Outcomes of Contemporary Interventional Therapy of ST Elevation Infarction in Patients Older than 75 Years

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ABSTRACT

Background: Data on contemporary real-world outcomes of interventional revascularization in patients ≥ 75 y of age with ST elevation infarction (STEMI) are limited.

Methods: We analyzed all 504 consecutive patients who underwent angiography for acute STEMI between 1999 and 2005 at our center, and followed them up over one year. Outcomes in patients ≥ 75 y of age were compared with younger patients.

Results: Patients ≥ 75 y of age ($n = 115$) were majority females (55% versus 21%, $p < 0.001$), more cases of diabetes (42% versus 27%, $p = 0.004$), hypertension (78% versus 65%, $p = 0.03$) and a history of coronary events (25% versus 15%, $p = 0.002$). Younger patients were more often smokers (63% versus 30%, $p < 0.001$). After coronary angiography patients ≥ 75 y of age underwent less frequent intervention (PCI; 84% versus 93%, $p = 0.01$). However, if PCI was performed, technical success rates were similar to younger patients (84% versus 86%). The 30-d mortality was 13% versus 6.4% ($p = 0.03$), but after successful PCI, the 30-d mortality rate was not significantly higher in old patients (7.4% versus 3.9%, $p = 0.23$). Bleeding complications were very low in both age groups if the radial access route was chosen. Multivariate predictors of 30-d mortality were cardiogenic shock/survived cardiac arrest, ejection fraction $< 30\%$, conservative treatment or unsuccessful PCI (OR 3.01), renal insufficiency, diabetes, and age. One-year mortality was higher in the elderly (24.3% versus 9.9%, $p < 0.001$). Among 30-d-survivors, only multivessel disease and age were multivariate predictors of 1-y mortality.

Conclusion: Patients ≥ 75 y of age benefit from PCI in STEMI, and failed or unattempted PCI worsens prognosis in the old as well as in younger patients.

Key words: acute coronary syndrome, percutaneous intervention, acute cardiac care

Introduction

Old patients are often underrepresented in controlled trials investigating therapy in ST elevation myocardial infarction (STEMI).^{1,2} However, with increasing life expectancy of the population, especially in industrialized countries, the management of STEMI in this age group is of growing importance. Controlled trials showed superiority of primary percutaneous coronary intervention (PCI) over thrombolysis in both younger and elderly patients,^{3,4} but the published data reflect clinical practice a decade ago. Moreover, little is known about the results of current PCI practice in a real-life cohort of “all comers” with STEMI as opposed to selected study patients, which often exclude groups such as patients in cardiogenic shock or after cardiac arrest. Therefore, we analyzed data from all patients undergoing acute coronary angiography with the intention of having primary PCI at a single university department of cardiology over seven years and compared procedural characteristics and outcomes of patients 75 y of age or older with those under 75 y of age, and obtained 30-d and 1-y follow-up.

Patients and Methods

We analyzed all consecutive patients between the years 1999 and 2005 with acute STEMI or myocardial infarction with new left bundle branch block, symptom duration under 24 h, and acute coronary angiography with the intention of having primary PCI. Primary PCI is our standard treatment of STEMI, and is available at all times in our institution. Impaired renal function is not regarded as a contraindication for interventional STEMI treatment. During the study period, primary PCI was delivered by five experienced interventional cardiologists. For data collection, records from the emergency transport system (ambulance or helicopter), emergency room, cath lab, coronary care unit, and ward were reviewed. Follow-up was carried out by contacting all patients or their general practitioners by telephone or questionnaire. In particular, the following events were registered: death, reinfarction, stroke, and bleeding complications (see definitions below). For analysis, the patients were divided into two groups: those 75 y of age or older on the day of STEMI (old patients) or younger patients (under 75 y of age).

Definitions:

- Acute STEMI: persisting ST elevations >0.1 mV in at least 2 standard leads, or >0.2 mV in at least two contiguous precordial leads at hospital admission time, or presence of left bundle branch block not previously known, and creatine kinase (CK) elevation >170 U/L, and/or troponin I >0.5 ng/mL within the first 6 h of admission.
- Hypertension was diagnosed if there was a history of antihypertensive medication or if consistently elevated blood pressures ($>140/90$ mm Hg) after the acute phase were detected necessitating anti-hypertensive treatment.
- Diabetes was diagnosed if there was a history of antidiabetic medication or elevated blood glucose levels were measured after the acute phase.
- Success of primary PCI: the result was classified by visual assessment as successful if there was $<30\%$ residual stenosis at the culprit site, and TIMI flow-grade 3, otherwise as unsuccessful.
- Multivessel disease: at least one additional $\geq 70\%$ coronary stenosis in a different coronary artery by visual assessment of the interventionalist.
- Cardiogenic shock: clinical diagnosis based on tachycardia, hypotension, pulmonary edema, and signs of low cardiac output.
- Reinfarction: recurrent ischemic symptoms and/or ECG signs after the index STEMI together with a second peak of CK or troponin I levels $>50\%$ higher than the previous value.
- Ejection fraction: visual assessment of echocardiographic ejection fraction was performed within the first 4h following admission.
- Bleeding: severe bleeding was defined as bleeding leading to hemodynamic instability, according to the GUSTO III criteria;⁵ moderate bleeding was defined as bleeding necessitating blood transfusion, but not leading to hemodynamic consequences.
- Creatinine clearance was calculated according to the simplified formula from the Modification of Diet in Renal Disease (MDRD) study.⁶
- Stroke: the diagnosis was based on clinical signs and compatible cranial computed tomography findings.

Primary PCI

All patients received 500 mg aspirin and 5,000 IU of unfractionated heparin intravenously before or on admission to the hospital, unless they had been previously anticoagulated. All patients undergoing primary PCI were given an oral loading dose of 300 mg clopidogrel followed by 4 wk–6 mo of 75 mg clopidogrel and 300 mg aspirin. All procedural details of the PCI, including the use of glycoprotein IIa/IIIb inhibitors, were left to the discretion of the interventionalist. Radial sheaths were always removed immediately after

the procedure, while femoral sheaths were removed after normalization of partial thromboplastin time.

Statistical Analysis

Continuous variables are presented as mean $\pm$ standard deviation (SD), unless indicated otherwise. Time intervals and age were compared by unpaired Mann-Whitney U test. Categorical variables were compared by Fisher's exact test. Multivariate analysis of predictors of mortality was performed by multiple logistic regression and results presented as odds ratios (OR) with 95% confidence intervals (CI). All statistical calculations were carried out using SPSS version 14.01 (SPSS Inc., Chicago Ill., USA).

Results

Patients

Five hundred and four consecutive patients were analyzed (Table 1, Figure 1). Of these, 115 patients (22.8%) were ≥ 75 y of age at hospital admission. There were significantly more female patients in the older group (55% versus 21%, $p < 0.001$). Old patients suffered more frequently from arterial hypertension, diabetes, and renal insufficiency, and had, more frequently, a history of myocardial infarction, stroke, or coronary revascularization. Conversely, smoking was more prevalent among the younger.

Clinical Status at Hospital Admission

Clinical, electrocardiographic, and echocardiographic parameters at admission are summarized in Table 1. No major differences in the incidence of anterior wall infarction, cardiogenic shock, cardiac arrest, severely reduced left ventricular systolic function (ejection fraction $<30\%$) were detectable. The time delays from symptom onset to hospital admission, and between hospital admission and start of catheterization were not significantly different in the two groups.

Cardiac Catheterization

Distribution of infarct-related arteries was not different in both groups (left main 3% versus 2%, left anterior descending 42% versus 43%, circumflex 11% versus 11%, right coronary 44% versus 45%, bypass graft 2% versus 1%). However, in the older group, multivessel disease was significantly more prevalent (60% versus 38%, $p < 0.001$).

Management of patients is summarized in Figure 1. PCI success rate in the old patients was almost identical to younger patients (84% versus 86%, $p = 0.63$), as was the rate of stent implantation (89% versus 90%, $p = 0.71$; Table 1). Drug eluting stents became available only in 2002, and only 16 were implanted in both groups combined. A conservative management was chosen more often in old than in younger patients (12% versus 5%, $p < 0.01$). The most frequent reason for conservative management was diffuse severe coronary three-vessel disease, with small vessel diameters deemed

TABLE 1: Hospital admission and procedural characteristics of 504 patients with STEMI

Characteristics (percentages in parentheses)	Age <75 y n = 389	Age ≥75 y n = 115	p-value
Baseline data			
Age (y)	58±11	80 ± 4	
Female	81 (21%)	63 (55%)	<0.001
Hypertension	254 (65%)	90 (78%)	0.030
Diabetes	106 (27%)	48 (42%)	0.004
Smoking	244 (63%)	35 (30%)	<0.001
Creatinine clearance ≤60 ^a	85 (22%)	55 (48%)	<0.001
Prior myocardial infarction and/or PCI	60 (15%)	29 (25%)	0.002
Prior stroke	28 (7%)	19 (17%)	0.005
Clinical status at admission			
Prehospital cardiac arrest/cardiogenic shock	46 (12%)	15 (13%)	0.75
Anterior infarction	159 (41%)	46 (40%)	0.91
Ejection fraction <30%	36 (9%)	15 (13%)	0.28
Time intervals			
Symptom — door (min)	250 ± 267	236 ± 238	0.62
Door — angiography (min)	59 ± 48	64 ± 48	0.35
Procedural data			
PCI attempted	360 (93%)	97 (84%)	0.01
- successful (%)	308 (86%)	81 (84%)	0.63
- stent implantation	323 (90%)	86 (89%)	0.71
Conservative treatment	20 (5%)	14 (12%)	0.02
Emergency CABG	9 (2%)	4 (3%)	0.48
Use of GPIIb/IIIa-antagonists	295 (76%)	87 (76%)	0.90
^a mLmin/1.73m ² (MDRD-formula).			
Abbreviations: CABG = coronary artery bypass grafting, PCI = percutaneous coronary intervention.			

unsuitable for intervention. A total of 3.5% of old patients and 2.3% of younger patients ($p = 0.48$) underwent emergency bypass operation. Access bleeding complications were slightly more frequent in old patients (5/115 or 4.3% versus 12/389 or 3.1%, $p = 0.56$) and were significantly less frequent in both age groups if radial access was used (Table 2).

The small number of patients who underwent emergency bypass surgery ($n = 13$) had a high 30-d mortality (3/13), which, most likely, was due to selection of a high-risk group. The reasons for choosing emergency bypass operation were presence of left main disease in 7/13 or severe three-vessel disease with at least one occluded main vessel in 6/13. In the

following, we report outcomes both including and excluding these patients.

30-D Outcomes

Mean duration of hospital stay was 13 ± 9 d (median 12) in old patients and 12 ± 7 d (median 11) in younger patients ($p = 0.21$). The overall 30-d mortality was 13% versus 6.4% ($p = 0.03$; Table 3). Excluding patients undergoing emergency bypass surgery, the rates were 12.6% versus 6% ($p = 0.04$). In patients who had successful PCI, the 30-d mortality was markedly lower and not significantly different between the two groups (7.4% versus 3.9%, $p = 0.23$). However, if after angiography a conservative management

Figure 1: Flow diagram of entire patient cohort up to one year after STEMI. CABG (coronary artery bypass grafting), †30-d mortality.

was chosen, or if primary PCI was unsuccessful, mortality was drastically higher: 26.7% ($p = 0.02$ versus successful PCI) in old patients and 15.3% ($p = 0.001$ versus successful PCI) in the younger group (Figure 2(a)). Reinfarction and stroke rates during the first 30 d did not differ significantly between younger and old patients (Table 3). On multivariate analysis, the following significant predictors of 30-d mortality emerged (Figure 3): previous cardiac arrest or cardiogenic shock on arrival at the hospital, ejection fraction $<30\%$, not performed or unsuccessful PCI, renal insufficiency, diabetes, anterior infarction, and age.

In the old group, medication 30 d after STEMI included antiplatelet agents in 95%, beta blockers in 85%, and ACE inhibitors or angiotensin blockers in 84%. These numbers were not significantly lower than in the younger group. Statins, however, were taken significantly less frequently in the old group (67% versus 87%, $p < 0.001$).

1-Y Outcomes

One-year follow-up was complete in 499 (99%) of all patients. Five patients were lost to follow-up, all of them <75 y of age. One-year cumulative mortality was 24.3% versus

TABLE 2: Femoral versus radial arterial access: bleeding complications

Access site	Age <75 y n = 389		Age ≥ 75 y n = 115	
	Femoral 210 (54%)	Radial 179 (46%)	Femoral 76 (66%)	Radial 39 (34%)
Severe bleeding ^a	1 (0.5%)	1 (0.6%)	1 (1.3%)	0
Moderate bleeding ^b	8 (3.8%)	2 (1.1%)	4 (5.3%)	0
Total need for transfusion	9 (4.3%)	3 (1.7%)	5 (6.6%)	0

$p = 0.04$ (total femoral vs. radial access bleedings)

^a Blood transfusion needed, and hemodynamic instability.

^b Blood transfusion needed.

Figure 2: (A) 30-d mortality of patients grouped by age and PCI success (unsuccessful PCI includes patients in whom no PCI was performed). (B) Overall 1-y mortality of the different management strategies (PCI, conservative management, or bypass operation, CABG) after coronary angiography, separated by age group. The horizontal lines depict the 1-y mortality in the entire age group.* Five patients were lost to follow-up.

9.9% ($p < 0.001$; Table 3 and Figure 2(b)). Excluding patients undergoing bypass surgery, 1-y mortality was 23.4% versus 9.6% ($p < 0.001$). For patients with successful PCI, 1-y mortality was 17.3% versus 6.9% ($p = 0.01$). On multivariate analysis of predictors of 1-y mortality in 30-d survivors,

multivessel disease and age were independent predictors (Figure 4).

Discussion

This analysis reports the results of a contemporary interventional STEMI treatment strategy in “all comers” at a single center. Patients >75 y of age had a higher overall 30-d mortality than younger patients (13% versus 6.4%, $p = 0.03$), but after successful PCI 30-d mortality was quite low in both groups (7.4% versus 3.9%, $p = 0.23$). Several factors contribute to the higher overall 30-d mortality in the older patients, which was almost entirely of cardiac etiology (Table 3):

1. Although the overall success rate when PCI was attempted was similar in old and younger patients (84% versus 86%), in old patients conservative management was chosen more frequently than in the younger group (12% versus 5%; $p = 0.02$).
2. Diabetes and renal insufficiency were strong predictors of 30-d mortality, which were more frequently present in old patients.
3. Different from most controlled trials, patients in cardiogenic shock or after prehospital cardiac arrest were included in the analysis. In such patients >75 y of age, the threshold of performing PCI may have been higher.

However, if patients survived the first 30 d, PCI success was not anymore a predictor of prognosis. In these patients, prognosis was determined significantly by age and presence of multivessel disease (Figure 3).

Bleeding complications (Table 2) were relatively low in our patients and not significantly higher in old patients. The radial access was advantageous compared to the femoral route with regard to bleeding in both age groups.

TABLE 3: Overall 30-d and 1-y outcomes after STEMI

Outcomes	30-d follow-up			1-y follow-up		
	<75 y, n = 389	≥ 75 y, n = 115	p-value	<75 y, n = 384 ^a	≥ 75 y, n = 115	p-value
mortality (%)	6.4	13.0	0.03	9.9	24.3	<0.001
-cardiac death	5.9	12.2	0.04	8.6	18.3	0.006
-noncardiac death	0.5	0.9	0.54	1.3	6.1	0.009
reinfarction (%)	4.1	5.3	1.00	5.5	9.6	0.14
stroke (%)	0.8	0.9	1.00	1.6	5.2	0.04

^a1-y follow-up not completed in 5 patients.

Figure 3: Predictors of 30-d mortality in all patients except those undergoing CABG (n = 492). ORs for 30-d mortality on the x-axis.

Figure 4: Predictors of 1-y mortality among all 30-d survivors except those undergoing CABG (n = 454). ORs for 1-y mortality on the x-axis.

Previous Findings

Concordant with the findings of the present study, Sakai et al.⁷ found that elderly STEMI patients after successful primary PCI did not have a significantly higher cardiac in-hospital mortality than younger patients (4.1% versus 2.4%, $p = \text{ns}$). This large study recruited patients 1994–1998 and used stenting only in 41% of PCI. Only one previous study analyzed the risk factors for death at 1 y among 30-d survivors of STEMI after interventional therapy. Mehta et al.⁸ analyzed 3,280 patients with STEMI from the STENT-PAMI and CADILLAC trials^{9,10} who were treated by primary PCI and survived more than 30 d after STEMI. Similar to our results, age and presence of multivessel disease were independent predictors of 1-y mortality. Age >70 y of age predicted a 1-y mortality with an OR of 3.3. This is comparable with our findings of an OR of 1.039/y for 1-y mortality (Figure 3), which for the group of patients >75 y of age results in an OR of 2.8 (CI: 1.1;6.9).

A German multi-center registry in the nineties¹¹ reported less frequent reperfusion therapy (mostly fibrinolysis), longer prehospital delay to reperfusion therapy, and very high in-hospital mortality rates in old patients with STEMI (26.4% for all >75-y-old patients). Nevertheless, relative benefits from reperfusion therapy increased with age. The present study shows that contemporary mortality at a referral center for PCI is dramatically lower (13% 30-d mortality).

Recently, newer data from a multicenter German registry compared results of primary PCI, fibrinolysis, or conservative management in 2,045 STEMI patients >75 y of age from 154 cardiology departments during the years 2000–2002.¹² In-hospital mortality of the whole group was 19.9% and was clearly lower in the subgroup undergoing primary PCI than in the subgroup treated with fibrinolysis (10.2% versus 25.4%). Data on failed PCI, emergency bypass surgery, or conservative treatment after angiography were not detailed in these registries, which encompassed a wide array of hospitals and treatment strategies, and therefore, are difficult to compare with our single center experience.

Differing from our findings, an analysis of the PAMI data base¹³ found significantly more bleeding complications in elderly versus younger patients using the Judkins technique (18% versus 7%). This difference is probably due to the high proportion of patients in our study treated via the radial arterial access, carrying significantly less bleeding complications (Table 2).

Limitations

This analysis is retrospective and presents the results from a single tertiary referral center. However, unlike studies derived from randomized trials,^{8–10} we analyzed all consecutive STEMI patients in whom acute coronary

angiography was performed at our institution, including patients in cardiogenic shock or after cardiac arrest, and unlike many registries^{7,14} we included and followed all patients whether they were treated after angiography by PCI, by emergency bypass surgery, or conservatively. Thus, our analysis reflects current “real-life” characteristics and results of an interventional STEMI treatment strategy with minimal selection bias.

Conclusion

Modern interventional STEMI therapy with aggressive concomitant antiaggregatory drug treatment benefits patients, including those 75 y of age or older, who increasingly present to the emergency rooms. After successful primary PCI, 30-d mortality rates did not differ significantly between younger and elderly patients. In contrast, failed or unattempted revascularization portends a grave prognosis in both age groups. Radial artery access diminishes bleeding complications, particularly in the elderly. In 30-d survivors of STEMI, age and presence of multivessel disease are independent predictors of 1-y mortality.

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