ORIGINAL ARTICLE

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Reduced mobility is associated with adverse outcomes after in-hospital cardiac arrest

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SUMMARY

OBJECTIVE: In-hospital cardiac arrest is a critical medical emergency. Knowledge of prognostic factors could assist in cardiopulmonary resuscitation decision-making. Frailty and functional status are emerging risk factors and may play a role in prognostication. The objective was to evaluate the association between reduced mobility and in-hospital cardiac arrest outcomes.

METHODS: This retrospective cohort study included patients over 18 years of age with in-hospital cardiac arrest in Botucatu, Brazil, from April 2018 to December 2021. Exclusion criteria were patients with a do-not-resuscitate order or patients with recurrent in-hospital cardiac arrest. Reduced mobility was defined as the need for a bed bath 48 h before in-hospital cardiac arrest. The outcomes of no return of spontaneous circulation and in-hospital mortality were evaluated.

RESULTS: A total of 387 patients were included in the analysis. The mean age was 65.4±14.8 years; 53.7% were males and 75.4% had reduced mobility. Among the evaluated outcomes, the no return of spontaneous circulation rate was 57.1%, and in-hospital mortality was 94.3%. In multivariate analysis, reduced mobility was associated with no return of spontaneous circulation when adjusted by age, gender, initial shockable rhythm, duration of cardiopulmonary resuscitation, and epinephrine administration. However, in multiple logistic regression, there was no association between reduced mobility and in-hospital mortality.

CONCLUSION: In patients with in-hospital cardiac arrest, reduced mobility is associated with no return of spontaneous circulation. However, there is no relation to in-hospital mortality.

KEYWORDS: Cardiac arrest. Resuscitation. Hospital mortality. Functional status. Rehabilitation.

INTRODUCTION

In-hospital cardiac arrest (IHCA) is a medical emergency with high mortality and an incidence of 1–6 per 1,000 hospital admissions[1,2]. Traditionally, this condition is neglected compared to other cardiovascular conditions, such as myocardial infarction and stroke[3]. However, cumulative evidence points to IHCA as a single clinical entity that deserves special attention[4].

Regarding the prognosis, IHCA presents high mortality rates, reaching 77 to 86%[4,5]. In addition, we must be aware of the sequelae, especially neurological, and important loss of functionality that these patients usually suffer if they survive[6]. Because of this poor prognosis, sometimes the resuscitation of these patients may be considered futile[7]. The knowledge of prognostic factors could assist in cardiopulmonary resuscitation (CPR) decision-making with the patients and their family/caregivers[8].

Frailty and functional status are emerging risk factors for adverse outcomes in cardiorespiratory victims[9,10]. These conditions can be related because frailty is a condition of vulnerability after a stressor event[11], and functional status is the ability to perform daily activities, which is usually compromised in frail patients[12]. Both conditions were chronic markers of an unfavorable prognosis. However, the presence of in-hospital reduced mobility (RM), which reflects acute and chronic functional decline, was not yet evaluated in the IHCA scenario. Therefore, our study aimed to evaluate the association between RM and IHCA outcomes.

METHODS

This study was a subanalysis of a larger unpublished retrospective cohort study approved by the ethics committee of our institution (56979721.9.0000.5411) that evaluated the risk

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factors of IHCA. Considering that the assessment of RM has not been described in IHCA, we used a previous study that evaluated the association between frailty and IHCA to estimate the sample size. The sample size was calculated using the difference of return of spontaneous circulation (ROSC) between frail and nonfrail patients (47.9 and 35.5%, respectively)[8], an α of 5%, and a power of 80%, resulting in a minimum sample of 279 patients.

The inclusion criteria were patients over 18 years of age with IHCA in Botucatu, Brazil, from April 2018 to December 2021. Exclusion criteria were patients with a do-not-resuscitate order or with recurrent IHCA. Our hospital is a University Tertiary Hospital, which usually has severely ill patients hospitalized in the wards.

Demographic, laboratory, and clinical data were collected from the data registry for the rapid response team (RRT) and the electronic medical records. The RRT is a specialized team responsible for the prompt assessment, screening, and treatment of patients with signs of clinical deterioration and IHCA in our hospital. The outcomes of no-ROSC and in-hospital mortality were evaluated.

Recurrent IHCA was defined as a new cardiac arrest during the same hospital stay. The RM was defined as the need for a bed bath 48 h before IHCA. Although there is a controversial definition of RM in the literature, the need for bed baths in our study probably included patients with chronic and acute RM. In our hospital, the nursing staff only performed bed baths when the patient had some mobility difficulty. Shockable rhythms included pulseless ventricular tachycardia and ventricular fibrillation, and in nonshockable rhythms, we included pulseless electrical activity and asystole as IHCA first rhythms. ROSC was defined as the restoration of a pulse for at least 20 min.

All statistical analyses were performed with the SigmaPlot software for Windows v12.0 (Systat Software Inc., San Jose, CA, USA). Data are expressed as percentages, mean values with standard deviation, or medians with 25th and 75th percentiles, where appropriate. Comparisons between two groups for continuous variables were performed using the Student's t-test or the Mann-Whitney U test. Comparisons between two groups for categorical variables were made using the χ^2 test or Fisher's exact test.

We constructed two regression models for each analyzed outcome (no-ROSC or in-hospital mortality). In the first model, the RM was adjusted by clinically relevant variables defined by the literature: age, gender, initial shockable rhythm, time of CPR, and epinephrine administration. In the other model, RM was adjusted with parameters that exhibited significant differences in the univariate analysis for each outcome. The significance level adopted was 5%.

RESULTS

A total of 412 patients with IHCA attended by the RRT were evaluated. However, 25 patients were excluded: 17 due to a do-not-resuscitate order and 8 due to recurrent IHCA. Thus, we included 387 patients in the analyses (Figure 1). The mean age was 65.4±14.8 years; 53.7% were males, and 91.2% of initial cardiac arrest rhythms were nonshockable. Most of the patients, 292 (75.4%), had RM. Among the evaluated outcomes, the no-ROSC rate was 57.1% and in-hospital mortality was 94.3%.

Demographic and clinical data according to ROSC are shown in Table 1. In this analysis, older patients, longer duration of CPR, and RM have been associated with no-ROSC. As shown in Table 1, increased age, duration of CPR, presence of arterial hypertension, higher levels of urea and creatinine, epinephrine administration, and RM were associated with increased in-hospital mortality.

In multiple logistic regression, RM persistence was associated with no-ROSC when adjusted by age, gender, initial shockable rhythm, duration of CPR, and epinephrine administration [odds ratio (OR)=1.999; 95% confidence interval (CI) 1.118–3.575; p=0.020] and also when adjusted for statistically significant variables in univariate analysis such as age and duration of CPR (OR=1.982; 95%CI 1.110–3.539; p=0.021) (Figure 2). We also evaluated the performance of RM to predict no-ROSC. The sensibility was 80.5%, the specificity was 31.3%, the positive predictive values were 61.0%, and the negative predictive values were 54.7%.

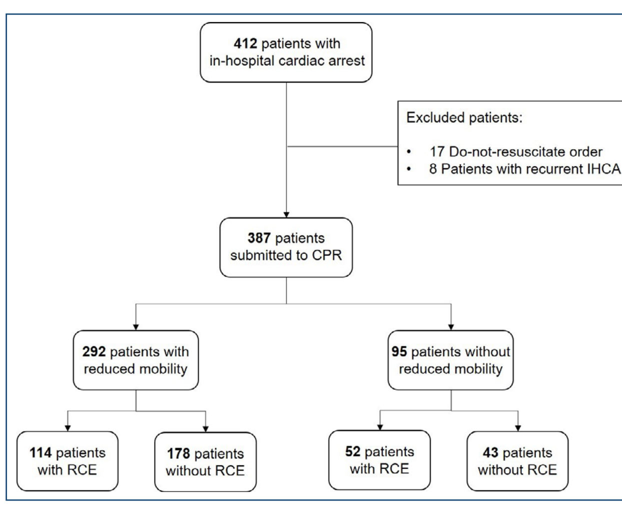

Figure 1. Flow diagram of studied patients with in-hospital cardiac arrest.

Table 1. Baseline characteristics and laboratory data of 387 patients with in-hospital cardiac arrest.

Variable	ROSC		p-value	In-hospital mortality		p-value
	Yes (166)	No (221)		Yes (365)	No (22)	
Age (years)	65.0 (55.0–73.0)	69.0 (58.0–78.0)	0.007	67.0 (57.0–77.0)	53.0 (43.5–68.5)	<0.001
Male gender, n (%)	86 (51.8)	122 (55.5)	0.575	198 (54.2)	10 (45.5)	0.560
Admission category, n (%)						
Medical	81 (48.8)	106 (48.0)	0.953	178 (48.8)	9 (40.9)	0.619
Surgery	85 (51.2)	115 (52.0)		187 (51.2)	13 (59.1)	
Initial rhythm, n (%)						
Shockable (VF, pVT)	18 (10.8)	16 (7.20)	0.290	32 (8.8)	2 (9.1)	0.737
Nonshockable (PEA, asystole)	148 (89.2)	205 (92.8)		333 (91.2)	20 (90.9)	
IHCA initial rhythm, n (%)						
Asystole	41 (24.7)	110 (49.8)	<0.001	151 (41.3)	0 (0)	0.001
PEA	107 (64.5)	95 (42.9)		182 (49.9)	20 (91.0)	
pVT	7 (4.2)	3 (1.4)		9 (2.5)	1 (4.5)	
VF	11 (6.6)	13 (5.9)		23 (6.3)	1 (4.5)	
Duration of CPR (min)	14 (7.0–21.0)	30 (20.0–35.0)	<0.001	24 (15–32)	6 (2–12.5)	<0.001
Medical history, n (%)						
Arterial hypertension	101 (60.8)	145 (65.6)	0.391	238 (65.2)	8 (36.4)	0.012
Diabetes	110 (66.3)	140 (63.3)	0.627	233 (63.8)	17 (77.3)	0.294
Epinephrine, n (%)	162 (97.6)	220 (99.5)	0.218	362 (99.2)	20 (90.9)	0.018
Amiodarone, n (%)	147 (88.5)	203 (91.8)	0.358	35 (9.6)	2 (9.1)	0.767
Reduced mobility, n (%)	114 (68.7)	178 (80.5)	0.010	280 (76.7)	12 (54.5)	0.037
Hemoglobin (g/dL)	12.0 (±2.5)	11.8 (±2.5)	0.605	11.9 (±2.6)	12.2 (±1.9)	0.580
Hematocrit (%)	36.5 (±7.4)	36.2 (±7.4)	0.751	36.3 (±7.5)	36.9 (±.5.2)	0.713
Urea (mg/dL)	54.5 (35.0–95.0)	57.5 (35.7–96.5)	0.240	57.0 (38–96.7)	27.5 (22.2–51.2)	<0.001
Creatinine (mg/dL)	1.0 (0.7–1.7)	1.1 (0.7–2.0)	0.437	1.1 (0.8–1.9)	0.7 (0.6–1.2)	0.005
Sodium (mmol/L)	136 (131–139)	136 (133–139)	0.139	136 (133–139)	135 (131–137)	0.136
Potassium (mmol/L)	4.3 (3.9–4.9)	4.4 (3.9–4.9)	0.643	4.3 (3.9–4.9)	4.3 (3.9–4.9)	0.947

PEA: pulseless electrical activity; pVT: pulseless ventricular tachycardia; VF: ventricular fibrillation; CPR: cardiopulmonary resuscitation; ROSC: return of spontaneous circulation. Data are expressed as the mean±SD, median (25–75%), or percentage.

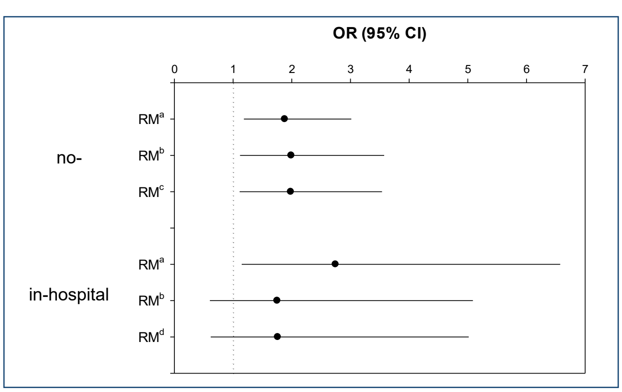

Figure 2. Logistic regression models for the prediction of the return of spontaneous circulation and in-hospital mortality in 387 patients with in-hospital cardiac arrest.

There was no association, in multiple logistic regression, between RM and in-hospital mortality, when adjusted by age, gender, initial shockable rhythm, duration of CPR, and epinephrine administration (OR=1.752; 95%CI 0.604–5.087; p=0.302) or when adjusted by age, time of CPR, arterial hypertension, and epinephrine administration (OR=1.760; 95%CI 0.618–5.016; p=0.290) (Figure 2).

DISCUSSION

The objective of our study was to evaluate the association between RM and IHCA outcomes. We discovered that RM is associated with no-ROSC but not with in-hospital mortality.

IHCA is still a neglected condition compared to out-of-hospital cardiac arrest (OHCA) and other cardiovascular conditions such as myocardial infarction and stroke among others[3]. Although guidelines for IHCA and OHCA are similar[13,14], there are important differences that make IHCA a unique clinical entity. A favorable point to study this condition is that, unlike OHCA, patients are under clinical observation before the event. Despite this observation, mortality is still very high. In our study, mortality was higher than expected by the literature. We believe that the inclusion of COVID-19 patients and the inclusion of patients who had cardiac arrest only in the wards, not in the ICU (intensive care unit), were responsible for this increased mortality. That is, patients in the ICU are under active surveillance and usually receive CPR earlier than in the wards.

Several patient characteristics are associated with IHCA outcomes. A review and meta-analysis that included 23 IHCA studies showed that male sex, increasing age, active malignancy, and chronic kidney disease are among the IHCA prognostic factors[15]. However, all these are nonmodifiable factors, and since patients usually present deterioration signs before cardiac arrest and abnormal vital signs, the search for a possible modifiable factor as RM is an interesting approach[16].

Patients with RM usually have low functional status. Functional status can be viewed as a summary measure of the general impact of health conditions, usually assessed by the ability to perform daily activities, and depending on the degree of impairment, it can result in physical restriction[17,18]. Interestingly, patients with chronic diseases such as frailty usually have functional decline, and both conditions were associated with poor outcomes[18,19]. When assessing RM, we are evaluating both chronic and acute functional decline. In addition, the RM could be the result of previous comorbidities and only a marker of illness severity, or it could be an acute consequence that could be attenuated by interventions.

Regarding being a marker of poor prognosis, RM has a sensitivity of 80.5% to predict no-ROSC. Therefore, its presence is useful clinical information for the health-care team, patients, and families to define care plans and manage hospital resources[8].

RM is also a potentially modifiable factor before cardiac arrest. Although functional decline can be a consequence of varied and complex conditions, evidence points to the importance of early physiotherapy interventions in critical patients[15]. A large review that evaluated more than 80 studies demonstrated that early physiotherapy intervention has a positive effect on functional capacity[20]. Our study did not show an association between RM and in-hospital mortality; however, we believe that this was due to the lower number of patients receiving hospital discharge. Therefore, our study reinforces the importance of physiotherapy protocols for hospitalized patients with initial signs of RM.

Limitations

We must consider some limitations of this study. First, only patients from a single center were evaluated. Second, the retrospective design of the study is restrictive. Despite these limitations, we believe that our study brings important knowledge regarding functional status and IHCA outcomes.

CONCLUSION

In patients with IHCA, RM is associated with no-ROSC. However, there is no relation to in-hospital mortality. These data are among the first to demonstrate that functional decline is associated with the worst outcomes in patients with IHCA.

AUTHORS' CONTRIBUTIONS

TL: Conceptualization, Formal Analysis, Methodology, Writing – original draft. **ELFJ:** Conceptualization, Investigation, Methodology, Writing – original draft. **FAR:** Investigation, Methodology. P**SA:** Investigation, Writing – original draft. B**FP:** Investigation, Writing – original draft. **SARP:** Supervision, Visualization, Writing – review & editing. **LZ:** Supervision, Visualization, Writing – review & editing. **MFM:** Conceptualization, Formal Analysis, Funding acquisition, Methodology, Project administration, Supervision, Visualization, Writing – review & editing.

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