA of respiratory causes can thus provide a picture of the real-life epidemiology of CA, improve the prognosis appreciation, and finally, tailor decision to continue or withhold care, according to the presentation characteristics.

We therefore performed a study comparing the presumed respiratory and cardiac causes of OHCA, according to characteristics and outcome.

Methods

Patients' selection and study design

This retrospective multicenter study included out-of-hospital cardiac arrest patients aged 18–80 years admitted in one of the 4 participating ICUs between January 2006 and April 2013, and treated with therapeutic hypothermia. We excluded cardiac arrest patients from traumatic, toxic and neurologic origins. All ICUs have 24/24 access to cath lab and imaging, along with cardiology and neurology specialists. The national committee on data management (Commission Nationale Informatique Liberté) approved this study (decision DE 2013-055) and our hospital ethic committee waived the need for patient's consent.

Patients' management

Patients were treated according to the ILCOR recommendations [12,13]. Therapeutic hypothermia was initiated as soon as possible with surface or catheter cooling according to guidelines, with a target temperature of 32 °C–34 °C during 24 h. All patients were sedated with an association of midazolam and fentanyl during hypothermia and paralyzed using continuous infusion of cisatracurium. All patients were intubated and mechanically ventilated aiming at a PaO_2 between 75 and 100 mmHg and $PaCO_2$ between 35 and 45 mmHg. Therapeutic goals were to obtain mean arterial pressure > 80 mmHg and urine output > 0.5 mL/kg/hr. Patients were given fluid infusion or catecholamines (noradrenaline, dobutamine, adrenaline) according to haemodynamic monitoring data which was left at the physician's discretion. Neurologic outcome was assessed using the Cerebral Performance Category (CPC) scale ranging from 1 to 5, at ICU discharge. CPC 1 and 2 were considered as favorable outcome and CPC 3 to 5 as unfavorable outcome. After rewarming, prognosis was assessed according to international guidelines, based on clinical examination, biomarkers, electrophysiology and imaging.

Study protocol

Patient data collection included pre-hospital clinical data (age, sex, initial rhythm as shockable or non-shockable, durations of no-flow and low-flow and ROSC) and ICU clinical and biochemical data (presumed cause of cardiac arrest, catecholamines requirement as a surrogate of post-cardiac arrest shock, length of stay, cause of death, outcome assessed by CPC scale at ICU discharge, arterial lactate concentration on admission and in the first 24 h). The presumed cause of cardiac arrest was dichotomized as respiratory or cardiac after careful analysis of the ICU files, by two independent investigators (JCO and MT); in case of disagreement, a third expert (CI) reached consensual classification. The following aetiologies were considered respiratory: aspiration, pneumonia, pulmonary embolism, asthma attack, COPD exacerbation, hanging and drowning. Cardiac causes were resumed as ischemic heart disease, structural non-ischemic heart disease or arrhythmogenic primary disease.

Statistical analysis

The data are described as their frequencies and percentages for the categorical variables, and as their medians (25th–75th percentile range) for the quantitative variables. Categorical variables were compared using the Chi-square test or the Fisher exact test, as appropriate, and quantitative variables using Wilcoxon's ranked-sum test. We used a stepwise logistic regression to estimate the odds ratios and 95% confidence intervals to determine the association between the selected factors and unfavorable outcome. For model building, we introduced selected variables from univariate analysis with p < 0.2. All tests were two-sided and statistical significance was set at the $p = 0.05$ level. Analyses were performed using R open source software 3.1.1 (available online at http://www.R-project.org).

Results

Characteristics of the general population

Two hundred and fifty-one patients aged 65 [53–75] years met the study inclusion criteria at the 4 participating ICUs (Table 1). They presented no-flow, low-flow and ROSC durations of 3 [0–10], 15 [10–25] and 20 [12–30] minutes, respectively (Table 1). A shockable rhythm was found in 44% (n = 105). From this population, 33% (n = 84) of patients presented a favorable outcome at ICU discharge, whereas 67% (n = 167) of patients were considered unfavorable outcome (Table 2). In the latter group, 152 patients died, from MOF in 32% (n = 48) and neurologic failure with care withdrawal in 68% (n = 104).

Comparison of patients with cardiac and respiratory causes of OHCA

The presumed cause of cardiac arrest was classified as cardiac in 62% (n = 156) and respiratory in 38% (n = 95). The respiratory origin diagnoses were represented by aspiration in 41% (n = 39), drowning in 29% (n = 27), COPD exacerbation in 14% (n = 13), asthma attack in

Table 1
Demographic characteristics of the population of the study and according to the presumed cause of cardiac arrest.

	All patients (n = 251)	Respiratory cause (n = 95)	Cardiac cause (n = 156)	p value
Age (years)	65 [53–75]	68 [59–77]	63 [51–73]	0.01
Sex ratio (M/F)	175/76	52/43	123/33	< 0.001
Active smoking	79 (32)	30 (33)	49 (32)	0.75
Coronary artery disease	49 (20)	9 (10)	40 (26)	0.002
High blood pressure	99 (39)	37 (38)	62 (40)	0.75
Diabetes	43 (17)	19 (19)	24 (15)	0.49
No-flow (min)	3 [0–10]	5 [0–10]	3 [0–8]	0.10
Low-flow (min)	15 [10–25]	17 [10–25]	15 [10–25]	0.20
ROSC (min)	20 [12–30]	25 [16–35]	18 [11–30]	0.02
Initial rhythm	101 (46)	4 (5)	97 (68)	< 0.001
- Shockable	117 (54)	71 (95)	46 (32)	
- Non shockable				
Adrenaline (mg)	3 [1–6]	4 [2–7]	3 [0–5]	0.01
Defibrillation attempt(s)	148 (59)	22 (23)	126 (81)	< 0.001
Number of shocks	0 [1–3]	0 [0-0]	2 [1–5]	< 0.001
Coronary angiography	120 (47)	5 (5)	115 (74)	< 0.001

Data are expressed as n (%) or median and [interquartile range]. A *p* value < 0.05 was considered significant.