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Short title: Outcomes in survivors of cardiac arrest qualified to coronary angiography

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ABSTRACT

Introduction: Most cardiac arrests in adults is related to coronary artery disease (CAD) and the role of early invasive cardiology procedures remains unsettled.

Aims: We investigated the prognosis of patients hospitalized due to out-of hospital cardiac arrest (OHCA) or in-hospital cardiac arrest (IHCA) and referred within 24 hours for admission to tertiary cardiology department, regarding the role of early coronary angiography (CA) and percutaneous coronary intervention (PCI).

Methods: This was an observational, single-centre study using a retro and prospective cohort. Consecutive patients hospitalized due to OHCA or IHCA and referred within 24 hours for admission to cardiology department were in the study. Survival to hospital discharge was the primary outcome.

Results: 148 patients aged 71 (14) years were included, 68 hospitalized due to OHCA and 80 patients after IHCA. Overall, in-hospital survival in the study group was 45% (66/148). In a multivariable logistic regression model, independent predictors of death were: ejection fraction (EF) ≤30% (odds ratio [OR], 4.1; 95% confidence interval [CI], 1.69–10.03), blood oxygen saturation (SpO_2) ≤90% (OR, 2.77; 95% CI, 1.19–6.46), non-ST elevation myocardial infarction (NSTEMI) (OR, 2.71; 95% CI, 1.02–7.21). Risk of death was lower in patients who underwent early CA (OR, 0.28; 95% CI, 0.1–0.74) or received at least one defibrillation (OR, 0.11; 95% CI, 0.05–0.27), even after adjustment for other factors.

Conclusions: In this series from a tertiary cardiac centre, patients who underwent early CA had improved outcomes after cardiac arrest. In multivariable logistic regression model lower SpO_2, lower EF and NSTEMI were independent risk factors for death, whereas early CA and initial shockable rhythm improved survival.

Key words: out-of-hospital cardiac arrest, percutaneous coronary intervention, sudden cardiac death

WHAT'S NEW?

In this analysis from a tertiary cardiology department, subjects suffering from a cardiac arrest, qualified to early coronary angiography had improved outcomes in terms of survival and neurological status. In multivariable logistic regression model, we did identify lower blood oxygen saturation, lower left ventricular ejection fraction and non-ST elevation myocardial infarction as an independent risk factor for death, while qualification to early coronary angiography, as well as initial shockable rhythms improved survival.

INTRODUCTION

Sudden cardiac death is a major public health issue, even though over the last years cardiac arrest management has changed in all stages of the 'chain of survival', starting from the implementation of public education programs like early call-out of emergency services and basic cardiopulmonary resuscitation (CPR) to the evolution of automatic external defibrillators (AED), and to the use of in-hospital therapeutic hypothermia [1].

However, the outcome after out-of-hospital cardiac arrest (OHCA) is unfavorable due to frequent irreversible cerebral and cardiac injury. Approximately 70% of these patients do suffer from significant stenosis or acute occlusion of the coronary artery and a significant target of treatment is therefore to achieve adequate reperfusion quickly and consequently, to stabilize rhythm and the hemodynamics [2, 5].

According to the recent European Resuscitation Council Guidelines for resuscitation, emergency cardiac catheterization (and percutaneous coronary intervention [PCI] if required) is recommended in adult patients with the return of spontaneous circulation (ROSC) after OHCA of a suspected cardiac origin with ST-elevation (STE) on the electrocardiogram (ECG)

[1]. Considering a consensus statement from the European Association for Percutaneous Cardiovascular Interventions/Stent for Life groups cardiac catheterization should be performed immediately in the presence of STE and considered as soon as possible (within 2 hours) in other patients in the absence of an obvious non-coronary cause, particularly if they are hemodynamically unstable [3]. Among patients resuscitated from ventricular fibrillation/pulseless ventricular tachycardia (VF/pVT) OHCA with STE on their post-resuscitation ECG, the prevalence of coronary artery disease (CAD) varied between 70% to 85% (more than 90% of these patients undergone successful PCI). Conversely, among patients resuscitated from VF/pVT OHCA without STE on their post-resuscitation ECG, the prevalence of CAD was lower and varied between 25% to 50% [4].

As opposed to scenario with obvious ST-elevation myocardial infarction (STEMI) signs, the impact of early, routine qualification for invasive cardiology procedures on prognosis remains unclear. Therefore, in this single-centre study, we investigated outcomes of patients hospitalized in tertiary cardiology department within the first 24 hours after OHCA or after in-hospital cardiac arrest (IHCA), regarding the role of early coronary angiography (CA) and PCI.

METHODS

This was an observational single-centre study using a retro- and prospective cohort in the 2010–2017-time range. The data regarding analyzed subjects were extracted through a medical record review and included consecutive patients who were hospitalized in tertiary cardiology centre within the first 24 hours after OHCA or IHCA (108 subjects were analyzed retrospectively and 40 — evaluated prospectively). The study was approved by the Local Institutional Review Board (No RNN/189/15/KE). Patients provided written informed consent to participate in the study.

The decision to qualify a patient for CA was made by a physician on duty, and it was based on synthetic, individualized clinical assessment of the likelihood that cardiac arrest was due to an acute manifestation of CAD — according to recent European Resuscitation Council Guidelines for resuscitation.

PCI success was determined as Thrombolysis In Myocardial Infarction (TIMI) level 3 flow in the target vessel following coronary angioplasty [6], less than 50% residual stenosis, and resolution of STE (in STEMI patients) by at least 70% in an ECG recorded after 60–90 min of the procedure. Data concerning the cardiac arrest incident were investigated using Utstein Style standards [7]. Survival to hospital discharge was the primary measured endpoint and we aimed to identify the prognostic factors related to survival.

Post-arrest neurologic status was evaluated at discharge with cerebral performance category (CPC) measure [8].

Statistical analysis

Statistical analysis was performed using MedCalc version 12.0 (MedCalc Software, Ostend, Belgium) and STATISTICA version 13.1 (StatSoft, Cracow, Poland). We did make a wide analysis of demographics and relevant clinical characteristics. Data were presented as percentages for categorical variables and as mean with standard deviation (SD) or median with interquartile range (IQR) for continuous variables depending on their distribution. The normality of data distribution was tested using the Shapiro–Wilk's test. The student's t-test for independent variables or the Mann–Whitney's U-test were applied to test the intergroup differences. The categorical variable analysis was performed with the χ^2 test and Fisher's exact probability test. For continuous variables the receiver operating curves analysis was performed to establish optimal cut-off values for end-point prediction. Based on single-variable tests, the multivariable logistic regression model (including variables with *P*-value <0.2 in single variable analysis) was applied to identify independent predictors of death and odds ratios (OR) with 95% confidence interval (CI) were presented. All *P*-values were 2-sided and *P*-value less than 0.05 were considered statistically significant.

RESULTS

Baseline clinical characteristics of the study group are presented in Table 1 and angiographic characteristics of studied patients are shown in Table 2.

Overall, 148 patients (61 females), mean (SD) age 71 (14) years (range 26–95) were included: 68 patients hospitalized due to OHCA and 80 patients after IHCA, 46 were further transferred to the intensive care unit.

The proportion of patients discharged home in the study group was 45% (66/148) (54% after OHCA, 36% after IHCA). Early CA (<24 h from admission) was performed in 99 (66.9%) patients (including immediate procedure when infarction was suspected), more frequently in survivors (83.3% vs. 53.7%; *P* <0.001), similarly to PCI (59% vs. 37%; *P* = 0.006). Survival rate was 55% in those qualified for CA, 22% in those disqualified, and 55% in those with successful PCI. PCI success rate was similar in survivors 85% (36/42) vs. 81% (26/32) in non survivors (*P* = 0.84). Mean (SD) duration of hospitalization was 12.8 (4.7) days for survivors and 10.7 (5.8) days for decedents (*P* = 0.02). Patients qualified to CA had better CPC than patients disqualified (median [IQR]: 3 (1–5) for subjects qualified vs. 5 (3–5) for patients disqualified (*P* = 0.003).

Comparative analysis (Table 3) revealed that patients with OHCA vs. IHCA were younger: (mean [SD]) 69 years (14) vs. 76 years (13); *P* = 0.03, mostly male: 67% vs. 51%; *P* = 0.04, more frequently had VF/pVT: 72% vs. 28%; *P* <0.001, more frequently achieved ROSC: 97% vs. 69%; *P* <0.001, had more defibrillation attempts (median [IQR]): 1 (1–3) vs. 0 (0–1) and had lower N-terminal pro-B-type natriuretic peptide (NT-proBNP) (median [IQR]: 1716.5 [512.5–4783.0] pg/ml vs. 5372.0 [1867.5–8137.8]; *P* = 0.002. Survival to hospital discharge was lower in patients with IHCA than with OHCA — 36% vs. 54%; *P* = 0.03.

In the OHCA survivors had higher systolic blood pressure (SBP) (median [IQR]): 110 (100–125) mm Hg vs. 100 (80–110) mm Hg; *P* <0.001, as well as diastolic blood pressure (DBP) (median [IQR]): 70 (60–75) mm Hg vs. 60 (50–67) mm Hg; *P* = 0.002 and SpO_2 (median [IQR]): 92 (90–94)% vs. 90 (85–92)%; *P* = 0.01 (Supplementary material, *Table S1*).

In the IHCA group, non-survivors less likely had shockable CA mechanism [VF/pVT(%)]: 18 (62%) vs. 5 (10%); *P* <0.001, rarely achieved ROSC (%) 29 (100%) vs. 26 (51%); *P* <0.001. Defibrillation attempts were more often in survivors group (median [IQR]): 1 (0–1) vs. 0 (0–0); *P* <0.001as well as higher SpO_2 (median [IQR]: 92 (90–95)% vs. 90 (85–90)%, more often PCI (%) 19 (66%) vs. 19 (37%); *P* = 0.028, higher EF (median [IQR]): 43 (30–50)% vs. 29 (20–35)%; *P* <0.001 (Supplementary material, *Table S2*).

Patients referred to CA had significantly higher systolic blood pressure (median [IQR]; SBP: 109 [99–120] mm Hg vs. 95 [80–116] mm Hg; *P* = 0.02), high sensitivity cardiac troponin T (hs-cTnT) (median [IQR]: 0.25 [0.05–0.25] ng/ml vs. 0.25 [0.10–1.48] ng/ml; *P* = 0.006) and MB isoenzyme of creatine kinase (CK-MB mass) (median [IQR]: 14.4 [4.7–60.5] ng/ml vs. 5.7 [2.8–15.1] ng/ml; *P* = 0.008) and lower NT-proBNP levels (median [IQR]: 1862 [874–5651] pg/ml vs. 6446 [1792–8150] pg/ml; *P* = 0.03). They also had more frequently shockable rhythms (pVT/VF: 56% vs. 33%; *P* = 0.006), non-ST elevation myocardial infarction (NSTEMI): 37% vs. 12%; *P* = 0.002 or with STE (STEMI): 39% vs. 4%; *P* <0.001) and lower CPC (median [IQR]): 3 (1–5) vs. 5 (3–5; *P* = 0.003). Acute coronary syndromes (ACS) were diagnosed in 96 patients — more frequently in survivors (74% vs. 56%; *P* = 0.02), especially STEMI (36.4% vs. 20.7%; *P* = 0.04) and unstable angina (13.6% vs. 3.7%; *P* = 0.03).

For continuous variables receiver operating curves analysis was performed to establish optimal cut-off values for end-point prediction used further in the multivariable analysis — we did identify left ventricular ejection fraction (LVEF) ≤30% with area under the curve (AUC) 0.734, *P* <0.001 and SpO_2 ≤90% with AUC 0.615; *P* = 0.01 (Supplementary material, *Table S3*).

In multivariable logistic regression analysis, the following 5 independent predictors related to mortality were identified (Table 4). LVEF ≤3% on admission, (OR, 4.11; 95% CI, 1.69–10.03), SpO_2 ≤90% on admission (OR, 2.77; 95% CI, 1.19–6.46), and initial NSTEMI diagnosis (OR, 2.71; 95% CI, 1.02–7.21) were related to higher mortality. Risk of death was lower in patients who underwent early CA (OR, 0.28; 95% CI, 0.10–0.74) or received at least one defibrillation (OR, 0.11; 95% CI, 0.05–0.27). No prognostic significance was identified for other analyzed factors including: STEMI, unstable angina, PCI, CAD history, pVT/VF, pulseless electrical activity, SBP, DBP, diabetes mellitus, hs-cTnT, age, gender, and serum creatinine level.

DISCUSSION

The main finding of our study is that cardiac arrest patients qualified for early CA differ considerably from those disqualified; however, in multivariate analysis early invasive management strategy appears to be protective regarding short-term survival.

Our analysis was performed in a single tertiary cardiology centre with access to the intensive care unit and overall survival was 45% — significantly higher than reported in most publications [9, 10]. Notably, our data seem consistent with reports from Swedish Health Care Registry on Heart Disease (SWEDEHEART) registry [11]. This study gave information on angiographic findings and survival from all consecutive patients who undergone CA due to sudden cardiac arrest (SCA) in Western Sweden between 2005 and 2013. The mortality within the first 24 hours of all patients who underwent CA was 56 (9%) in the SCA and 153 (1%) in the ACS group. After one week 161 (26%) SCA patients and 412 (2%) ACS patients had died. Total mortality at any time during the study period was 42% in the SCA and 14% the ACS group.

The HACORE (HAnnover Cooling Registry) [12] presented the influence of obligatory therapeutic hypothermia and cardiac catheterization in the absence of clear non-cardiac cause of arrest as part of the Hannover Cardiac Resuscitation Algorithm before intensive care admittance. In overall, 30-day mortality of all the subjects treated according to prespecified algorithm and receiving hypothermia after OHCA was 41%; for those with ROSC before hospital arrival, it was 39%. Patients with ongoing CPR at hospital admission necessitating either ongoing mechanical or extracorporeal CPR had the utmost in-hospital mortality rate of 58%.

Our study confirms that CAD may be the most common cause of OHCA. Acute coronary culprit lesions were observed in 87% of patients qualified to early CA. It was followed by nearly 85% successful PCI procedures. These findings are similar to those reported in by Garcia et al. [13]

who assessed subjects resuscitated from shockable rhythms who got early admission to the cardiac catheterization laboratory. In this study, 197 (63%) patients survived to hospital discharge with positive neurological outcome (CPC of 1 or 2) and 121 (52%) of the patients who underwent early CA, underwent percutaneous coronary intervention whereas 15 (7%) were qualified for coronary artery bypass grafting.

In our multivariable logistic regression analysis risk of death was lower in patients who underwent early CA (OR, 0.28; 95% CI, 0.10–0.74). Coherent findings were described in a meta-analysis by Camuglia et al. [14] where the overall survival in the acute angiography group was 58.8% vs. 30.9% in the control group (OR, 2.77; 95% CI, 2.06–3.72). Survival with good neurological result (as per the Utstein framework) in the early angiography group was 58% vs. 35.8% in the control group (OR, 2.20; 95% CI, 1.46–3.32).

Receiving at least one defibrillation (OR, 0.11; 95% CI, 0.05–0.27) was an independent predictor of survival. Analysis made by Moutacalli et al. [15] concerning profits of immediate CA in survivors of out-of-hospital cardiac arrest without an obvious extracardiac cause confirmed that patients who received defibrillation (n = 127) had a mortality rate of 48%, compared to 88% in the 33 patients with an initial non-shockable rhythm (primary asystole or pulseless electrical activity) (P <0.001). In the study by Zijlstra et al. [16] which investigated diverse defibrillation strategies in survivors after out-of-hospital cardiac arrest — 2289 (81%) survivors with a known defibrillation status were defibrillated, 1349 (59%) were defibrillated by emergency medical service (EMS), 454 (20%) were defibrillated by a first responder AED and 429 (19%) were defibrillated by an onsite AED. The percentage of survivors defibrillated by first responder AEDs (from 13% in 2008 to 26% in 2013; P <0.001) and onsite AEDs (from 14% in 2008 to 30% in 2013; P <0.001) increased. The improved use of these non-EMS AEDs was correlated with the rise in survival rate of subjects with a shockable initial rhythm.

In the POL-OHCA registry, which was a case — control study established on medical records — 3 400 000 emergency visits were recorded. Patients who were treated by EMS ambulance team using defibrillation and/or ordering at least 1 dose of 1 mg of epinephrine were regarded to have OHCA managed by CPR attempts. Defibrillation at OHCA site was identified as a positive survival to hospital admission marker with OR 1.29 (95% CI, 1.18–1.41; P <0.001) [17].

We identified admission LVEF ≤30% as a strong independent predictor of death (OR, 4.11; 95% CI, 1.69–10.03) and that finding is consistent with observations made by Burstein et al. [18]. In their study mean LVEF at 24 hours was 36.4% for survivors and 34.7% for non-survivors. LVEF <40% was not a significant predictor of survival on univariate analysis. In addition, it was not predictive either, if the analysis was restricted to patients admitted to CCU or those qualified for cardiac catheterization.

In the Autonomic Tone and Reflexes After Myocardial Infarction (ATRAMI) study, which enrolled 1284 patients with recent MI, patients with LVEF of 35%–50% had a relative risk of 2.5 for cardiac mortality compared with patients with LVEF >50%, whereas in patients with LVEF <35%, the relative risk was 7.3 [19]. In an interesting analysis made by Narayanan et al. [20] LV diameter added to the risk stratification for SCD independently of the LVEF. In multivariable analysis, severe LV dilatation was an independent predictor of SCD (OR, 2.5 [95% CI, 1.03–5.9]; P = 0.04). In addition, subjects with both EF ≤35% and severe LV dilatation had higher odds for SCD compared with those with low EF only (OR, 3.8 [95% CI, 1.5–10.2] for both vs. 1.7 [95% CI, 1.2–2.5] for low EF only), implying that severe LV dilatation additively enhanced SCD risk.

We did identify non-ST-elevation myocardial infarction as an independent predictor of death (OR, 2.71; 95% CI, 1.02–7.21). In the study by Lemkes et al. [21] which randomly assigned 552 patients who had cardiac arrest without signs of STEMI to undergo direct CA or CA that was postponed until after neurologic recovery, among patients who had been successfully resuscitated after out-of-hospital cardiac arrest and had no signs of STEMI, an approach of immediate angiography was not found to be better than a strategy of delayed angiography with respect to overall survival at 90 days. At 90 days, 176 of 273 patients (64.5%) in the immediate angiography group and 178 of 265 patients (67.2%) in the delayed angiography group were alive (OR, 0.89; 95% CI, 0.62–1.27; P = 0.51).

In the study by Behnes et al. [22] which sought to evaluate the predictive effect of acute myocardial infarction with STEMI and NSTEMI in patients with ventricular tachyarrhythmias and SCA on admission, multivariable Cox regression models exposed non-acute myocardial infarction (hazard ratio [HR] 1.46; P = 0.001) and NSTEMI (HR 1.46; P = 0.04) as connected with increasing long-term all-cause mortality at 2.5 years, which was also proven after propensity-score matching.

In our multivariable logistic regression analysis, we identified the qualification to CA itself, as negative predictor of death with OR 0.28 (95% CI, 0.10–0.74). Contrary to our study, in the previously described analysis made by Lemkes et al. [20], which was further analyzed after one-year follow-up [23], patients successfully resuscitated from out-of-hospital cardiac arrest and without signs of STEMI, an approach of urgent angiography were not found to be superior to a strategy of postponed angiography regarding clinical consequences at 1 year. In Immediate Unselected Coronary Angiography Versus Delayed Triage in Survivors of Out-of-hospital

Cardiac Arrest Without ST-segment Elevation (TOMAHAWK) trial by Desch et al [24] which evaluated 554 patients with positively resuscitated out-of-hospital cardiac arrest of possible coronary origin to undergo either immediate CA (immediate-angiography group) or initial intensive care assessment with delayed or selective angiography (delayed-angiography group), at 30 days, 143 of 265 patients (54%) in the immediate-angiography group and 122 of 265 patients (46%) in the delayed-angiography group had died (HR 1.28; 95% CI, 1.00–1.63; P = 0.06). The composite of death or severe neurologic deficit occurred more frequently in the immediate-angiography group (in 164 of 255 patients [64.3%]) than in the delayed-angiography group (in 138 of 248 patients [55.6%]), for a relative risk (RR) of 1.16 (95% CI, 1.00–1.34). In the recently published EMERGE trial [25] which evaluated 180-day survival rate with CPC 1 or 2 of patients who experience an OHCA without STE on ECG and undergo emergency CA vs. delayed CA there was no difference in the overall survival rate at 180 days (emergency CA, 36.2% [51 of 141] vs. delayed CA, 33.3% [46 of 138]; HR 0.86; 95% CI, 0.64–1.15; P = 0.31) and in secondary outcomes between the 2 groups. Patients' populations in above cited studies were strongly different to ours and comprised only with patients without signs of STEMI.

Limitations

Our study has several limitations that should be taken into consideration while interpreting the results. Cohorts and interventions of the cited papers are different from the subjects and interventions of this study. This is a single centre study where all the patients were hospitalized in a tertiary cardiology department which could affect the profile of subjects especially OHCA subset towards those with suspected myocardial infarction. Thus, the observed outcomes may not be fully recognizable although reflect clinical practice in many multidisciplinary hospitals. Absence of clear impact of PCI upon survival is puzzling but may reflect on one hand clarification of optimal management strategy even in the absence of acute coronary syndrome, and difficulties in obtaining effective tissue reperfusion in cardiac arrest victims.

Our follow-up was limited to in-hospital phase. Importantly, the study was nor randomized so no comparisons regarding management strategies can be directly drawn albeit the result might be hypothesis-generating. A substantial number of patients were analyzed retrospectively based on medical records which may lead to the selection bias, even though no intervention factor existed in prospectively tracked cohort.

We must acknowledge the potential bias from mixed analysis of patients with OHCA and early IHCA.

CONCLUSIONS

In this single-centre experience of a tertiary cardiology department, the patients who were qualified to early CA had improved outcomes after cardiac arrest. In multivariable logistic regression model lower SpO_2, lower EF, NSTEMI were independent risk factors for death, whereas early CA angiography and shockable rhythm improved survival.

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Table 1. Baseline characteristics of the study subjects

	Early CA group (n = 99)	No CA (n =49)	*P*-value
Age, years, mean (SD)	71 (12)	72 (17)	0.15
Male, n (%)	64 (65)	23 (47)	0.06
Survivors (%)	55 (56)	11 (22)	**<0.001**
Arrest witnessed, n (%)	87 (88)	42 (86)	0.91
VF/pVT, n (%)	56 (57)	16 (33)	**0.01**
PEA/asystole, n (%)	43 (43)	33 (67)	**0.01**
ROSC, n (%)	86 (87)	35 (71)	**0.03**
Transfer to ICU, n (%)	41 (41)	20 (41)	0.91
Defibrillation attempts, median (IQR)	1 (0–2)	0 (0–1)	**0.005**
Admission SBP, mm Hg, median (IQR)	109 (99–120)	95 (80–116)	**0.02**
Admission DBP, mm Hg, median (IQR)	68 (60–70)	60 (50–70)	0.15
Admission SpO_2%, median (IQR)	90 (90–93)	90 (85–92)	**0.005**
STEMI, n (%)	39 (39)	2 (4)	**<0.001**
NSTEMI, n (%)	37 (37)	6 (12)	**0.003**
UA, n (%)	11 (11)	1 (2)	0.11
PCI, n (%)	74 (75)	0 (0)	**<0.001**
Cerebral Performance Category at discharge, median (IQR)	3 (1–5)	5 (3–5)	**0.003**
OHCA/HCA, n (%)	45 (45)/54 (55)	23 (47)/26 (53)	0.99
Admission EF (%), median (IQR)	35 (25–44)	30 (20–49)	0.31
Admission hs-cTnT, ng/ml, median (IQR)	0.25 (0.10–1.48)	0.25 (0.05–0.25)	**0.006**
Admission CK-MB mass, ng/ml, median (IQR)	14.4 (4.7–60.5)	5.7 (2.8–15.1)	**0.008**

Admission NT-proBNP, pg/ml, median (IQR)	1862 (874–5651)	6446 (1792–8150)	**0.03**
Hypercholesterolemia, n (%)	82 (83)	28 (57)	0.25
Diabetes, n (%)	36 (36)	23 (47)	0.29
Hypertension, n (%)	85 (86)	39 (80)	0.99
Nicotine addiction, n (%)	27 (27)	2 (4)	**0.002**

Abbreviations: CA, coronary angiography; CK-MB mass, creatine kinase-MB isoenzyme; DBP, diastolic blood pressure; EF, ejection fraction; HCA, hospital cardiac arrest; hs-cTnT, high sensitivity cardiac troponin T; ICU, intensive care unit; IQR, interquartile range; NSTEMI, non ST-elevation myocardial infarction; NT-proBNP, N-terminal pro-B-type natriuretic peptide: OHCA, out-of hospital cardiac arrest; PCI, percutaneous coronary intervention; PEA, pulseless electrical activity; pVT, pulseless ventricular tachycardia; ROSC, return of spontaneous circulation; SBP, systolic blood pressure; SD, standard deviation; SpO_2, peripheral oxygen saturation; STEMI, ST-elevation myocardial infarction; UA, unstable angina; VF, ventricular fibrillation

Table 2. Characteristics of patients who underwent coronary angiography

	Survivors (n = 55)	Non-survivors (n = 44)	*P*-value
No lesion, n (%)	10 (18)	8 (18)	0.087
Single vessel disease, n (%)	18 (33)	7 (16)	
Two vessel disease, n (%)	12 (22)	7 (16)	
Three vessel disease, n (%)	15 (27)	22 (50)	
Target vessel revascularization (n = 74; 100%)			
LMCA, n (%)	2 (5)	8 (25)	**0.05**
LAD, n (%)	21 (50)	14 (44)	
LCx, n (%)	9 (21)	7 (22)	
RCA, n (%)	10 (24)	3 (9)	
PCI, n (%)	42 (76)	32 (73)	0.85
PCI successful, n (%)	36 (65)	26 (59)	0.84
STEMI, n (%)	24 (44)	15 (34)	0.33
NSTEMI, n (%)	17 (31)	20 (45)	
UA, n (%)	8 (15)	3 (7)	

No ACS, n (%)	6 (10)	6 (13)	
Defibrillation attempts, median (IQR)	1 (1–2)	0 (0–1)	**<0.001**
Admission SpO_2 (%), median (IQR)	92% (90–94)	90% (88–92)	**<0.001**
Shockable rhythm, n (%)	43 (78)	13 (30)	**<0.001**
Admission SBP, mm Hg, median (IQR)	110 (100–120)	100 (85–120)	**0.03**
Admission DBP, mm Hg, median (IQR)	69 (60–70)	65 (50–70)	0.25
Admission EF (%), median (IQR)	40 (28–47)	30 (20–38)	**0.002**
Admission hs-cTnT, ng/ml, median (IQR)	0.41 (0.10–1.87)	0.25 (0.10–1.12)	0.94
Admission CK-MB mass, ng/ml, median (IQR)	13.4 (4.4–44.1)	19.4 (6.3–72.0)	0.23
Admission NT-proBNP, pg/ml, median (IQR)	1604 (551–5127)	2372 (1444–5929)	0.28

Abbreviations: LAD, left anterior descending artery; LCx, left circumflex artery; LMCA, left main coronary artery; RCA – right coronary artery; other — see Table 1

Table 3. OHCA vs. IHCA comparison

	OHCA (68)	**IHCA (80)**	***P*-value**
Age, years, mean (SD)	69 (14)	73 (13)	**0.03**
Male, n (%)	46 (67)	41 (51)	**0.04**
Survivors (%)	37 (54)	29 (36)	**0.03**
VF/pVT, n (%)	49 (72)	23 (28)	**<0.001**
PEA/asystole, n (%)	19 (28)	57 (71)	**<0.001**
ROSC, n (%)	66 (97)	55 (69)	**<0.001**
Transfer to ICU, n (%)	38 (56)	23 (29)	**0.02**
Coronary angiography, n (%)	45 (66)	54 (67)	0.86
PCI, n (%)	24 (53)	38 (70)	**0.05**

Defibrillation attempts, median (IQR)	1 (1–3)	0 (0–1)	**<0.001**
SBP, mm Hg, median (IQR)	110 (95–120)	100 (90–118)	0.19
DBP, mm Hg, median (IQR)	63 (60–70)	60 (56–73)	0.95
SpO_2 (%), median (IQR)	90 (89–93)	90 (88–93)	0.26
STEMI, n (%)	15 (22)	26 (32)	0.47
NSTEMI – n (%)	20 (29)	23 (29)	
UA, n (%)	7 (10)	5 (6)	
No ACS, n (%)	26 (38)	26 (32)	
EF (%), median (IQR)	32 (25–47)	30 (25–44)	0.92
hs-cTnT, ng/ml, median (IQR)	0.25 (0.08–0.81)	0.25 (0.10–0.60)	0.88
CK-MB mass, ng/ml, median (IQR)	12.6 (4.4–49.7)	9.5 (4.0–42.6)	0.71
NT-proBNP, pg/ml, median (IQR)	1716.5 (512.5–4783.0)	5372.0 (1867.5–8137.8)	**0.002**

Abbreviations: IHCA, in-hospital cardiac arrest; TIMI, Thrombolysis in Myocardial Infarction; other — see Table 1 and 2

Table 4. Independent predictors of death in the entire cohort identified in the multivariable logistic regression analysis

Variable	**Odds ratio (95% CI)**	***P*-value**
Admission EF ≤30%	4.11 (1.69–10.03)	0.002
SpO_2 ≤90%	2.77 (1.19– 6.46)	0.02
NSTEMI	2.71 (1.03–7.21)	0.04
Early CA	0.28 (0.10–0.74)	0.01
Defibrillation	0.11 (0.05–0.27)	<0.001

Adjustment was made to the following variables: admission ejection fraction (EF); age; coronary artery disease history; systolic blood pressure; diastolic blood pressure; diabetes mellitus; gender; non-ST elevation myocardial infarction (NSTEMI); percutaneous coronary intervention; any defibrillation attempt; pulseless ventricular tachycardia/ventricular fibrillation; – peripheral oxygenation (SpO_2); coronary angiography (CA)