

# Impact of admitting department on the management of acute coronary syndrome after an out of hospital cardiac arrest

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**Aim.** This study aimed to analyze the influence of the hospital admitting department on adherence to the Guidelines of European Society of Cardiology for management of acute coronary syndromes in patients after out-of-hospital cardiac arrest (OHCA) of coronary etiology.

**Methods.** We studied retrospective-prospective register of 102 consecutive patients with OHCA as a manifestation of acute coronary syndrome (ACS). Patients were admitted to the coronary care unit (CCU) 52, general intensive care unit (GICU) 21, or GICU after initial Cath lab treatment (CAG-GICU) 29. This study compared the differences in the management of ACS in patients with OHCA of coronary etiology based on the admitting department in a tertiary care institution.

**Results.** Twelve of the 21 (57.1%) patients admitted to the GICU were evaluated as having ACS on-site where they experienced OHCA. In the CCU group, 50 out of 52 (96.2%) and 28 of 29 (100%) patients in the CAG-GICU group ( $P < 0.001$ ). Coronary angiography was performed in 10 of 21 patients (48%) admitted to the GICU. It was performed in 49 out of 52 (94%) CCU patients and, in the CAG-GICU group, 28 out of 29 patients. The mean time to CAG differed significantly across groups (that is, GICU 200.7 min., CCU 71.2 min., and CAG-GICU 7.5 min. ( $P < 0.001$ )). Aspirin was used in 48% of GICU, 96% of CCU, and 79% of CAG-GICU patients ( $P < 0.001$ ), while in the pre-hospital phase, aspirin was used in 9.5% of GICU, 71.2% of CCU, and 50% of CAG-GICU patients ( $P < 0.001$ ). P2Y12 inhibitor prescriptions were lower in patients admitted to the GICU (33% vs. 89% CCU and 57% CAG-GICU,  $P < 0.001$ ). The department's choice significantly affected the time to initiation of antithrombotics, which was the longest in the GICU.

**Conclusion.** The choice of admission department for patients with OHCA caused by ACS was found to affect the extent to which the recommended treatments were used. An examination of OHCA patients by a cardiologist upon admission to the hospital increased the likelihood of an early diagnosis of ACS as the cause of OHCA.

**Key words:** out-of-hospital cardiac arrest, acute coronary syndrome, coronary care unit, general intensive care unit, coronary angiography, antithrombotic therapy

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## INTRODUCTION

At 29.6% worldwide<sup>1</sup> and 45% in Europe<sup>2</sup>, cardiovascular disease (CVD) is the leading cause of death; the percentage of acute coronary syndrome (ACS) cases presenting as an out-of-hospital cardiac arrest (OHCA) is increasing<sup>3</sup>. The incidence of OHCA having a cardiac etiology varies locally and to a significant extent. The reported global average is 55 adult patients per 100,000 people, and the average survival rate is approximately 7% (ref.<sup>1</sup>). The most common cause of death in patients after OHCA is the withdrawal of life support due to brain death, which accounts for more than 70% of deaths<sup>3</sup>. However, predicting neurological outcomes in the acute phase is difficult and requires a time interval of several days<sup>4,5</sup>. Thus, the treatment approach to OHCA with cardiac etiology should not be solely determined by the initial

neurological condition. Early circulatory stabilization is also imperative for ensuring cerebral perfusion and minimizing secondary brain damage.

In cases where coronary ischemia is confirmed to be the etiology of OHCA, early coronary reperfusion therapy is indicated. There is evidence that early coronary angiography (CAG) with the potential for percutaneous coronary intervention (PCI), especially when ST segments on the ECG are elevated (STE), is associated with reduced mortality<sup>6-8</sup>. In patients without STE (non-STE/NSTE), the benefits of early intervention are contested, as are comparisons between early and deferred implementation strategies<sup>9</sup>.

This work is based mainly on the Guidelines<sup>10,11</sup>, which clearly recommend an early invasive strategy and adjuvant antithrombotic treatment for revascularization of STE myocardial infarctions (STE MI). In cases with NSTE ACS, antithrombotic treatment and invasive revascular-

ization are recommended, with more potential benefits associated with early implementation.

In this sense, it is desirable to optimize patient care after an OHCA so that diagnostic coronary angiography, with the option of subsequent mechanical reperfusion and related pharmacotherapy, are available as soon as possible. However, acute cardiac care after an OHCA is not always consistent and shows considerable variability between hospitals and individual departments within hospitals. In addition, the level of interdisciplinary cooperation varies substantially. In addition to general intensive care units (GICUs), specialized coronary care units (CCUs) exist in which care is focused on cardiac issues<sup>12</sup>. Particularly in the US, there is an effort to create a unified framework for the organization of physician expertise and education in critical care cardiology<sup>13</sup>.

The present study analyzed the influence of hospital admitting department (i.e., CCU vs. GICU) relative to adherence to recommendations for treating OHCA with a cardiac etiology.

## METHODS

This was a single-center study conducted at a large tertiary care institution with 24/7 primary percutaneous coronary intervention (pPCI). This study was approved by the Institutional Ethics Committee.

Consecutive patients admitted to our tertiary care hospital after an OHCA (between November 2013 and October 2017) and who were discharged or died with a confirmed coronary etiology were included in this retrospective prospective registry.

The GICU of the University Hospital accepts a wide range of patients with both medical and trauma diagnoses. Physicians familiar with anesthesiology and intensive care routinely diagnose and treat all types of shock and organ failure. Ultrasound examinations, including transthoracic echocardiograms, are used as part of the diagnostic procedure. They utilize a broad range of intensive care procedures, especially for invasive monitoring. Treatment options for respiratory failure include extracorporeal membrane oxygenation, continuous elimination techniques, and minor surgical procedures, such as chest drainage and tracheostomy.

The hospital CCU focuses on cardiac diseases, which are often associated with other comorbidities. Cardiologists are trained in both acute cardiac and post-resuscitation care and routinely perform all diagnostic and therapeutic methods associated with such treatment, including invasive hemodynamic monitoring, artificial lung ventilation, intra-aortic balloon pump, and short-term extracorporeal membrane oxygenation.

Both types of intensive care units (ICUs), that is, CCU and GICU, cooperate closely. Specialized cardiology care is also available to GICU patients, where it is up to the physician to decide when, and if, to request a cardiology examination. The CAG-GICU patients in this study demonstrated the ICU model of close cooperation between the GICU and CCU.

The distribution of patients between the GICU and CCU (Fig. 1) depends mainly on the pre-hospital evaluation, by emergency services physicians, of the patient's condition after an OHCA.

Besides clinical evaluation and anamnestic data the emergency services physician is equipped with ECG and portable ultrasound machine.

Based on the on-site report, a trained dispatcher at the hospital directs the patient to either the CCU or GICU. In our study, this process produced three groups of patients: (A) patients suspected of having an OHCA with a coronary etiology were admitted to the CCU, (B) some patients were initially taken directly to the Cathlab for a CAG ( $\pm$ PCI) and then immediately transferred to the GICU (CAG-GICU group), and (C) patients whose coronary etiology was not initially clear were admitted directly to the GICU, where the coronary etiology was determined on the basis of extended examination methods (echocardiography, dynamics markers of myocardial ischemia etc.). The CAG-GICU group included patients with a primary diagnosis of OHCA having a coronary etiology. The main reasons for the transfer of CAG patients to the GICU were limited capacity in the CCU and situations when it was expected that the patient would benefit from GICU care, such as the need for a toilet bronchoscopy after gastric aspiration, which occurs in approximately 29% of OHCA cases<sup>14</sup>.

The study population consisted of a total of 102 patients admitted to:

- A. Coronary Care Unit (CCU) - 52 patients
- B. GICU after initial CAG (CAG-GICU) - 29 patients
- C. General ICU (GICU) - 21 patients.

The study compared patient characteristics and their relevant anamnestic burden (i.e., present and previous morbidity, medication, data regarding the OHCA itself, baseline clinical status of patients at admission, and subsequent adherence to ACS guidelines).

## Statistical analysis

Standard descriptive statistics were used in the analysis: absolute and relative frequencies for categorical variables, and the mean supplemented by the standard deviation for continuous variables. Statistical significance of differences was analyzed using the Mann-Whitney U test for continuous variables and Fisher's exact test for categorical variables. Relationships between patient characteristics and endpoints were analyzed using logistic regression and described using odds ratios and statistical significance. The analysis was performed using SPSS 25.0.0.1. (IBM Corporation, 2019),  $P$  value = 0.05, was used as a level of statistical significance in all analyses.

## RESULTS

### Baseline characteristics

Patients admitted to the GICU had a higher average age ( $72 \pm 11$  years) than CCU ( $62 \pm 13$ ), and CAG-GICU patients; men predominated in all groups. Ventricular fibrillation was the first rhythm detected in 50% of GICUs,

90.4% of CCUs, and 82.1% of CAG-GICU patients. The resuscitation duration of patients admitted to the GICU was significantly longer (GICU  $25 \pm 11.7$  min vs. CCU  $19.5 \pm 11.7$  min vs. CAG-GICU  $16.5 \pm 9.9$  min). There were no differences between groups in terms of pre-hospital treatment times, that is, from the moment the emergency service answered the call to hospital admission (GICU  $62 \pm 24$  vs. CCU  $64 \pm 23$  vs. CAG-GICU  $63 \pm 20$  min). Patients admitted to the GICU were immediately diagnosed by the emergency service physician at

the OHCA site as having ACS in 57.1% of cases, 96.2% of CCU patients had been immediately diagnosed with ACS, and 100% of CAG-GICU patients had been immediately diagnosed with ACS.

No significant differences were found between the groups in terms of the history of ischemic heart disease or non-coronary vascular disease. The incidence of stroke or lower limb ischemia was comparable in all groups. The presence of chronic heart failure (GICU, 26.3%; CCU, 3.8%; CAG-GICU, 7.4%) and arterial hyperten-

**Table 1.** Baseline characteristics.

	GICU (1) n (%)	CCU (2) n(%)	CAG-GICU (3) n (%)	<i>P</i> overall	<i>P</i> 1 vs.2	<i>P</i> 1 vs. 3	<i>P</i> 2 vs. 3
Male	20 (95.2%)	45 (86.5%)	23 (79.3%)	0.281	0.425	0.215	0.529
Age (years)	$72 \pm 11$	$62 \pm 13$	$61 \pm 14$	0.005	0.002	0.005	0.894
BMI	$25.15 \pm 2.84$	$27 \pm 4.14$	$26.94 \pm 4.19$	0.382	0.159	0.281	0.786
IHD	6 (30%)	9 (17.3%)	6 (22.2%)	0.514	0.331	0.737	0.763
History of heart attack	2 (10.5%)	6 (11.5%)	3 (11.5%)	1.000	1.000	1.000	1.000
History of CAG	2 (10.5%)	1 (1.9%)	0 (0%)	0.158	0.173	0.165	1.000
Hypertension	15 (75%)	22 (42.3%)	15 (53.6%)	0.017	0.018	0.307	0.057
Chronic heart failure	5 (26.3%)	2 (3.8%)	2 (7.4%)	0.019	0.013	0.107	0.603
Diabetes	7 (35%)	9 (17.3%)	6 (2.2%)	0.279	0.123	0.511	0.763
Smoker	0 (0%)	19 (40.4%)	10 (38.5%)	0.001	0.001	0.002	1.000
Ex-Smoker	2 (11.1%)	8 (17%)	2 (8.7%)	0.707	0.713	1.000	0.480
Family history of IHD	0 (0%)	14 (29.8%)	4 (57.1%)	0.010	0.052	0.009	0.205
Critical limb ischemia	2 (10%)	2 (3.8%)	0 (0%)	0.170	0.307	0.176	0.544
History of stroke	2 (10%)	0 (0%)	1 (3.7%)	0.059	0.074	0.567	0.342
First rhythm – ventricular fibrillation	10 (50%)	47 (90.4%)	23 (82.1%)	0.004	0.001	0.087	0.333
ROSC (min)	$25 \pm 12$	$19 \pm 12$	$16 \pm 10$	0.023	0.045	0.008	0.201
Length of pre-hospital management (min)	$62 \pm 24$	$64 \pm 23$	$63 \pm 20$	0.96	0.789	0.819	0.948
Bystander resuscitation	16 (84.2%)	42 (80.8%)	25 (89.3%)	0.137	0.050	0.33	0.765
Pre-hospital assessment as ACS	12 (57.1%)	50 (96.2%)	28 (100%)	<0.001	<0.001	<0.001	0.539
Pre-hospital Heparin	4 (19%)	35 (67.3%)	16 (57.1%)	0.001	<0.001	0.009	0.466
Pre-hospital aspirin	2 (9.5%)	37 (71.2%)	14 (50%)	<0.001	<0.001	0.005	0.088
Lactate on admission (mmol/L)	$6.4 \pm 3.6$	$3.4 \pm 2.1$	$3.2 \pm 2.4$	0.002	0.003	0.002	04.06
Diastolic blood pressure (mmHg)	$70 \pm 15$	$76 \pm 20$	$68 \pm 18$	0.180	0.308	0.479	0.079
Systolic blood pressure (mmHg)	$125 \pm 34$	$120 \pm 33$	$114 \pm 28$	0.393	0.417	0.143	0.508
Catecholamine circulatory support at admission	15 (71.4%)	29 (56.9%)	16 (57.1%)	0.508	0.296	0.377	1.000
Artificial lung ventilation	21 (100%)	45 (86.5%)	28 (100%)	0.068	0.229	0.288	0.025
SpO <sub>2</sub> , %	$95 \pm 6$	$96 \pm 5$	$96 \pm 6$	0.74	0.554	0.181	0.166
Body temperature (° C)	$34.6 \pm 1$	$36.2 \pm 0,6$	$34.3 \pm 1.1$	<0.001	<0.001	0.312	<0.001

IHD, Ischemic Heart Disease; MI, Myocardial Infarction; CABG, Coronary Artery Bypass Grafting; ROSC, Return of Spontaneous Circulation; ACS, Acute Coronary Syndrome.

**Table 2.** In-hospital Procedures, Treatments.

Characteristic	GICU (1)	CCU (2)	CAG-GICU (3)	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>
					1 vs. 2	1 vs. 3	2 vs. 3
Coronary angiography n (%)	10 (48%)	49 (94%)	28 (100%)	<0.001	<0.001	<0.001	0.548
Time to CAG (min)	200.7 ± 220.9	71.2 ± 202.5	7.5 ± 6.1	<0.001	<0.001	0.001	<0.001
Aspirin administration n (%)	9 (42.9%)	13 (25%)	9 (32%)	0.304	0.163	0.553	0.601
Time to aspirin administration (min)	234 ± 479	113 ± 310	218 ± 498	0.134	0.052	0.148	0.971
Inhibitors P2Y <sub>12</sub> administration n (%)	7 (33%)	46 (89%)	16 (57%)	<0.001	<0.001	0.149	0.004
Clopidogrel administration n (%)	2 (9.5%)	9 (17.3%)	4 (14.3%)	0.763	0.494	0.688	1.0
Time to clopidogrel administration (min)	22 ± 26	759 ± 788	613 ± 1032	0.072	0.034	0.064	0.487
Prasugrel administration n (%)	0 (0%)	8 (15.4%)	0 (0%)	0.016	0.095	–	0.045
Time to prasugrel administration (min)	–	122 ± 68	–	–	–	–	–
Ticagrelor administration n (%)	5 (23.8%)	29 (55.8%)	12 (42.9%)	0.047	0.019	0.229	0.35
Time to ticagrelor administration (min)	207 ± 229	560 ± 1470	90 ± 39	0.437	0.350	0.135	0.647
In-hospital heparin administration n (%)	9 (42.9%)	14 (26.9%)	7 (25.9%)	0.386	0.265	0.237	1.0
Time to heparin administration (min)	130 ± 210	46 ± 79	30 ± 50	0.080	0.043	0.124	0.346
LMWH administration n (%)	3 (15%)	2 (3.8%)	10 (35.7%)	0.01	0.127	0.188	<0.001
β-blocker therapy n (%)	4 (19.0%)	33 (63.5%)	17 (60.7%)	0.002	0.001	0.004	0.814
ACEi therapy n (%)	1 (4.8%)	26 (50%)	13 (46.4%)	<0.001	<0.001	0.001	0.817
Statin therapy n (%)	3 (14%)	43 (83%)	12 (43%)	<0.001	<0.001	0.058	<0.001

CAG, Coronary Angiography; LMWH, Low Molecular Weight Heparin; ACEi, Angiotensin-Converting Enzyme Inhibitors.

sion (GICU, 75%; CCU, 42.3%; and CAG-GICU, 53.6%) significantly increased the likelihood of being admitted to the GICU.

We found no differences between patients admitted to the GICU and CCU, relative to basic vital signs at admission (Table 1). Lactate levels were elevated in all three groups. However, patients admitted directly to the GICU had significantly higher baseline lactate levels than the CCU and CAG-GICU groups (6.4 vs. 3.4 vs. 3.2 mmol/L, respectively) (Table 1).

All patients directly admitted to the GICU and via CAG were artificially ventilated, while 86.5% of those admitted to the CCU were artificially ventilated. Patients directly admitted to the GICU or admitted after initial CAG ± PCI were, in contrast to those admitted directly to CCU, hypothermic, without intentional therapeutic hypothermia in the pre-hospital phase (GICU 34.6 °C vs. GICU-CAG 34.3 °C vs. CCU 36.2 °C).

### CAG Performance

Coronary angiography was performed in 10 of 21 (48%) patients admitted to the GICU. It was performed in 49 out of 52 (94%) CCU patients and in 28 of 29 CAG-GICU patients (Table 2). GICU patients had significantly longer mean times from admission to CAG (GICU 200.7 vs. CCU 71.2 vs. CAG-GICU 7.5 min.).

### Pharmacotherapy

Antiplatelet therapy with aspirin was used in 48% of GICU, 96% of CCU, and 79% of CAG-GICU patients ( $P<0.001$ ). In the pre-hospital phase, aspirin was adminis-

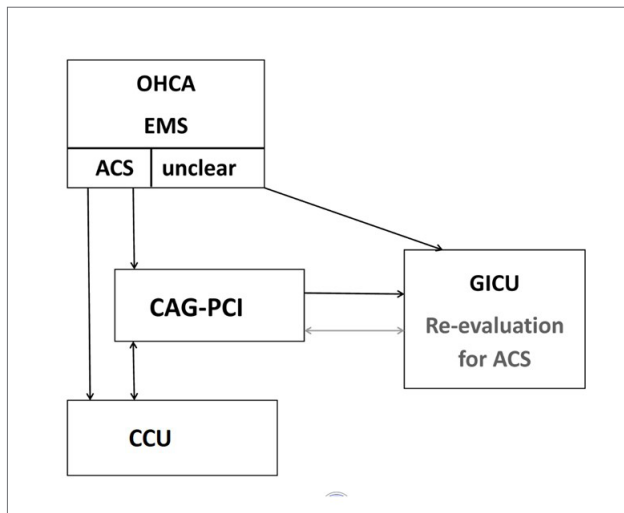
tered to 9.5% of GICU, 71.2% of CCU, and 50% of CAG-GICU patients ( $P<0.001$ ). Aspirin treatment was initiated in 42.9% of patients during the GICU stay after an OHCA coronary etiology was determined. This phenomenon correlates with the observation that ACS was diagnosed in the pre-hospital phase in only 57.1% of GICU patients (Table 2).

The use of P2Y<sub>12</sub> receptor inhibitors was also significantly lower in patients admitted to the GICU (33% vs. 89% CCU and 57% CAG-GICU,  $P<0.001$ ). Clopidogrel was used in 9.5% of GICU vs. 17.3% of CCU vs. 14.3% CAG-GICU patients ( $P=0.072$ ). Prasugrel was administered to 8 (15.4%) CCU patients; ticagrelor was administered to 23.8% of GICUs vs. 55.8% of CCUs, and 42.9% of CAG-GICU patients ( $P=0.437$ ) (Fig. 2).

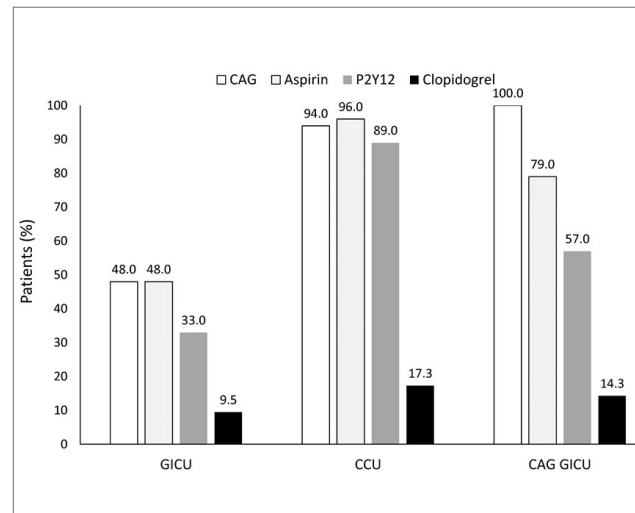
All patients admitted to the GICU had significantly lower rates of statin (14% vs. 83% CCU and 43% CAG-GICU,  $P<0.001$ ), beta-blockers (19% vs. 63.5% CCU and 60.7% CAG-GICU), and ACE inhibitors (4.8% vs. 50% CCU and 46.4% CAG-GICU) (Table 2).

### Prognosis predictors

The following continuous variables (using logistic regression) were identified as predictive of death (Table 3). (1) age of the patient with a cut-off of 64.5 years, OR 95% confidence interval (CI) 50.4 (6.464; 392.953,  $P<0.001$ ), (2) time needed for Restoration of Spontaneous Circulation (ROSC) with a cut-off above 19.5 min, OR 95% CI 4.457 (1.696; 11.708),  $P=0.002$ , (3) admission lactate levels above 4.95 mmol/L, OR 95% CI 9.086 (3.070; 26.891),  $P<0.001$ , and (4) time from admission to the



**Fig. 1.** Patient distribution scheme in the hospital. OHCA, Out-of-hospital cardiac arrest; ACS, acute coronary syndrome; EMS, emergency medical services; CAG-PCI, coronary angiography, percutaneous coronary intervention.



**Fig. 2.** Therapeutical interventions. Percentage of Coronary Angiography (CAG), Aspirin, and P2Y12 Inhibitors Administration in Particular Groups. The proportion of Clopidogrel Used in Antiplatelet Therapy.

**Table 3.** Logistic regression of continuous variable – binarized using optimal cut-off.

	Cut-off	n (n death)	OR 95% CI	P
Age (years)	≤64.5	46 (1)	Reference	<0.001
	>64.5	53 (28)	50.400 (6.464; 392.953)	
Height (cm)	≤186.5	83 (22)	Reference	0.749
	>186.5	5 (1)	0.693 (0.073; 6.543)	
Weight (kg)	≤77	37 (11)	Reference	0.941
	>77	62 (18)	0.967 (0.396; 2.362)	
BMI	≤27.17	51 (12)	Reference	0.514
	>27.17	37 (11)	1.375 (0.528; 3.580)	
Time to ROSC (minutes)	≤19.5	49 (8)	Reference	0.002
	>19.5	43 (20)	4.457 (1.696; 11.708)	
MAP (torr)	≤67	14 (3)	Reference	0.525
	>67	84 (25)	1.554 (0.399; 6.051)	
Blood oxygen saturation (%)	≤99.5	64 (16)	Reference	0.244
	>99.5	33 (12)	1.714 (0.692; 4.247)	
Body temperature (° C)	≤36.65	77 (24)	Reference	0.912
	>36.65	6 (2)	1.104 (0.189; 6.447)	
Lactate (mmol/L)	≤4.95	55 (9)	Reference	<0.001
	>4.95	25 (16)	9.086 (3.070; 26.891)	
Time to Echocardiography (h)	≤0.125	53 (9)	Reference	0.013
	>0.125	25 (11)	3.841 (1.322; 11.161)	
Time to CAG-PCI (h)	≤42.5	66 (14)	Reference	0.097
	>42.5	20 (8)	2.476 (0.848; 7.231)	

ROSC, Restore of Spontaneous Circulation; MAP, Mean Arterial Pressure; CAG-PCI, Coronary Angiography – Percutaneous Coronary Intervention.



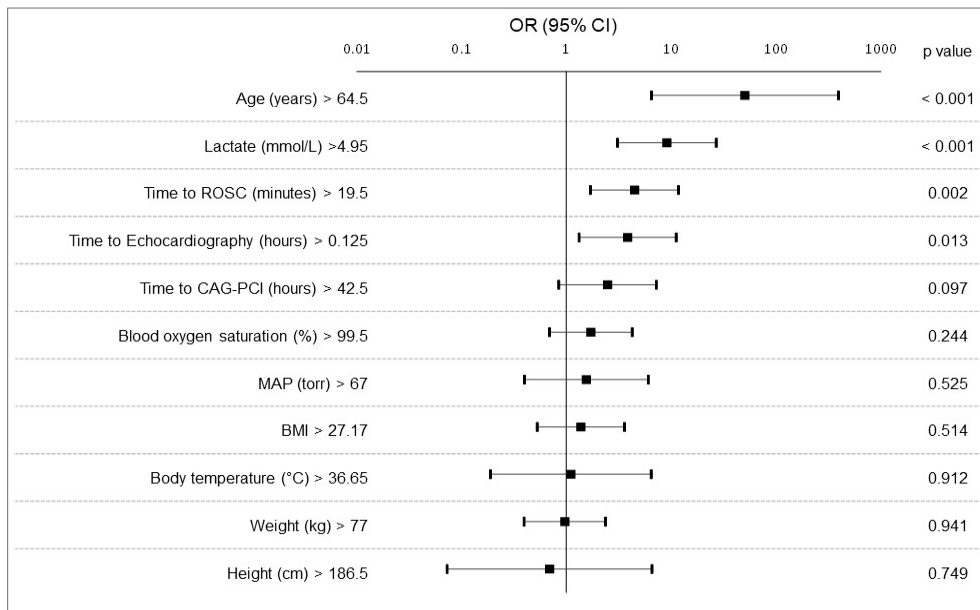


Fig. 3A. Logistic regression of continuous variables – binarized using optimal cut-off.

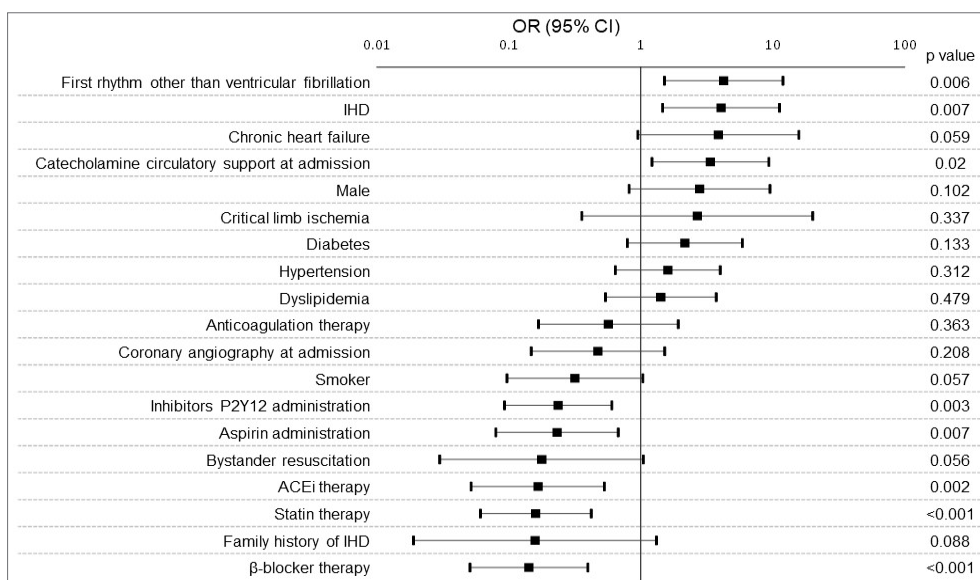


Fig. 3B. Logistic regression of categorical variables.

hospital to echocardiography greater than 0.125 h, 3.841 OR 95% CI 3.841 (1.322; 11.161),  $P=0.013$ . No association was found between mortality and time to CAG (Fig. 3A).

The analysis of categorical variables revealed a negative effect on survival (i.e., odds ratios for mortality) related to (1) a history of ischemic heart disease OR 95% CI 4.056 (1.464; 11.239),  $P=0.007$ ; (2) a first rhythm other than ventricular fibrillation OR 95% CI 4.242 (1.510; 11.918),  $P=0.006$ ; and (3) the need for catecholamine support on admission OR 95% CI 3.361 (1.213; 9.310),  $P=0.020$ .

Adherence to ACS pharmacotherapy recommendations was found to substantially reduce the risk of death: aspirin administration OR 95% CI 0.232 (0.080; 0.675),  $P=0.007$ ; P2Y<sub>12</sub> inhibitor administration OR 95% CI 0.236

(0.093; 0.603),  $P=0.003$ ; statin therapy OR 95% CI 0.160 (0.061; 0.422),  $P<0.001$ ; beta-blocker therapy OR 95% CI 0.142 (0.051; 0.398),  $P<0.001$ ; and ACE inhibitor therapy OR 95% CI 0.167 (0.052; 0.530),  $P=0.002$  (Fig. 3B).

## DISCUSSION

Cardiac etiologies for OHCA predominate over non-cardiac causes, which, depending on the study, range from 50% to 91% (ref.<sup>15</sup>). Despite the small number of etiology analyses and time trends, the importance of ACS as a cause of OHCA seems to be growing. Paterson et al., in their analysis of the Myocardial Ischemia National Audit Project Database, showed that in the patient population of

England and Wales, the proportion of ACS, as an etiology of OHCA between 2009 and 2013, increased every year. Additionally, the parallel increase in the proportion of patients treated with CAG-PCI was associated with a better prognosis for patients after OHCA due to ACS. Urgent CAG-PCI has been shown to reduce mortality in patients after an OHCA with a coronary etiology in patients with STE ACSs (ref.<sup>6-8</sup>), while in patients with NSTEMI ACS, the effect of CAG timing remains unclear.

The COACT trial<sup>16</sup> analyzed the NSTEMI ACS data of patients from 19 Dutch medical centers. Urgent coronary angiography was not superior to delayed coronary angiography.

Thus, in a system with the coexistence of autonomous CCUs and GICUs, the identification of ACS as the cause of OHCA at the resuscitation site can lead to a direct referral of the patient to the CCU followed by immediate administration of specific cardiac care.

In our study, the admission department of patients with OHCA caused by an atherothrombotic event significantly affected adherence to ACS treatment recommendations. Thus, during the initial medical examination in the pre-hospital phase, the suspicion that an OHCA had a coronary etiology led to better adherence to the recommended diagnostic and therapeutic procedures. Additionally, a medical examination by a cardiologist upon admission to the hospital after an OHCA also increased the likelihood of an early diagnosis of ACS being the cause of OHCA. We observed that early diagnosis and associated adherence to treatment recommendations significantly reduced the risk of death.

A possible limiting factor for OHCA admission to the CCU may be the unavailability of a suitable level of general intensive care in complicated cases and/or its permanent availability. This is mainly associated with a reliable airway protection level, expertise in mechanical ventilation, ventilation weaning, and treatment of other non-cardiac organ failures.

The education of intensivists who take care of patients after an OHCA includes the ability to assess the patient's neurological condition after sedation and address ethical issues related to end-of-life decision-making and the futility of treatment in cases with severe post-hypoxic damage, in which the prolonging of suffering and use of economic resources without a foreseeable benefit pose ethical concerns<sup>17,18</sup>.

When it comes to patient care after an OHCA with a coronary etiology, the decisive factor was the cardiology expertise of the physician performing the initial hospital evaluation, as well as their expertise in intensive care medicine. This two-subject education can be achieved either by an intensivist conducting a follow-up study in cardiology or vice versa<sup>19</sup>.

The current trend of educating cardiologists in intensive care medicine and the creation of CCUs represents a model in which comprehensive care for patients after an OHCA is available in one place<sup>12,19,20</sup>. Expanding the portfolio of general intensive care procedures available in CCUs would reduce the pressure on pre-hospital tri-

age of clearly cardiac patients. Another alternative is the cooperation of a cardiologist and an intensivist within one ICU (ref.<sup>21</sup>).

Despite good cooperation between the specific GICU and CCU described, lowering the threshold for admission of patients to the CCU after an OHCA and accelerating the diagnosis and treatment of ACS, even in initially unclear cases, would still be beneficial.

While the GICU is autonomous in the decision-making process, CAG and further treatment recommendations become the responsibility of the cardiologist after consultation. Conversely, in situations where GICU physicians are not convinced of the benefits of treating coronary ischemia, the GICU is entirely in charge of treatment.

In addition, our data pointed to the need to consider ACS as a potential cause of OHCA in high-risk patients who are preferably admitted to the GICU. In this situation, general intensivists should have expertise in cardiology and the treatment of these patients or immediately consult with a cardiologist regarding treatment to minimize delays and reduce the risk of omitting best practices.

In our study, CAG-GICU patients essentially represented the common ICU model where patients, after initial management, were hospitalized under comprehensive GICU care, and the cardiologist continued as a consultant.

Our results showed that the optimal adherence to the recommended treatment of ACS according to the relevant guidelines<sup>22</sup> occurred at the highest rate in CCU and CAG-GICU patients, where the treatment was managed by or involved a cardiologist.

As a result of pre-hospital triage, more complicated patients were admitted to the GICU. Additionally, in-hospital mortality differences reflected differences in GICU and CCU habits relative to end-of-life decision-making for patients with post-hypoxic brain damage.

## CONCLUSIONS

The admitting department for patients with OHCA caused by an atherothrombotic event significantly determined the degree to which adherence to ACS treatment recommendations was utilized. The suspicion that an OHCA has a coronary etiology during the initial pre-hospital medical examination leads to better adherence to the recommended diagnostic and therapeutic guidelines. Finally, we observed that both ACS diagnosis and treatment were delayed in elderly patients with significant comorbidities.

## ABBREVIATIONS

OHCA, Out-of-Hospital Cardiac Arrest; ACS, Acute Coronary Syndrome; CCU, Coronary Care Unit; GICU, General Intensive Care Unit; CAG, Coronary Angiography; PCI, Percutaneous Coronary Intervention; MI, Myocardial Infarction; STE MI,

ST-Elevation Myocardial Infarction; NSTEMI, non-ST-Elevation Myocardial Infarction; ICU, Intensive Care Unit; IHD, Ischemic Heart Disease; CABG, Coronary Artery Bypass Grafting; ROSC, Return of Spontaneous Circulation; LMWH, Low Molecular Weight Heparin; ACEi, Angiotensin-Converting Enzyme Inhibitors; MAP, Mean Arterial Pressure.

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