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Age-dependent care and long-term (20 year) mortality of 14,434 myocardial infarction patients: Changes from 1985 to 2008

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ABSTRACT

Objectives: To determine whether age-dependent inequalities in care and outcome changed over a 24 year period for patients admitted with a myocardial infarction (MI).

Methods: We examined four age groups (<55, 55–65, 65–75, and >75 years) and treatment and mortality in 14,434 consecutive patients admitted for MI to an intensive coronary care unit from 1985 to 2008. Temporal trend analyses were performed by comparing decades of admission (1985–1990 vs. 1990–2000 vs. 2000–2008).

Results: A total of 2040 (14%) of the patients were >75 years of age. Older patients more often were female and less often presented with an ST-segment elevation MI (STEMI). Systematic differences in care were present between the age groups: older patients were less likely to receive evidence-based medical care and reperfusion therapy during the last 24 years, although the differences became smaller over time. In 2000–2008, 30-day (adjusted OR 0.28, 95%CI: 0.23–0.34) and 5-year (adjusted HR 0.61, 95%CI: 0.54–0.68) mortality were lower compared to 1985–1990. These temporal trends were equal across all age groups. Hence, the change in mortality over the 24-year study period is similar among the spectrum of ages. Patients aged <55, 55–65, 65–75, and >75 years had a 20-year mortality of 38, 63, 87 and >95%, respectively.

Conclusions: Older patients with an MI remained less likely to receive evidence-based care during 24 years of observation. Temporal reductions in mortality were similar among all age groups. The application of proven MI therapies to appropriate patients regardless of age may even further improve these outcomes.

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1. Introduction

Due to aging of the general population in the Western world, more elderly patients present to hospital with a myocardial infarction (MI) [1]. Previous studies have suggested that elderly patients with an MI are less likely to receive evidence-based therapies and have a worse survival after hospitalization compared to younger patients [2–4]. Recent data has underlined the need for increased use of evidence-based management among the elderly and has shown potential for a reduction in mortality in this age group [3,5].

Within the past 25 years, substantial improvements in the treatment and outcome of MI have been made with, for example the implementation of thrombolytic therapy in the 1990s, primary percutaneous coronary intervention (PCI) in the beginning of the new century and tailored treatment according to individual risk [6–10]. A long-term analysis of patients admitted to hospital with an MI might identify changes in the use of treatment modalities, and early and late outcomes for the whole spectrum of ages. Therefore, the aims of this study were threefold. First, to determine whether, in accordance with the guideline recommendations [11,12], age-dependent inequalities in care changed over a 24-year period. Second, to compare temporal trends in mortality according to age for patients admitted with an MI. And third, to quantify the effect of age on 30-day and long-term mortality.

2. Methods

We included all consecutive patients aged >18 years admitted for ST-segment elevation myocardial infarction (STEMI) or non-ST-elevation myocardial infarction (NSTEMI) to the Intensive Coronary Care Unit (ICCU) of the Thoraxcenter, Erasmus University Medical Center between June 1985 and December 2008.

The primary discharge diagnosis of MI was made in the presence of the following characteristics: chest pain or equivalent symptoms in combination with dynamic ECG changes consistent with MI and a typical serial rise (to at least three times the upper normal value) and fall in serum biochemical markers of cardiac necrosis such as creatine kinase-MB or troponin-T (as of 2002). Patients were diagnosed as STEMI in the presence of ST-segment elevation >0.1 mV in at least two peripheral leads, or >0.2 mV in at least two contiguous precordial leads, and as NSTEMI otherwise. For patients admitted more than once, only the first hospitalization was taken into account.

2.1. Data collection

Trained physicians and nurses accustomed to the use of standardized case report forms collected the data. Demographic characteristics (age, gender), cardiac history (previous MI, PCI or coronary artery bypass surgery [CABG]), risk factors (hypertension, diabetes, family history, smoking status), anemia (hemoglobin level<13.0 g/dl

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men, <12.0 g/dl women), renal dysfunction (creatinine > 150 μmol/l), and pharmacological and invasive treatment modalities (thrombolysis and PCI) were collected. The decision to use or not use specific pharmacological and invasive treatment modalities was made according to the level of evidence and recommendations in the guidelines available at that time.

2.2. Follow-up and endpoints

The primary endpoint was all cause mortality at 30 days and at 20 years. In-hospital mortality was retrieved from the medical records. Long-term survival status was assessed through municipal Civil Registries in 2010 and was available for 99% of all patients.

2.3. Statistical analysis

The study patients were categorized into four groups of patients according to age: those aged <55, 55–65, 65–75, and >75 years. Categorical variables were summarized as percentages and chi-square test for trend was used to calculate p-values. Patients were stratified in three groups according to decade of hospitalization: 1985–1990; 1990–2000; 2000–2008. We assessed temporal trends in outcome by comparing these three periods. Cumulative survival curves were constructed using the Kaplan–Meier method for patients aged >75 years. The log-rank test was used to compare survival curves. We examined the independent association between decade of hospitalization and mortality, for the whole study population and for the elderly, respectively, using logistic regression for 30-day outcome and the Cox proportional hazards model for long-term outcome. Since complete long-term (20-year) follow-up of patients admitted after 1991 is unavailable, we used 5-year outcomes for comparing the influence of decades of hospitalization on outcome. Adjustment was performed for gender, previous MI, previous CABG, hypertension, diabetes, hyperlipidemia, family history, smoking status, renal dysfunction, anemia and discharge diagnosis. In addition, we examined the independent association between age and mortality using the analyses described above.

Results are reported as odds ratios (OR) – for 30-day mortality – and hazard ratios (HR) – for long-term mortality – and their respective 95% confidence intervals. All statistical tests were 2-tailed, and p-values were considered significant at <0.05. Analysis was performed using SPSS software version 17.0 (SPSS, Chicago, USA).

3. Results

We included 14,434 patients, of whom 2040 (14%) were >75 years of age. The distribution of age categories is shown in Table 1. A total of 106,517 person-years were analyzed.

3.1. Patient characteristics

Patient characteristics are shown in Table 1. Older patients were more often female; more often had a history of CABG, anemia and renal impairment. Older patients were less often current smokers, less often had hypercholesterolemia, a family history of previous MI, or a discharge diagnosis of STEMI. For each decade of age, the odds of presenting with a STEMI decreased by 15% (odds ratio, OR 0.85, 95%CI: 0.83–0.88).

3.2. Medical and invasive care during the study period

Age-dependent inequalities in care were present in 1985 and persisted during the 24-year study period. While use of reperfusion therapy (either by thrombolytic therapy or PCI) increased over time in all groups with STEMI (p<0.001), older patients were less likely to receive reperfusion therapy (p<0.001), although the differences appeared to become smaller during the study period (Fig. 1A). Prescription of evidence-based medical care (class 1A), including aspirin, B-blockers, and statins was and remained lower in the elderly during the whole study period (p<0.001 for all). The prescription of ACE-inhibitors/angiotensin-receptor blockers was lower for older patients in the 1990s, but not thereafter (Fig. 1B). Prescription of other medical therapy with a lower level of evidence for the treatment of MI, including calcium-antagonists, nitrates and diuretics at ICCU discharge was higher in the elderly (Table 1).

Table 1
Baseline characteristics and clinical presentation of patients hospitalized for MI according to age on admission.

	Age on admission				P for trend
	<55	55–65	65–75	>75	
No. of patients	4319 (30%)	4113 (29%)	3962 (27%)	2040 (14%)	
Baseline					
Gender (female)	20%	23%	32%	45%	<0.001
Cardiac history					
Previous MI	30%	34%	36%	34%	<0.001
Previous PCI	14%	15%	15%	15%	0.37
Previous CABG	7%	10%	12%	10%	<0.001
Risk factors					
Hypertension	29%	37%	39%	39%	<0.001
Diabetes	11%	14%	16%	17%	<0.001
Hyperlipidemia	29%	30%	26%	21%	<0.001
Family history	35%	29%	21%	14%	<0.001
Current smoker	51%	35%	21%	11%	<0.001
Renal dysfunction	5%	7%	12%	14%	<0.001
Anemia	30%	39%	50%	58%	<0.001
Discharge diagnosis					
STEMI	54%	47%	41%	45%	<0.001
Medication at ICCU discharge					
Ca-antagonist	19%	24%	27%	21%	<0.001
Diuretics	8%	11%	16%	20%	<0.001
Nitrates	11%	13%	14%	16%	<0.001
Antiarrhythmics	4%	4%	4%	4%	0.20

ICCU, intensive coronary care unit.

3.3. Temporal trends in mortality

In the total study population, the risk of 30-day mortality decreased between 1985 and 2008 from 11% in 1985–90 to 4% in 2000–08. This decrease was more pronounced for patients aged >75 years, from 27% in 1985–90 to 9% in 2000–08 (Fig. 2A). Also, for the study population as a whole, 5-year mortality decreased between 1985 and 2008, from 24% in 1985–90 to 17% in 2000–08, and for patients aged >75 years from 55% in 1985–90 vs. 40% in 2000–08 (Fig. 2B).

From 1985 to 2008, the adjusted risk of 30-day mortality decreased by nearly 75%, in both the overall study population (adjusted OR 0.28, 95%CI: 0.23–0.34) as well as in the elderly (adjusted OR 0.29, 95%CI: 0.18–0.45; Table 2). The risk of 5-year mortality decreased by nearly 40% in both the overall study population (adjusted hazard ratio, HR 0.61, 95%CI: 0.54–0.68) and in the elderly (adjusted HR 0.63, 95%CI: 0.49–0.80; Table 2). Hence, the relative risk reduction in 30-day and long-term mortality over the 24-year study period was similar among the spectrum of ages.

3.4. Age and mortality

As expected, the risk of mortality was higher in older MI patients at 30 days follow-up (13% for patients >75 years vs. 3% for those <55 years, p<0.001) and during long-term follow-up (Fig. 3: after 16 years, 95% for patients >75 years vs. 29% for those <55 years, p<0.001). The (adjusted) mortality rates for 30-day and 20-year outcomes are presented in Table 3. There were no significant interactions between the baseline characteristics and age and mortality. One in seven of the patients were >75, but one third of the deaths within 30 days occurred in this group.

4. Discussion

In this study conducted in a cohort of 14,434 MI patients, we showed that systematic differences in care were present between patients from different age groups: older patients were less likely to

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