Short and long-term outcome in very old patients with ST-elevation myocardial infarction after primary percutaneous coronary intervention☆

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ARTICLE INFO

Keywords:
Very elderly
ST-elevation myocardial infarction
Primary percutaneous coronary intervention
Long-term outcome

ABSTRACT

Background: Although octogenarians constitute a fast-growing portion of cardiovascular patients, few data are available on the outcome of patients aged ≥85 years with ST-Elevation Myocardial Infarction (STEMI).
Methods and Results: We analyzed 126 consecutive patients aged ≥85 years (age 88 ± 2 years) with STEMI, undergoing primary percutaneous coronary intervention (pPCI) within 12 hours from symptoms onset.
Long-term follow-up (median 898 days) was obtained for the 102 patients surviving the index-hospitalization. In-hospital mortality rate was 19%. Nonagenarians, diabetes mellitus, severe left ventricular systolic dysfunction and intra-aortic balloon pumping were significantly and independently correlated to in-hospital mortality at the multivariate analysis. A low rate of complications was detected. Among patients surviving the index hospitalization, 32 (31%) patients died during follow-up. 55 patients (54%) had re-hospitalization due to cardiovascular causes. The univariate analysis identified chronic renal failure, Killip class ≥ 3, TIMI Risk Score >8 and very high risk of bleeding as predictors of long-term overall mortality. At the multivariate analysis only chronic renal failure and very high risk of bleeding were significantly and independently correlated to long-term all-cause mortality. Renal function and anterior myocardial infarction were significantly and independently associated with the combined end-point of cardiac mortality and re-hospitalization due to cardiovascular disease at the multivariate analysis.
Conclusions: PPCI in patients ≥85 years old is relatively safe. In this population, pPCI is associated with a good long-term survival, although still worse than in younger patients, despite a considerable incidence of re-hospitalization due to cardiovascular events.

1. Introduction

The fastest growing segment of the western world population is the oldest old (age ≥ 85 years); in these subjects, the prevalence of coronary artery disease is high and age itself is a predictor of adverse events after acute coronary syndrome (ACS) [1–6]. However, elderly patients are underrepresented in clinical trials of ACS [1] or primary percutaneous coronary intervention (pPCI) [2–5,7,8]. Elderly patients with ST-segment elevation myocardial infarction (STEMI) are less likely to receive an invasive treatment due to the perception of poor outcome and often have atypical symptoms that cause longer delay to presentation and treatment, more adverse events and prolonged hospital stay [5, 9–11].

The majority of studies considered 75 years as age cut-off while the treatment and outcome of very-old patients (over 85 years old) are still poorly analyzed, especially longterm mortality and rehospitalizations.

Based on these considerations, we conducted a retrospective observational study to evaluate the short and long-term outcome of consecutive unselected patients aged ≥85 years with STEMI referred to pPCI.

2. Methods

From January 2007 to December 2013, a total of 126 patients aged ≥85 years with STEMI, admitted to the coronary care units of "Azienda

☆ All authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

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Diagnosis of STEMI was made on the basis of typical ECG changes and/or ischemic chest pain associated with elevation of cardiac biomarkers [12]. All patients underwent immediate coronary angiography and pPCI. Patients with contraindications to coronary angiography and pPCI, such as active bleeding and/or very severe comorbidities (e.g. known terminal illness), were not included in the study.

According to guidelines [13–15], all included patients received aspirin (250–300 mg), clopidogrel (300–600 mg) and intravenous heparin during the transport or at the arrival at the pPCI-center. Interventional strategy, stent selection and use of GPIIb/IIIa inhibitors were according to local standard practice. Post-procedural antiplatelet therapy included lifelong aspirin (100 mg/day) and clopidogrel (75 mg/day) for 1 to 12 months.

Detailed demographic, clinical, laboratory, echocardiographic, angiographic and procedural information was retrieved from the hospital databases and patient records. Follow-up data were obtained from a Regional Registry, which holds information on discharge diagnoses of all hospitalizations according to International Classification of Disease codes.

The following clinical endpoints were evaluated during the index hospitalization: death, re-infarction (defined as an increase in troponin associated to symptoms or electrocardiographic alterations) or re-revascularization (defined as the requirement for urgent repeat PCI or emergency coronary artery bypass graft), heart failure, arrhythmias, bleeding complications, cerebrovascular accident and contrast-induced nephropathy.

Global Utilization of Streptokinase and Tissue Plasminogen Activity for Occluded Coronary Arteries (GUSTO) classification for bleeding was adopted while *Thrombolysis In Myocardial Infarction* risk Score (TIMI risk Score) and *Can Rapid risk stratification of Unstable angina patients Suppress ADverse outcomes with Early implementation of the ACC/AHA Guidelines* (CRUSADE) score were utilized for risk stratification [16–18]. A cutoff of 40 (high risk) or 50 (very high risk) points for CRUSADE score, 8 points for TIMI Risk Score and 3 for the killip class were used to identify a subpopulation at high risk.

Cardiogenic shock was determined to be present using conventional clinical criteria of hypotension and signs of peripheral hypoperfusion that did not rapidly resolve. Successful percutaneous coronary intervention (PCI) was defined as the achievement of *Thrombolysis In Myocardial Infarction* (TIMI) grade 3 flow with <30% residual stenosis. The estimated glomerular filtration rate (eGFR) was calculated using the abbreviated *Modification of Diet in Renal Disease* formula (MDRD) [19] and the creatinine level measured on admission. A cutoff of eGFR ≤60 mL/min/1.73 mq was used to identify patients with relevant chronic renal failure.

Contrast induced nefropathy (CIN) was defined as acute kidney injury occurring after intravenous contrast administration, measured as a 25% increase in serum creatinine from baseline or 0.5 mg/dL increase in absolute value.

Severe left ventricular dysfunction was defined as ejection fraction ≤35%.

The primary follow-up clinical endpoint was defined as the occurrence of death. The secondary follow-up clinical endpoint was defined as a composite of cardiac death and re-hospitalization for cardiovascular causes (recurrent myocardial ischemic events, heart failure and cerebrovascular accident).

2.1. Statistical methods

Continuous variables are expressed as mean and standard deviation (SD) or median and interquartile range (IQR) as appropriate. Categorical data are presented as absolute numbers and percentages.

Chi-square test or Mann-Whitney test were used as appropriate to compare the two groups for categorical and continuous variables respectively.

Univariate and multivariate Cox proportional hazards analyses were used to test the association between the primary and secondary follow-up clinical endpoint and baseline covariates. Clinically relevant variables or those associated with a univariate $p < 0.1$ were included in multivariate models. Backward stepwise regression method was used. Survival curves were generated by the Kaplan–Meier method. Two-tailed tests were considered statistically significant at the 0.05 level.

All statistical analyses were performed using SPSS 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.)

3. Results

Demographic and clinical characteristics, angiographic and procedural data and mortality of the study population in comparison with younger contemporary cohort are presented in Table 1. In very-old patients, a higher prevalence of female gender, hypertension, chronic renal failure and minor use of radial approach and Glycoprotein IIb/IIIa inhibitors were observed. Moreover, very-old patients were significantly less likely to be smokers than younger ones but with more prevalence of diabetes, severe left ventricular dysfunction and killip class ≥ 3 at admission. In addition, Door-to-balloon time and ischemia time were slightly longer in very elderly patients compared to younger patients. The rates of in-hospital and longterm mortality were significantly superior for very-elderly patients compared to younger patients.

Table 2 describes the in-hospital outcome and the discharge medical therapy. Median length of hospital stay was 7 days (interquartile range 5 to 11). Twenty-four (19%) patients died during the index hospitalization. Vascular access-related complications occurred in 12 (10%) patients: three patients required surgical repair (due to intestinal ischemia or severe bleeding) and died during the index hospitalization, while the remaining patients had small groin hematomas without hemodynamic compromise. None had intracranial hemorrhage or cardiac tamponade. Moderate bleeding requiring haemotransfusion occurred in 2 patients (2%). 3 (2%) patients experienced a cerebrovascular accident during the index hospitalization: 2 patients had an ischemic stroke while one patient had a transient ischemic attack. Contrast-induced nephropathy after PCI occurred in 12 (10%) patients and one of them required dialysis. Stent thrombosis was observed in one patient (0,8%).

Table 3 shows the results of the univariate and multivariate Cox proportional Hazards Analyses performed to determine predictors of in-hospital mortality, of the primary and secondary follow-up clinical endpoint (i.e. all-cause mortality and cardiac mortality & re-hospitalization for cardiovascular causes).

Age ≥ 90 years ($p = 0.015$), Killip class ≥ 3 at admission ($p = 0.021$), time from symptoms onset to PCI ($p = 0.045$), TIMI Risk Score > 8 ($p = 0.008$), high risk of bleeding ($p = 0.047$), left ventricular function ($p < 0.001$), intra-aortic balloon pumping ($p = 0.005$) and PCI failure ($p = 0.007$) were all significantly related to in-hospital mortality at the univariate analysis. Nonagenarians, diabetes mellitus, severe left ventricular systolic dysfunction and intra-aortic balloon pumping were significantly and independently correlated to in-hospital mortality at the multivariate analysis.

The median duration of follow-up of patients who survived at index hospitalization was 898 days (IQR 436–1427 day). Among the 102 patients surviving the index hospitalization, the overall mortality rate was 31% (32 patients) while the cardiac mortality rate was 16.7% (17 patients). A total of 55 (53,9%) patients had at least one hospitalization for cardiovascular causes during follow-up: 19 patients had recurrent myocardial ischemic events (i.e. unstable angina or myocardial infarction), 30 patients had ≥1 hospitalization for heart failure, 4 patients were re-admitted because of a stroke and 2 patient had arrhytmias.

Table 1
Baseline characteristics, angiographic and procedural data, in-hospital and longterm mortality and Kaplan-Meier curve of overall survival separated by age groups.

	Age group (years)			*p*-Value	
	≥85 (n = 126)	75–85 (n = 485)	<75 (n = 1723)	G1 vs G2	G1 vs G3
Age (years)	88 ± 2	79 ± 3	60 ± 10	<0.001	<0.001
Nonagenarians	30 (24%)				
Male	53 (42%)	280 (58%)	1441 (84%)	0.001	<0.001
Diabetes mellitus	31 (25%)	109 (22%)	251 (15%)	0.761	0.031
Arterial hypertension	92 (73%)	314 (65%)	856 (50%)	0.023	<0.001
Hypercholesterolemia	45 (36%)	180 (37%)	797 (46%)	0.069	<0.001
Smoker	31 (25%)	110 (23%)	879 (51%)	0.761	<0.001
Previous cerebrovascular accidents	10 (8%)				
Peripheral artery disease	7 (6%)				
Haemoglobin (g/dL)	12 (11 − 13)				
eGFR (mL/min/1,73 m2)	56 (50–71)				
Chronic renal failure (eGFR ≤60 mL/min/1,73 m2)	63 (50%)	67 (14%)	82 (5%)	<0.001	<0.001
Previous myocardial infarction	16 (13%)	60 (12%)	169 (10%)	0.943	0.359
Previous PCI	5 (4%)	14 (3%)	51 (3%)	0.746	0.793
Previous CABG	6 (5%)	9 (2%)	11 (1%)	0.365	0.001
Anterior STEMI	64 (51%)	229 (47%)	743 (43%)	0.449	0.079
Heart rate (bpm)	73 ± 19	75 ± 20	75 ± 28	0.559	0.384
Systolic blood pressure (mmHg)	130 ± 31	139 ± 91	136 ± 31	0.850	0.622
Killip class ≥ 3	18 (14%)	62 (13%)	98 (6%)	0.971	0.002
Cardiogenic shock	12 (10%)				
Right ventricular involvement	8 (6%)	24 (5%)	64 (4%)	0.530	0.909
Cardiac arrest	5 (4%)				
TIMI Risk Score	6 (5–7)				
TIMI Risk Score > 8	18 (14%)				
CRUSADE Score	47 ± 13				
CRUSADE Score > 40 (high risk)	69 (55%)				
CRUSADE Score > 50 (very high risk)	40 (32%)				
Left ventricular ejection fraction (%)	47 ± 12				
Severe left ventricular systolic dysfunction (EF ≤35%)	24 (19%)	56 (12%)	91 (5%)	0.396	<0.001
Moderate or severe aortic stenosis	13 (10%)				
Moderate or severe mitral regurgitation	17 (13%)				
Advanced atrioventricular block	15 (12%)				
Time from symptoms to initial hospital arrival - prehospital delay (min)	110 (66–199)	102 (55–195)	85 (45–158)	0.879	0.030
Door-to-balloon time (min)	100 (75–134)	98 (72–135)	90 (68–118)	0.641	0.008
Time from symptoms to PCI (min)	216 (158–318)	226 (158–336)	191 (141–281)	0.767	0.015
Ischemia time ≤ 3 h	38 (30%)				
Radial approach	20 (16%)	120 (25%)	551 (32%)	0.021	<0.001
Infarct-related coronary artery					
• Left anterior descending	58 (46%)	216 (45%)	722 (42%)	0.862	0.290
• Right coronary artery	43 (34%)	163 (34%)	607 (35%)	0.914	0.978
• Left circumflex artery	12 (10%)	73 (15%)	321 (19%)	0.371	0.076
• Left main coronary artery	3 (2%)				
• Graft	3 (2%)				
• Other vessel	7 (6%)				
Multivessel coronary disease	76 (60%)	279 (58%)	819 (48%)	0.074	<0.001
Severe Left main coronary artery disease	14 (11%)				
PCI	126 (100%)				
PCI with stent	117 (93%)				
PCI with DES	7 (6%)				
Number of stents per patient	1 (1–2)				
Thrombus aspiration	71 (56%)				
IABP	11 (9%)				
Endotracheal Intubation	4 (3%)				
Temporary transvenous pacemaker	10 (8%)				
Glycoprotein IIb/IIIa inhibitors	13 (10%)	126 (26%)	672 (39%)	<0.001	<0.001
Successful PCI	103 (82%)				
In-hospital death	24 (19%)	45 (9%)	55 (3%)	0.002	<0.001
Longterm all-cause death	56 (44%)	149 (31%)	151 (9%)	0.007	<0.001

Data are expressed as mean ± SD or median (interquartile range) and numbers (percentages).
Intra-aortic balloon counterpulsation was required because of hemodynamic instability or high-risk procedure (left main or 3-vessel disease). CABG = Coronary artery bypass graft surgery; CRUSADE = Can Rapid risk stratification of Unstable angina patients Suppress ADverse outcomes with Early implementation of the ACC/AHA Guidelines; DES = drug-eluting stent; EF = Ejection fraction; eGFR = estimated glomerular filtration rate; IABP = intra-aortic balloon pumping; PCI = percutaneous coronary intervention; STEMI = ST-Elevation Myocardial Infarction; TIMI = Thrombolysis In Myocardial Infarction.

Chronic renal failure ($p = 0.002$), Killip class ≥ 3 ($p = 0.037$), TIMI Risk Score > 8 ($p = 0.013$) and very high risk of bleeding ($p = 0.02$) were significantly related with the primary follow-up clinical endpoint at the univariate analysis. At the multivariate analysis only chronic renal failure and very high risk of bleeding were significantly and independently correlated to long-term all-cause mortality.

Renal function ($p = 0.038$), anterior myocardial infarction ($p = 0.001$) and severe left ventricular dysfunction ($p = 0.016$) were significantly associated with the secondary follow-up clinical endpoint at the

Table 2
In-hospital events and discharge medical therapy.

In-hospital events	
Hospital stay (days)	7 (5–11)
Residual angina	2 (2%)
Re-infarction	1 (1%)
Heart failure	20 (16%)
Arrhythmias	31 (25%)
• Atrial fibrillation	14 (45%)
• Ventricular tachycardia	7 (23%)
• Atrioventricular block	2 (6%)
• Ventricular fibrillation	4 (13%)
• Asystolia	1 (3%)
• Unknown	3 (10%)
Stroke	2 (2%)
TIA	1 (1%)
Severe bleedings	2 (2%)
Moderate bleedings (requiring transfusion)	2 (2%)
Mild bleedings	8 (6%)
Vascular access-related complications	12 (10%)
Vascular access-related complications requiring surgical repair	3 (2%)
Hematomas	11 (9%)
Contrast induced nephropathy	12 (10%)
In-hospital death	24 (19%)
Discharge medical therapy	
Aspirin	85 (83%)[a]
Clopidogrel	83 (81%)[a]
B blockers	67 (66%)[a]
Angiotensin-converting enzyme inhibitors/angiotensin receptor blockers	67 (66%)[a]
Statins	67 (66%)[a]
Missing values about discharge medical therapy	17 (17%)[a]

Data are expressed as mean ± SD or median (interquartile range) and numbers (percentages). TIA = Transient Ischemic Attack.
[a] Percentage calculated on patients surviving the index hospitalization ($n = 102$).

univariate analysis. At the multivariate analysis only renal function and anterior myocardial infarction were significantly and independently correlated to long-term cardiac mortality and re-hospitalization for cardiovascular causes.

4. Discussion

With the increasing of the older population, the burden of acute myocardial infarction will gain more importance. Morbidity and mortality rates in patients with STEMI increase indeed with age; in particular, mortality of older patients is still higher than in younger patients even after implementation of an infarction network [5,7].

According to current guidelines of the AHA/ACC [14], patients with STEMI presenting within 12 h from symptom onset should be treated with reperfusion therapy; pPCI seems to be the most effective and safe reperfusion strategy in elderly patients with STEMI, but few data describe the subgroup of the oldest old [2–4,8,20–22]. Although there is a great interest in elderly population, the majority of studies considered indeed 75 years as age cut-off while the treatment and outcome of very-old patients (over 85 years old) are still poorly analyzed.

A summary of the results of the previously published observational studies in very-old patients is presented in Table 4.

Elderly patients with STEMI have been reported to have high mortality rates: published data suggest that mortality ranges from 10% to 25% in hospital and from 19% to 52% at 1 year, with the highest mortality seen in patients treated with conservative therapies [16,18,22–37].

In the current study, overall in-hospital mortality rate was 19%, consistent with previous observations [26,29,35,36,38]. Several variables were significantly related to in-hospital mortality: Killip class ≥ 3, age ≥ 90 years and PCI failure were correlated to worst in-hospital outcome, similarly to previous studies [26,35,37]. However the prevalence of in-hospital death in the subgroup with cardiogenic shock was unexpectedly lower than previously reported (42% in our study while in literature is 54–90%) [26,29,36]. Ischemic time was also correlated to in-hospital death, underlying the difficulty in the management of these patients that often have atypical symptoms with longer delay to presentation. Other variables significantly related to in-hospital death were TIMI Risk Score > 8, high risk of bleeding, severe left ventricular dysfunction along with intra-aortic balloon pumping (IABP), which clearly identify a high risk subgroup. Among these variables only nonagenarians, diabetes mellitus, severe left ventricular systolic dysfunction and intra-aortic balloon pumping were significantly and independently correlated to in-hospital mortality at the multivariate analysis.

A low use of radial access as well as of *drug-eluting stent* (DES) and Glycoprotein IIb/IIIa inhibitors in old patients were documented in our centers, like in other studies [35,38]. During the study period, coronary angiography was performed by femoral access in nearly all cases, as preferred puncture site for PCIp in our centers. Due to an high use of femoral access, a relevant rate of vascular access-related complications (10%) were observed which required surgical repair in 25% of cases. The low use of DES and Glycoprotein IIb/IIIa inhibitors reflects the widespread perception of the higher risk of bleeding in elderly patients and the reluctance of operators to commit elderly patients to dual antiplatelet therapy for a prolonged period. The association of older age and the frequency of haemorrhagic complications of PCI are also well known [39–42]. However, in literature there are different results as regards bleeding complications in elderly: in-hospital major bleeding ranging from 0.1% to 18% depending on different authors [22,25,28,29,43]. Moreover, it is interesting to note that the stroke rate in elderly pPCI patients seems to be lower in more recent studies [29,35,38], varying from 0.85% to 3%. Furthermore, Murphy et al. [34] underlined a higher rate of acute kidney injury in the elderly (≥ 80 years old) cohort than in younger patients (12.9% vs. 4.0%). A similar rate (10%) was found in elderly patients also by Valente et al. [26]. In our study a low rate of complications were detected, in particular in major bleedings (2%) or cerebrovascular accidents (2%); only one patient suffered stent thrombosis (0,8%) while contrast induced nephropathy after PCI occurred in 10% of patients.

It was found that those who survived to hospital discharge had a reasonable chance for long-term survival with a long-term mortality rate lower than reported by other authors [26,27,29,35,37]. Infact, our 1-year overall mortality rate was 14% with a total of 9.8% because of cardiac causes, while long-term overall mortality were 31% with a total of long-term cardiovascular mortality of 16.7%. Chronic renal failure and very high risk of bleeding were identified as independent predictors for long-term overall mortality at the multivariate analysis. Despite a good survival rate, a considerable number of hospitalizations due to cardiovascular events were observed, especially due to recurrent myocardial ischemic events and heart failure. Renal function and anterior myocardial infarction were significantly and independently correlated with the combined end-point of cardiac mortality and re-hospitalization due to cardiovascular diseases at the multivariate analysis.

On the basis of our data and other studies [6,21,22,25–27,33,37], older STEMI patients can receive similar care to younger patients. A PCI-based strategy is preferred in elderly patients with STEMI and rapid transfer for pPCI (in combination with appropriate adjunctive pharmacology) produced improved outcomes, although still worse than in younger patients. According to other authors, our study confirms that patients selection through clinical evaluation is important to be done before acceptance for pPCI: clinical characteristics have been shown to be more predictive of adverse outcomes than procedural factors [6,22,44,45].

Table 3
Univariate and multivariate Cox proportional Hazards Analyses for in-hospital mortality, for long-term all-cause mortality and for the combined endpoint of long-term cardiac mortality and re-hospitalization for cardiovascular causes.

In-hospital mortality	Univariate			Multivariate		
	HR	95% IC	*P* value	HR	95% IC	P value
Female	0.778	0.348–1.739	0.541	–	–	–
Age ≥ 90 years	2.748	1.218–6.203	0.015	3.361	1.182–9.556	0.023
Diabetes mellitus	2.169	0.947–4.967	0.067	3.490	1.172–10.390	0.025
Chronic renal failure (eGFR ≤60 mL/min/1,73 m2)	1.476	0.611–3.564	0.386	–	–	–
Killip class ≥ 3	2.884	1.173–7.091	0.021	–	–	–
Cardiogenic shock	2.534	0.943–6.813	0.065	–	–	–
Ischemia time (min)	1.002	1.000–1.005	0.045	–	–	–
TIMI Risk Score > 8	3.169	1.353–7.419	0.008	–	–	–
high risk of bleeding (CRUSADE Score > 40)	7.641	1.032–56.585	0.047	–	–	–
Anterior STEMI	1.939	0.829–4.536	0.127	–	–	–
EF	0.927	0.890–0.966	<0.001			
Severe left ventricular systolic dysfunction (EF ≤35%)	2.004	0.853–4.707	0.111	4.598	1.550–13.641	0.006
Multivessel coronary disease	0.949	0.421–2.141	0.900	–	–	–
IABP	3.793	1.500–9.590	0.005	3.629	1.085–12.134	0.036
Advanced atrioventricular block	2.311	0.860–6.209	0.097	–	–	–
PCI failure	3.041	1.349–6.856	0.007	–	–	–
Long-term all-cause mortality						
	HR	95% IC	*P* value	HR	95% IC	P value
Female	0.803	0.400–1.614	0.538	0.500	0.213–1.170	0.110
chronic renal failure	3.766	1.605–8.835	0.002	3.966	1.452–10.834	0.007
Killip class ≥ 3	2.623	1.062–6.480	0.037	–	–	–
TIMI Risk Score > 8	3.099	1.264–7.598	0.013	–	–	–
very high risk of bleeding (CRUSADE Score > 50)	2.336	1.144–4.770	0.020	3.467	1.422–8.452	0.006
Diabetes mellitus	1.761	0.808–3.837	0.155	–	–	–
Anterior STEMI	1.401	0.692–2.835	0.349	–	–	–
Multivessel coronary disease	1.042	0.508–2.136	0.912	–	–	–
Severe Left main coronary artery disease	1.607	0.560–4.612	0.378	–	–	–
Severe left ventricular systolic dysfunction (EF ≤ 35%)	1.748	0.713–4.285	0.222	–	–	–
Nonagenarians	1.125	0.459–2.756	0.797	–	–	–
Any relevant valvulopathy	1.288	0.575–2.883	0.539	–	–	–
Time from symptoms to PCI (min)	0.999	0.997–1.002	0.608	–	–	–
Successful PCI	0.355	0.084–1.494	0.158	–	–	–
Long-term cardiac mortality and re-hospitalization for cardiovascular causes						
	HR	95% IC	*P* value	HR	95% IC	*P* value
Female	0.704	0.420–1.180	0.183	–	–	–
eGFR (MDRD)	0.985	0.970–0.999	0.038	0.986	0.970–1.002	0.076
Anterior STEMI	2.456	1.447–4.169	0.001	2.431	1.310–4.512	0.005
Severe left ventricular systolic dysfunction (EF ≤ 35%)	2.216	1.163–4.221	0.016	1.907	0.874–4.161	0.105
Nonagenarians	1.603	0.855–3.006	0.141	1.845	0.928–3.669	0.081
Any relevant valvulopathy	1.593	0.899–2.824	0.111	–	–	–
Time from symptoms to PCI (min)	0.998	0.996–1.000	0.130	0.998	0.996–1.000	0.069
Successful PCI	1.724	0.737–4.037	0.209	–	–	–
Multivessel coronary disease	0.929	0.548–1.573	0.783	–	–	–
Severe Left main coronary artery disease	1.165	0.463–2.934	0.745	–	–	–
Diabetes mellitus	1.129	0.606–2.102	0.703	–	–	–
TIMI Risk Score > 8	1.748	0.790–3.870	0.168	–	–	–
very high risk of bleeding (CRUSADE Score > 50)	0.998	0.589–1.693	0.995	–	–	–

CRUSADE = Can Rapid risk stratification of Unstable angina patients Suppress ADverse outcomes with Early implementation of the ACC/AHA Guidelines; EF = Ejection fraction; eGFR = estimated glomerular filtration rate; IABP = intra-aortic balloon pumping; MDRD = Modification of Diet in Renal Disease; PCI = percutaneous coronary intervention; STEMI = ST-Elevation Myocardial Infarction; TIMI = Thrombolysis In Myocardial Infarction.

5. Study limitations

As observational retrospective registry, our study lacks of some data usefull to better stratify the frailty of the elderly patients and it is affected by selection bias because the treatment strategy was defined by clinicians.

6. Conclusion

In conclusion, our data suggest that patients aged ≥85 years with STEMI can be safely transferred to tertiary care centers for timely pPCI, with a low rate of PCI failure, but with an adeguate clinical evaluation before acceptance for coronary angiography. On the other hand, pPCI is less able to affect the poor prognosis for very old patients with cardiogenic shock.

Furthermore, those who survived to hospital discharge had a reasonable chance for long-term survival, although still worse than younger patients, despite a considerable incidence of re-hospitalization due to cardiovascular events.

Disclosures

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

No conflicts of interest, financial or otherwise, are declared by the authors.

Table 4
Results of the previously published observational studies.

Authors	Age group	n. patients	Inhospital mortality in patients treated with PCI	Mortality subgroup with cardiogenic shock	Major bleeding complications	In-hospital Stroke	Acute kidney injury	Longterm mortality (in pt. who survived to hospital discharge)	median follow-up
Shah et al.	≥85 years	73	25%	54%	13 (18%)	2 (3%)		14 (30%)	429 days
Valente et al.	≥85 years	88	15 (17%)	90%	11 (12%)		9 (10%)	37 (50,7%)	21,5 months
Fach et al.	>85 years	179	35 (19,6%)		35 (19,6%)	0 (0%)		69 (48%)	1 year-mortality
Yudi et al.	≥85 years	45	6 (13%)		4,4%			18 (46%)	739 ± 84 days
Kvakkestad et al.	≥80 years	600	12,9% (64/496)	78% (43/55)	13 (2,2%) Gastrointestinal	14 (2,3%)		42%	Three-years mortality
Newell et al.	≥85 years	138	13,9%		2,5%			28,9%	1-year mortality
Showkathali et al.	≥80 years	236	34 (14,4%)	12 (5,1%)					
	Subgroup ≥85 years	115	21 (18%)	6 (5%)					
Ricci et al.	≥80 years	605	16,1% 30-day mortality						

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