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## **Immediate coronary angiogram in out-of-hospital cardiac arrest patients with non-shockable initial rhythm and without ST-segment elevation - is there a clinical benefit?**

Sebastian Voicu, MD,PhD<sup>a,b</sup>, Vilhelmas Bajoras,MD<sup>c,d,e</sup>, Emmanuel Gall, MD<sup>c</sup>, Nicolas Deye, MD<sup>a,f</sup>, Isabelle Malissin,MD<sup>a,b</sup>, Jean-Guillaume Dillinger, MD, PhD<sup>c,f</sup>, Chakib Benajiba, MD<sup>c</sup>, Damien Logeart, MD,PhD<sup>c,f</sup>, Patrick Henry,MD,PhD<sup>c,f</sup>, Bruno Megarbane,MD,PhD<sup>a,b</sup>, Georgios Sideris, MD,PhD<sup>c,f</sup>

<sup>a</sup>Service de Réanimation Médicale et Toxicologique, Université de Paris, APHP, Lariboisière Hospital, 2 rue Ambroise Paré, 75475 Paris, France

<sup>b</sup>INSERM UMRS - 1144, Paris, France

<sup>c</sup>Service de Cardiologie, Université de Paris, APHP, Lariboisière Hospital, 2 rue Ambroise Paré, 75475 Paris, France

<sup>d</sup>Clinic of Cardiac and Vascular Diseases, Institute of Clinical Medicine of the Faculty of Medicine, Vilnius University, Vilnius, Lithuania

<sup>e</sup>Center of Cardiology and Angiology, Vilnius University Hospital Santaros Klinikos, Vilnius, Lithuania

<sup>f</sup>INSERM U942, Paris, France

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Address for correspondence: Sebastian Voicu, Réanimation Médicale et Toxicologique, Hôpital Lariboisière, 2 rue Ambroise Paré, 75475 Paris, France.

## **Abstract**

**Aim** Coronary angiogram (CA) may be useful after resuscitated out-of-hospital cardiac arrest (OHCA), but data regarding its benefit in patients with non-shockable initial rhythm without ST-segment elevation is scarce. We aimed to evaluate the prevalence of acute coronary syndrome (ACS) and survival in OHCA patients with non-shockable initial rhythm without ST-segment elevation and compare them to patients with shockable initial rhythm without ST-segment elevation.

**Methods** Retrospective single-centre study approved by the ethics committee of our institution, including adults successfully resuscitated from OHCA of presumed cardiac cause, undergoing routine CA on admission. Baseline characteristics, angiographic data including presence of ACS and survival were compared between patients with non-shockable and shockable initial rhythm focusing on patients without ST-segment elevation.

**Results** Among 517 patients included between 2002 and 2018, 311 had no ST-elevation, of whom 179 had non-shockable and 132 shockable initial rhythm. Compared with shockable initial rhythm patients without ST-elevation, non-shockable initial rhythm patients without ST-elevation had longer no-flow duration, 5 (1-10) versus 2 (0-8) min,  $p=0.024$ , more frequent shock requiring vasopressors, 72% versus 47%  $p<0.0001$ , a lower prevalence of ACS, 2 (1%), versus 29 (22%),  $p<0.001$  and higher mortality, 85% versus 39% ( $p<0.0001$ ). Among ACS patients, none survived in the non-shockable without ST-elevation group, while 20 (69%) survived in the shockable rhythm without ST-elevation group.

**Conclusions** Prevalence of ACS in patients without ST-segment elevation and non-shockable initial rhythm is extremely low, and survival extremely poor, therefore routine emergency CA does not seem beneficial in these patients.

**Keywords:** non-shockable initial rhythm; out-of-hospital cardiac arrest; coronary angiogram; acute coronary syndrome

## **Introduction**

Coronary angiogram (CA) followed if necessary by angioplasty in case of acute coronary syndrome (ACS) is recommended according to guidelines if ST-segment elevation is documented on the post-resuscitation electrocardiogram (ECG), and may be considered in patients without ST-elevation and high suspicion of acute myocardial ischemia<sup>1</sup>. However, according to a recent prospective randomized trial, in patients with shockable initial rhythm without ST-segment elevation, emergency CA on admission versus delayed CA did not show any clinical benefit<sup>2</sup>. Several studies assessed the benefit of CA in shockable rhythm patients or in the overall population of cardiac arrest patients<sup>3-5</sup>, and in studies analyzing non-shockable initial rhythm patients, CA was performed in as little as 40% of the patients, making results subject to selection bias<sup>6</sup>. Therefore, precise data regarding the role of CA with angioplasty as part of a diagnostic and therapeutic management algorithm in patients resuscitated from out-of-hospital cardiac arrest (OHCA) with non-shockable initial rhythm is lacking.

We therefore performed a retrospective study in OHCA patients in our center that performs CA in all patients resuscitated from OHCA without an obvious non-cardiac cause, irrespective of the initial rhythm and of the ECG changes.

The purpose of the study was to determine the prevalence of ACS in survivors of OHCA with non-shockable initial rhythm without ST-elevation, to assess survival to hospital discharge in these patients, and compare them to shockable initial rhythm patients without ST-elevation.

## **Methods**

This retrospective single-center study was performed in Lariboisière University Hospital in Paris, according to the Declaration of Helsinki (2013 version) of the World Medical Association. The study was approved by the ethics committee of our institution (CE - SRLF), and informed consent from the patients or the next of kin was not required given the retrospective nature of the study.

## **Patients and data gathering**

We included patients admitted to our centre age 18 years or more, who were successfully resuscitated from an OHCA without obvious non-cardiac cause. We excluded patients who had refractory cardiac arrest or unsustained return of spontaneous circulation (ROSC)<sup>7</sup>, and patients who had an obvious non-cardiac cause to their cardiac arrest like poisoning, trauma, obvious asphyxia (*i.e.* decreased tissue oxygenation resulting from external causes such as airway obstruction by a foreign body<sup>7</sup>). We recorded the baseline characteristics of the patients, parameters of the cardiac arrest, clinical and biochemical parameters, coronary angiogram data and survival to hospital discharge. Data were recorded according to the Utstein-style recommendations for reporting resuscitation outcomes<sup>7</sup>.

In France, OHCA patients are managed on site by an emergency medical team capable of cardiopulmonary resuscitation, intubation, mechanical ventilation and advanced basic life support. The emergency medical team is usually preceded by firefighters able to administer basic life support, electric shocks for defibrillation and oxygen, until the medical team arrives on site.

After ROSC, patients were transferred to our center directly to the catheterization laboratory where a team of two cardiologists performed CA, and a team of two or more intensivists managed vital functions including respiratory and inotropic support.

### **Coronary angiogram and ACS definition**

CA was performed on admission irrespective of the initial rhythm and ECG changes, according to the standard technique, preferably through the radial approach<sup>8,9</sup>.

ACS was defined in this study as the presence of an unstable, culprit lesion on angiogram. ACS was diagnosed by the physician in charge of the CA according to angiographic criteria for unstable, culprit lesions such as presence of ruptured plaques with fresh thrombus<sup>10,11</sup>. Angiograms were retrospectively analyzed by two experienced interventional cardiologists unaware of the initial rhythm (SV, GS) in order to verify and confirm the presence of an unstable, culprit lesion.

After the CA, patients were transferred to the intensive care unit for hemodynamic management, mechanical ventilation, and targeted temperature management. Survival was evaluated at hospital discharge and was defined according to the cerebral performance category score<sup>12</sup>. Patients with cerebral performance category score of 1, 2 or 3 at hospital discharge were considered survivors.

Causes of the arrest were recorded as specified by the physicians in charge in the medical record of the patients, after the detailed in-hospital evaluation comprising history, clinical, biochemical and imaging data. When no cause was given in the medical record, data was reevaluated by a group of three of the authors (SV, EG, GS) to establish the appropriate cause.

### **Statistical analysis**

Continuous variables were expressed as medians (interquartile range) and categorical variables as frequencies and percentages. Continuous variables were compared using student t-test if normally distributed and Mann-Whitney test if otherwise. Welch correction was used in case of non-homogeneous variance. Categorical variables were compared using chi-square test when appropriate and Fisher's exact test otherwise. Differences were considered significant if two-sided  $p < 0.5$ . Statistical analysis was performed using R statistical software, version 3.3.2 (R Project for Statistical Computing).

### **Results**

During the study period from January 2002 to December 2018, 825 OHCA patients were admitted to our center and 517 were included in the study (Figure 1, Table 1). All patients were comatose on admission.

In this study we only included patients without an obvious non-cardiac cause on admission, and after the detailed in-hospital evaluation, causes of the arrest in the overall population were determined as follows: ACS (31%), chronic ischemic heart disease (15%), hypoxia (*i.e.*

decreased tissue oxygenation resulting from a medical condition, not from an external cause<sup>7</sup>, 13%), primary heart rhythm disease (8%), neurological disorder (5%), dilated cardiomyopathy (4%), other causes (16% including pulmonary embolism, electrolyte disturbances, aortic dissection *etc.*), and unknown (8%).

### **Coronary angiogram and mortality in patients without ST-segment elevation**

Of the 517 patients included, 311 had no ST-segment elevation, 179 with non-shockable initial rhythm and 132 with shockable initial rhythm (Table 2).

Among the 179 non-shockable initial rhythm patients without ST-segment elevation, 2 (1%) had ACS, compared with 29 (22%) in patients with shockable initial rhythm without ST-elevation ( $p < 0.0001$ , Table 3). Culprit arteries in the two patients with ACS in the non-shockable initial rhythm group were LAD and circumflex respectively. Both patients had successful angioplasty with direct stenting and had TIMI 3 final flow of the culprit artery.

Mortality rate was 85% in patients with non-shockable initial rhythm without ST-segment elevation, and 39% in patients with shockable initial rhythm without ST-segment elevation,  $p < 0.0001$  (Table 2). Mortality according to the presence of ST-segment elevation and ACS is shown in Figure 2.

Both patients with ACS in the non-shockable initial rhythm without ST-elevation group died, one due to multiorgan failure, the other due to severe anoxic injury. Among patients with shockable initial rhythm without ST-elevation and ACS, 20 (69%) survived. No statistical test was performed to compare mortality rate between groups given the reduced number of patients in the first group.

### **ST-segment elevation and ACS in shockable versus non-shockable initial rhythm patients**

Among 51 non-shockable initial rhythm patients with ST-segment elevation, 16 had ACS, while in 35 (69%) ST-segment elevations were false positive. Among 155 patients with

shockable initial rhythm and ST-segment elevation, 113 had ACS while in 42 (27%) ST-segment elevations were false positive ( $p < 0.0001$  for false positive ST-segment elevation between groups, Figure 1).

## **Discussion**

The most important finding in this study was that prevalence of ACS in patients resuscitated from OHCA with non-shockable initial rhythm without ST-elevation was extremely low, 1%. This is the first study focusing specifically on the population of non-shockable initial rhythm patients without ST-elevation on the post resuscitation ECG, and performing CA routinely on admission in all patients.

Although recommendations on CA after OHCA suggested non-shockable initial rhythm is associated with “unfavorable pre-hospital settings” and should argue against CA<sup>13</sup>, no precise evaluation of ACS prevalence and survival in the non-shockable initial rhythm population exists to date. Several studies suggested a clinical benefit of routine CA after successfully resuscitated OHCA in shockable initial rhythm patients<sup>14,15</sup> or in mixed cohorts of shockable and non-shockable initial rhythm patients<sup>16,17</sup>. Data regarding non-shockable initial rhythm patients undergoing CA after OHCA despite absence of ST-elevation is scarce, since studies have focused on shockable rhythm patients due to the close association between shockable initial rhythm and ACS<sup>18–20</sup>. After screening 1174 publications, a systematic review<sup>21</sup> was able to identify only 97 patients in one study<sup>22</sup> and 55 patients in a second study<sup>23</sup>, as this population was rarely specifically identified in the literature. No benefit of the CA was observed, but in these studies CA was not performed routinely (16% of the patients had had CA in the study by Wilson et al<sup>22</sup>), the selection criteria were not specified, therefore the prevalence of acute coronary lesions was most likely not accurately estimated. Another study evaluating the usefulness of CA according to prognosis reported as little as 47% of CA in the group with most unfavorable prognosis comprising a majority of non-shockable initial rhythm patients, the selection bias remaining therefore a concern<sup>6</sup>. In our study, we performed CA in all patients on



admission and our results offer a more accurate and free of selection bias estimation of ACS prevalence. Based on two simple criteria of non-shockable initial rhythm and absence of ST-elevation, we identified a population in which ACS is extremely rare and CA is most likely not clinically beneficial, especially in the initial phase of the hospital management. More elaborate scores<sup>6</sup> based on several parameters and assessing the overall mortality risk rather than the probability of ACS, may also be used for this purpose. However, some parameters such as durations of no-flow (time from collapse of the patient to the beginning of cardiopulmonary resuscitation) and low-flow (time from the beginning of cardiopulmonary resuscitation to return of spontaneous circulation) included in these scores are not always available and may be subject to errors of estimation in the acute setting of OHCA.

Among 179 patients with non-shockable initial rhythm without ST-elevation, our analysis identified only 2 patients with ACS, who despite successful angioplasty and intensive care management, died of neurological failure and multiorgan failure, therefore we can reasonably consider that angioplasty did not influence their prognosis.

Recently, the COACT randomized trial showed that in cardiac arrest patients with shockable rhythm and no ST-elevation, CA on admission versus later during hospitalization, did not influence mortality and was not associated with any clinical benefit, instead it delayed reaching target temperature compared to the delayed CA group<sup>2</sup>. The prevalence of ACS was 16%, (similar to 22% in the homologous population of our study), and despite this relatively high prevalence, immediate CA failed to show a clinical benefit. Given the very low prevalence of ACS of 1% in our non-shockable initial rhythm patients without ST-elevation, and their dismal survival, it is most likely that CA on admission does not provide any clinical benefit in terms of prognosis in this population. If the optimistic assumption was made that a hypothetical 180<sup>th</sup> patient in our cohort were to present an ACS and survive due to the CA and angioplasty, this would result in a number needed to treat undergoing CA of 180. This is a very high number, suggesting a low clinical benefit, especially in the light of previous guidelines that considered a

number needed to treat as low as 167 too high to recommend certain techniques in the field of cardiac arrest management<sup>24</sup>.

The present study is the only one in the literature focusing specifically on non-shockable initial rhythm patients without ST-segment elevation and performing routine CA in all patients offering data free of selection bias. Our data show that the initial management of OHCA patients with non-shockable initial rhythm and without ST-elevation may prioritize other aspects than CA, which may be clinically more beneficial, like targeted temperature management according to a recent trial<sup>25</sup>, hemodynamic management and neurological protection<sup>24</sup>.

Finally, our study suggests that more false positive cases of ST-segment elevation may occur in patients with non-shockable initial rhythm compared to shockable initial rhythm, a finding that needs to be confirmed and explored in future studies, as diagnostic characteristics of the ECG changes after OHCA may be influenced by ischemia-reperfusion injury as previously reported<sup>9</sup>.

Our study has several limitations. Its retrospective non-randomized design limits the degree of validity of its conclusion. However, the data showing in the absence of a selection bias, a very low prevalence of ACS and the dismal prognosis, strongly suggests CA to be most likely not beneficial in this population.

Our study included a relatively limited number of patients with non-shockable initial rhythm without ST-elevation, 179 representing approximately only a third of the total number of patients included in the multicenter study analyzing the shockable rhythm without ST-elevation population<sup>2</sup>. However, it is the largest so far to have analyzed specifically non-shockable initial rhythm patients, and moreover, to have done so without a selection bias.

Since the initial rhythm prevalence may be influenced by many factors, including time to cardiopulmonary resuscitation, and ACS diagnosis on CA may vary according to definitions and be subject to inter-observer variability, the prevalence of ACS in other cohorts may differ from our results, as previous studies with different methodologies and higher ACS prevalence

suggested<sup>6,22</sup>. Therefore, in order to be more generalizable, our results need to be confirmed by future data.

Although our study identified a population with a very low prevalence of ACS, we could not determine risk factors which might identify ACS patients within this population before CA, and this may be attempted in larger studies.

Finally, the number of patients with non-shockable initial rhythm and no ST-elevation with ACS in our population is too small to accurately estimate their mortality. However, this is due to the low prevalence of the ACS in this population, therefore a more powerful estimation of mortality should be performed in larger future studies, some ongoing, including patients without post-resuscitation ST-elevation<sup>26</sup>.

In conclusion, in patients resuscitated from CA with non-shockable initial rhythm, and no ST-elevation, prevalence of ACS as observed after routinely performed CA was extremely low, and prognosis of the patients extremely poor. Therefore, routine CA on admission is most likely not clinically beneficial in these patients.

Conflict of interest: none

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Legends to figures

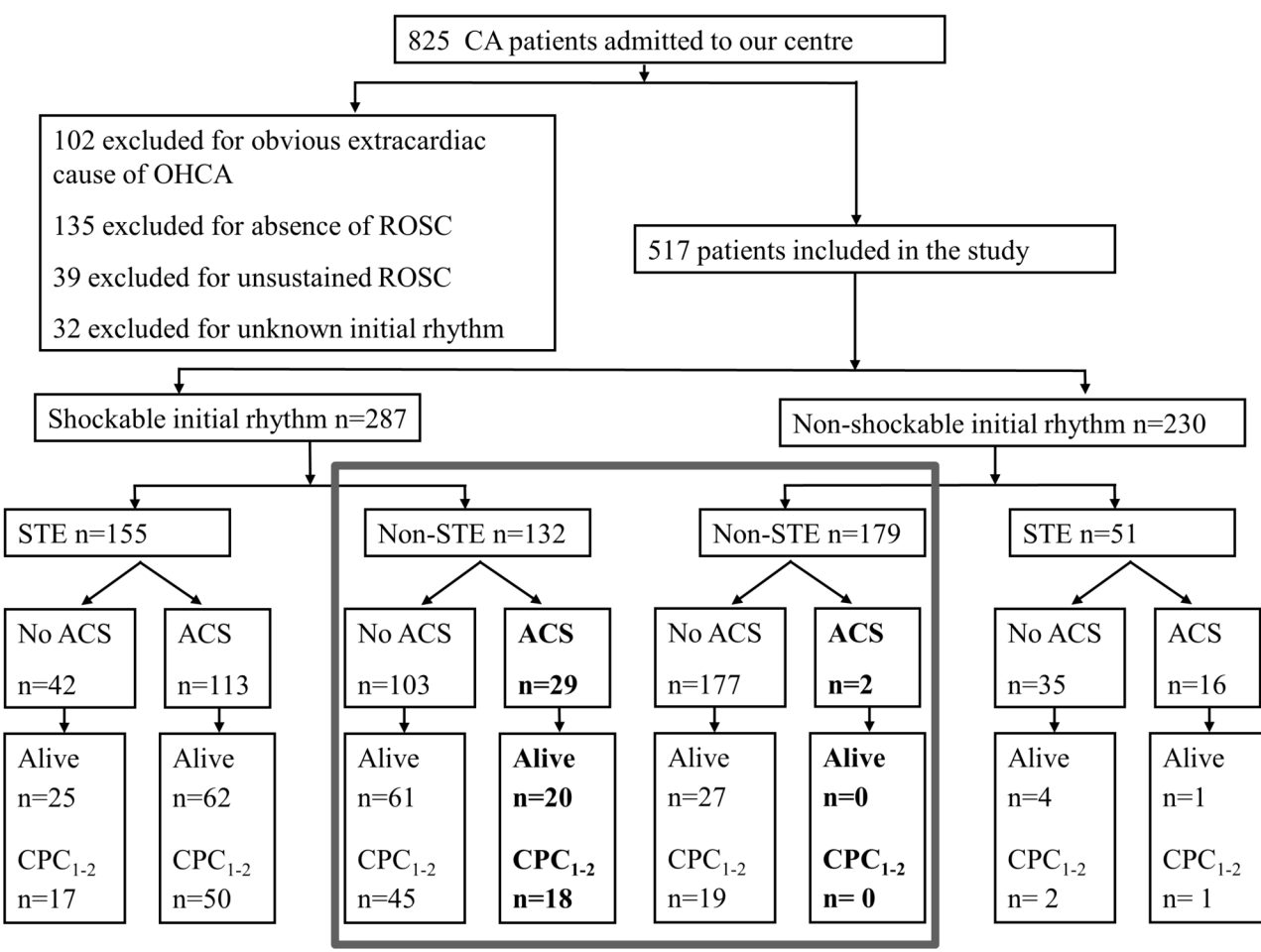
**Figure 1:** Flow chart and outcome

CA-cardiac arrest; OHCA-out-of-hospital cardiac arrest; ROSC-return of spontaneous circulation; STE-ST-segment elevation; ACS-acute coronary syndrome. CPC- cerebral performance category score. The population of interest is represented in the grey rectangle.

**Figure 2** Survival according to initial rhythm and presence of acute coronary syndrome in patients without ST-elevation

Numbers above columns represent survival. ACS – acute coronary syndrome. \*-given the reduced number (2 patients) in the non-shockable non-ST-elevation with ACS group, statistical comparison with the shockable non-ST-elevation with ACS group was not performed. Survivors are represented in grey and non-survivors in black.





$P < 0.0001$

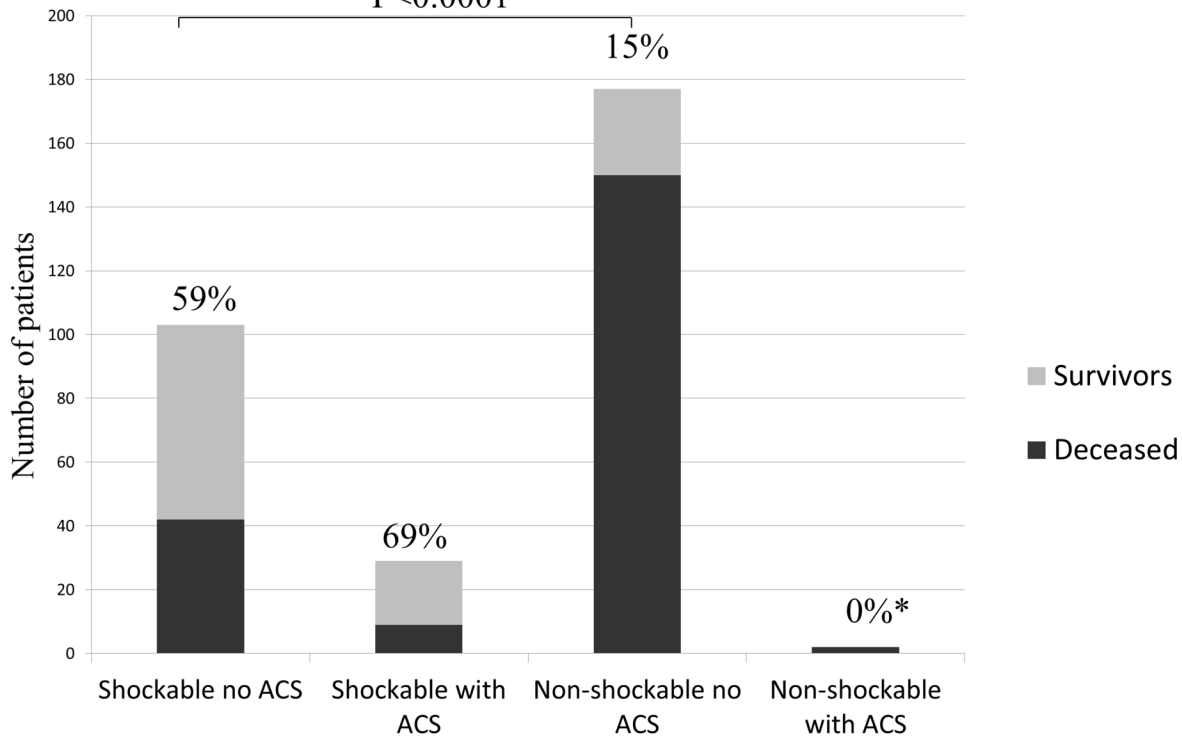


Table 1 Characteristics of the overall population according to the initial rhythm

	Overall n=517	Shockable n=287	Non- shockable n=230	p-value
Age (years)	58 (49-67)	55 (47-65)	61 (52-72)	<0.0001
BMI	26 (23.7- 29.3)	25.7 (23,5- 27.8)	26.8 (24.2- 30.2)	0.003
Male gender	407 (79%)	242 (84%)	165 (72%)	0.0005
Hypertension	183 (36%)	97 (35%)	86 (38%)	0.43
Diabetes mellitus	64 (12%)	31 (11%)	33 (14%)	0.22
Previous history of coronary artery disease	79 (15%)	46 (16%)	33 (14%)	0.60
Family history of sudden death	13 (4%)	12(6%)	1 (1%)	0.007
Hypercholesterolemia	112 (22%)	73 (26%)	39 (17%)	0.02
Current smoker	187 (37%)	126 (45%)	61 (27%)	<0.0001
COPD	14 (3%)	4 (1%)	10 (4%)	0.040
Initial VF*	270 (52%)	270 (94%)	0 (0%)	<0.0001
Initial VT	13 (3%)	13 (5%)	0 (0%)	0.001
Initial asystole	179 (35%)	0 (0%)	179 (78%)	<0.0001

Initial PEA	25 (5%)	0 (0%)	25 (11%)	<0.0001
Initial extreme bradycardia	17 (3%)	0 (0%)	17 (7%)	<0.0001
No-flow (min)	4 (1-10)	3 (1-8)	5 (1-10)	0.057
Low-flow (min)	20 (10-30)	20 (10-30)	20 (10-30)	0.77
Bystander CPR	176 (34%)	116 (40%)	60 (26%)	0.0006
Epinephrine bolus (mg)	1 (0-4)	1(0-3)	2(1-4)	<0.0001
Number of electric shocks	1 (0-3)	2(1-5)	0(0-0)	<0.0001
Shock after ROSC	310 (60%)	139 (49%)	171 (75%)	<0.0001
Systolic blood pressure (mmHg)	128 (101-154)	130 (103-156)	126 (100-152)	0.57
Diastolic blood pressure (mmHg)	74 (60-88)	76 (60-88)	72 (58-85)	0.21
Median GCS on admission	3 (3-3)	3 (3-3)	3 (3-3)	0.013
LVEF on admission (%)	45 (30-50)	40 (30-50)	50 (35-55)	0.003
Arterial pH on admission	7.24 (7.12-7.33)	7.27 (7.19-7.35)	7.18 (7.06-7.29)	<0.0001
Lactate on admission (mmol/L)	5.2 (2.7-9.0)	3.8 (2.0-6.6)	7.5 (4.0-11.5)	<0.0001
Troponin on admission	2.2 (0.3-70.0)	4.9 (0.6-150.0)	0.8 (0.1-	<0.0001

(ng/mL)			23.0)	
ST-elevation on post-resuscitation ECG	206 (40%)	155 (54%)	51 (22%)	<0.0001
Single-vessel disease	112 (22%)	89 (31%)	23 (10%)	<0.0001
Two-vessel disease	79 (15%)	54 (19%)	25 (11%)	0.013
Three-vessel disease	88 (17%)	60 (21%)	28 (12%)	0.009
Acute coronary syndrome	160 (31%)	142 (49%)	18 (8%)	<0.0001
Successful PCI	154 (30%)	137 (48%)	17 (7%)	<0.0001
Mortality to discharge	317 (61%)	119 (41%)	198 (86%)	<0.0001

\*-shockable/non-shockable status was known in all patients, but the type of initial rhythm was not known in 4 and 9 of the patients with shockable and non-shockable rhythm respectively. BMI-body mass index; COPD-chronic obstructive pulmonary disease; VF-ventricular fibrillation; VT-ventricular tachycardia; PEA-pulseless electrical activity; CPR-cardiopulmonary resuscitation; ROSC-return of spontaneous circulation; GCS-Glasgow Coma Scale; LVEF-left ventricular ejection fraction; ECG-electrocardiogram. PCI-percutaneous coronary intervention.

Table 2 Characteristics of the patients with non-shockable initial rhythm

	Non-shockable n=230	No ST- elevation n=179	ST-elevation n=51	p-value
Age (years)	61 (52-72)	62 (54-73)	57 (48-67)	0.16
BMI	26.8 (24.2-30.2)	27.3 (24.2-30.9)	25.8 (23.2- 27.5)	0.20
Male gender	165 (72%)	124 (69%)	41 (80%)	0.12
Hypertension	86 (38%)	71 (40%)	15 (30%)	0.18
Diabetes mellitus	33 (14%)	29 (16%)	4 (8%)	0.13
Previous history of coronary artery disease	33 (14%)	27 (15%)	6 (12%)	0.55
Family history of sudden death	1 (1%)	1 (1%)	0 (0%)	1.00
Hypercholesterolemia	39 (17%)	31 (18%)	8 (16%)	0.79
Current smoker	61 (27%)	44 (25%)	17 (34%)	0.21
COPD	10 (4%)	9 (5%)	1 (2%)	0.70
Asystole	179 (78%)	139 (78%)	40 (78%)	0.91
Pulseless electrical activity	25 (11%)	21 (12%)	4 (8%)	0.43
Initial extreme	17 (7%)	12 (7%)	5 (10%)	0.54

bradycardia				
No-flow (min)	5 (1-10)	5 (1-10)	6 (2-10)	0.61
Low-Flow (min)	20 (10-30)	20 (10-30)	22 (12-33)	0.16
Bystander CPR	60 (26%)	44 (25%)	16 (31%)	0.33
Epinephrine bolus (mg)	2 (1-4)	2 (1-4)	3 (1-5)	0.14
Shock after ROSC	171 (75%)	129 (72%)	42 (82%)	0.15
Systolic blood pressure (mmHg)	126 (100-152)	128 (105 -152)	114 (95-153)	0.48
Diastolic blood pressure (mmHg)	72 (58-85)	72 (59-85)	72 (56-85)	0.99
GCS on admission	3 (3-3)	3 (3-3)	3 (3-3)	0.78
LVEF on admission (%)	50 (35-55)	50 (35-55)	50 (30-50)	0.64
Arterial pH on admission	7.18 (7.06-7.29)	7.18 (7.07-7.30)	7.16 (7.03- 7.24)	0.15
Lactate on admission (mmol/L)	7.5 (4.0-11.5)	7.3 (4.0-10.9)	8.4 (3.9 -12.0)	0.48
Troponin on admission (ng/mL)	0.8 (0.1-23.0)	0.4 (0.1-10.0)	2.4 (0.4-74.0)	0.008
Single-vessel disease	23 (10%)	16 (9%)	7 (14%)	0.31
Two-vessel disease	25 (11%)	15 (8%)	10 (20%)	0.023

Three-vessel disease	28 (12%)	18 (10%)	10 (20%)	0.066
Acute coronary syndrome	18 (8%)	2 (1%)	16 (31%)	<0.0001
Successful PCI	17 (7%)	2 (1%)	15 (29%)	<0.0001
Mortality to discharge	198 (86%)	152 (85%)	46 (90%)	0.34

BMI-body mass index; COPD-chronic obstructive pulmonary disease; CPR-cardiopulmonary resuscitation; ROSC-return of spontaneous circulation; GCS-Glasgow Coma Scale; LVEF-left ventricular ejection fraction. PCI-percutaneous coronary intervention.



Table 3 Comparison of patients with non-shockable and shockable rhythm without ST-elevation

	Non-shockable no ST-elevation n=179	Shockable no ST-elevation n=132	p-value
Age, (years)	62 (54 -73)	58 (48-68)	0.007
Male gender	124 (69%)	108 (82%)	0.012
Hypertension	71 (40%)	45 (35%)	0.33
Diabetes mellitus	29 (16%)	13 (10%)	0.11
Previous history of coronary artery disease	27 (15%)	26 (20%)	0.28
Family history of sudden death	1 (1%)	6 (7%)	0.044
Hypercholesterolemia	31 (18%)	34 (26%)	0.065
Current smoker	44 (25%)	46 (36%)	0.047
COPD	9 (5%)	2 (2%)	0.13
Ventricular fibrillation	0 (0)	124 (94)	<0.0001
Ventricular tachycardia	0 (0)	8 (6)	0.002
Asystole	139 (78%)	0 (0)	<0.0001
Pulseless electrical activity	21 (12%)	0 (0)	<0.0001
Complete heart block	5 (3%)	0 (0)	0.03

No-flow (min)	5 (1-10)	2 (0-8)	0.024
Low-flow (min)	20 (10-30)	19 (11-30)	0.88
Bystander CPR	44 (25%)	55 (42%)	0.001
Epinephrine bolus (mg)	2 (1-4)	1 (0-3)	0.001
Shock after ROSC	129 (72%)	62 (47%)	<0.0001
Systolic blood pressure (mmHg)	128 (105-152)	128 (102-160)	0.96
Diastolic blood pressure (mmHg)	72 (59-85)	70 (57-82)	0.71
Median GCS on admission	3 (3-3)	3 (3-3)	0.022
LVEF on admission (%)	50 (35-55)	40 (30-50)	0.002
Arterial pH on admission	7.18 (7.07-7.30)	7.28 (7.20-7.36)	<0.0001
Lactate on admission (mmol/L)	7.3 (4.0-10.9)	3.6 (1.9 – 6.9)	<0.0001
Troponin on admission (ng/mL)	0.4 (0.1-10.0)	1.4 (0.3-48.0)	0.001
Single-vessel disease	16 (9%)	23 (17%)	0.026
Two-vessel disease	15 (8%)	20 (15%)	0.062
Tree-vessel disease	18 (10%)	29 (22%)	0.004
Acute coronary syndrome	2 (1%)	29 (22%)	<0.0001
Successful PCI	2 (1%)	27 (20%)	<0.0001
Mortality to discharge	152 (85%)	51 (39%)	<0.0001

COPD-chronic obstructive pulmonary disease; CPR-cardiopulmonary resuscitation; ROSC-return of spontaneous circulation; GCS-Glasgow Coma Scale; LVEF-left ventricular ejection fraction.  
PCI-percutaneous coronary intervention.