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Thirty Year Trends in Patient Characteristics, Treatment Practices, and Long-Term Outcomes of Adults Aged 35 to 54 Years Hospitalized With Acute Myocardial Infarction

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Abstract

Much of our knowledge about the characteristics, clinical management, and post-discharge outcomes of acute myocardial infarction (AMI) is derived from clinical studies in middle-aged and older individuals with little contemporary information available about the descriptive epidemiology of AMI in relatively young men and women. The objectives of our population-based study were to describe more than 3 decade long trends in the clinical features, treatment practices, and long-term outcomes of young adults aged 35 to 54 years old discharged from the hospital after AMI. The study population consisted of 2,142 residents of the Worcester (MA) metropolitan area who were hospitalized with AMI at all central Massachusetts medical centers during 16 annual periods between 1975 and 2007. Our primarily male study population had an average age of 47 years. Patients hospitalized during the most recent decade (1997–2007) under study were more likely to have a history of hypertension and heart failure than those hospitalized during earlier study years. Patients were less likely to have developed heart failure or stroke during their hospitalization in the most recent as compared with the initial decade under study (13.7% and 0.7%; and 20.9% and 2.0%, respectively). One and two-year post-discharge death rates also declined significantly between 1975–1986 (6.2% and 9.0%, respectively) and 1988–1995 (2.6% and 4.9%). These trends were concomitant with the increasing use of effective cardiac therapies and coronary interventions during hospitalization. The present results provide insights into the changing characteristics, management, and improving long-term survival of relatively young individuals hospitalized with AMI.

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All authors had access to the data and had a role in writing this manuscript.

Keywords

Acute myocardial infarction; young patients; Worcester Heart Attack Study

Introduction

The objectives of our multi-hospital observational study in residents of central Massachusetts were to describe multi-decade long trends (1975 to 2007) in patient characteristics, treatment practices, and long-term outcomes in adults aged 35–54 years discharged from the hospital after acute myocardial infarction (AMI) at all medical centers in central MA. Data from the Worcester Heart Attack Study were used for purposes of analysis (1–5).

Methods

The study population consisted of greater Worcester residents aged 35 to 54 years who were hospitalized with a discharge diagnosis of AMI at all medical centers in the Worcester (MA) metropolitan area during 16 annual study periods between 1975 and 2007 (1–5). Sixteen hospitals were originally included in this investigation but fewer hospitals (n= 11) have been included during recent years due to hospital closures or conversion to long-term care or rehabilitation facilities. We restricted the present sample to adults 35 to 54 years of age who were hospitalized with an independently validated AMI because we were interested in describing the clinical epidemiology of AMI in a comparatively young patient population.

The details of this study have been extensively described (1–5). In brief, potentially eligible patients were identified through a review of computerized hospital databases of patients with discharge diagnoses consistent with possible AMI. The medical records of residents of the Worcester metropolitan area (2000 census=478,000) were reviewed in a standardized manner and the diagnosis of AMI was confirmed according to pre-established criteria (1–5).

Trained study clinicians abstracted information from hospital medical records with regards to patient's demographic characteristics, presenting symptoms, medical history, clinical and laboratory findings, receipt of cardiac treatments and revascularization procedures, length of hospital stay, duration of pre-hospital delay in seeking acute medical care, and post-discharge survival status (1–5). The development of heart failure, cardiogenic shock, atrial fibrillation, and stroke during the patient's index hospitalization was ascertained through the review of information contained in hospital charts and defined according to pre-established criteria (6–9). The approaches used to ascertain survival status after hospital discharge included a review of records for additional hospitalizations and a statewide and national search of death certificates for residents of the Worcester metropolitan area; follow-up was continued through 2009.

Chi-square tests for categorical variables, and analysis of variance for continuous variables, were used to examine potentially changing trends in various patient demographic and clinical factors. Long-term survival after hospital discharge was examined by calculating all-cause case-fatality rates; trends in post-discharge survival were examined through the use of chi-square tests for trends. Logistic regression modeling was used to assess trends in long-term post-discharge death rates while controlling for several potentially confounding demographic, medical history, and clinical characteristics of prognostic importance. Given the non-randomized observational nature of this investigation, the use of various hospital cardiac treatment approaches was not controlled for in our regression models examining the long-term prognosis of discharged patients. For ease of analysis and interpretation, we

aggregated the individual study years into selected approximate decade long groupings (1975–1986, earliest; 1988–1995, middle; 1997–2007, most recent) for purposes of examining changing trends in our principal study outcomes. The Committee for the Protection of Human Subjects in Research at the University of Massachusetts Medical School approved this study.

Results

A total of 2,142 greater Worcester adults aged 35–54 years were hospitalized with confirmed AMI during the years under study (Table 1). These patients represented 6.3% of all patients hospitalized with AMI during the years under study. These patients were primarily men (80%), were, on average, 47 years old, were typically experiencing their first AMI (80%), and presented with a relatively low frequency of other medical conditions with the exception of previously diagnosed hypertension (43%) and diabetes (17%). More than half of these young patients (52.4%) were classified as smokers based on information collected during the most recent decade under study.

The percentage of patients reporting previously diagnosed angina decreased from the earliest to the most recent study period, whereas the proportion of patients with a history of hypertension, diabetes, and heart failure increased over time. More than one half of our population presented with an ST-segment elevation AMI during the most recent study period (Table 1). There were no significant changes in duration of pre-hospital delay following the onset of acute coronary symptoms over time with a median pre-hospital delay of 1.8 hours observed during the most recent decade under study. There was a significant decline in the median hospital stay from approximately 13 days during 1975–1986 to 3 days during 1997–2007.

Overall, relatively few young patients developed important clinical complications during their index hospitalization with the exception of heart failure (17.2%) (Table 2). There was a slight increase in the proportion of patients who developed cardiogenic shock from the earliest to the most recent decade under study (1.9% to 2.9%). The percentage of patients experiencing heart failure or stroke decreased markedly during the years under study (Table 2).

There was a marked and steady increase in the use of effective medical therapies over time (Figure 1). In the earliest period, 11% of hospitalized patients were prescribed aspirin and less than 1% were prescribed a lipid lowering agent. These percentages increased steadily over time, reaching 89% and 66%, respectively, during the 1997–2007 period. Similarly, there were significant increases in the use of combinations of effective cardiac medications (e.g., aspirin, beta blockers, angiotensin-converting enzyme inhibitors, lipid-lowering agents) during the patient's index hospitalization. Between 1975–1986, approximately 30% of patients received any 1 or 2 of the 4 effective cardiac medications examined, and few received 3 or more. In the most recent decade under study, nearly 80% of relatively young patients were prescribed 3 or more effective cardiac medications during their acute hospitalization (Figure 2). There were also marked increases over time in the proportion of patients undergoing cardiac catheterization and PCI during their acute hospitalization (Figure 3).

All cause post-discharge death rates decreased in our population over time. Overall, 3-month, 1 year, and 2-year death rates were 2.9%, 4.3%, and 5.4%, respectively. The 3-month, 1 year, and 2-year death rates declined significantly between 1975–1986 (2.5%; 6.2%; and 9.0%) and 1988–1995 (0.8%; 2.6%; and 4.9%).

To more systematically examine trends in post hospital discharge death rates, we carried out a series of multivariable adjusted regression analyses controlling for several potentially confounding demographic, medical history, and clinical factors of prognostic importance (Table 3). The results of these analyses were consistent with our univariate findings, showing marked decreases in 3-month, 1 year, and 2 year post-discharge death rates during the years under study. The risk of dying at 1 and 2 years after being discharged from the hospital, after adjusting for several potentially confounding prognostic factors, decreased considerably between 1975–1986 and 1988–1995. These trends, however, were no longer statistically significant during the most recent 10 year period under study.

Discussion

The results of this population-based observational study in adults aged 35–54 years hospitalized with independently validated AMI in a large central New England metropolitan area suggest that there was a significant decline in the proportion of patients dying after hospital discharge between the earliest and middle periods under study. In addition, the hospital use of effective cardiac medications and interventional procedures has increased markedly during the more than three decade long period under study, concomitant with encouraging declines in post discharge death rates.

Previous studies have shown that comparatively young patients hospitalized with AMI tend to be predominantly men, with high cholesterol and serum glucose levels, and a high prevalence of hypertension (1,10). Being a current smoker was a highly prevalent risk factor in our young hospitalized cohort, as more than one half of patients during the most recent period under study were current smokers. In the Valsartan in AMI trial, 3 out of 4 young AMI patients were current smokers as compared with only 1 out of 6 older patients (11).

We observed a steady increase in the prevalence of previously diagnosed hypertension, diabetes, and heart failure in our study population from the earliest to the most recent study years. These results differ somewhat from those reported in the previous literature where the prevalence of hypertension has been shown to be relatively low in young patients (10,12). On the other hand, data from a Swedish national hospital registry reported a marked increase in the proportion of patients aged <45 years presenting with heart failure and a more modest increase in those presenting with hypertension at the time of hospitalization for heart failure between 1987 and 2006 (13).

Nearly half as many young patients developed heart failure during their index hospitalization in comparing the most recent to the earliest decade long period under study. In the multinational Global Registry of Acute Coronary Events (GRACE) study, a sample of patients less than 55 years who were hospitalized with AMI were followed between 1999 and 2006 (14). In these patients, the incidence rates of heart failure declined considerably during the 7-year period under study (8% to 3%) (14).

We observed a marked increase in the use of effective cardiac medications and coronary intervention procedures between 1975 and 2007. In other community-based investigations, the use of evidence-based cardiac medications and coronary interventional procedures has increased markedly over time and this increase has been associated with reduced morbidity and mortality after AMI (15,16). In young patients <55 years old hospitalized with AMI in the GRACE study, there was a marked and steady increase in the use of effective cardiac therapies and coronary revascularization procedures between 1999 and 2007 (14).

Our results demonstrating marked increases in the use of PCI, and corresponding declines in CABG surgery during hospitalization for AMI are in agreement with the findings of several prior studies including the Acute Care Tracker database and the Nationwide Inpatient

Sample (16,17). Our findings confirm expected increases in the use of effective cardiac interventions that have become the standard of care for patients hospitalized with AMI over the past several decades.

Our results suggest a slight decline in all-cause post-discharge death rates in our population over the multi-decade long period under study. There have been few published studies that have characterized trends in long-term prognosis after AMI in a relatively young adult population (10,12,18–20). In a cohort study using data from the medical registries from all hospitals in Denmark, more than 200,000 patients with a first AMI were followed from 1984 through 2008 (20). Standardized 30-day and 1-year death rates were low and decreased significantly over the 25-year long follow-up for those aged 35–49 years.

Although the reasons for the presently observed decline in post discharge death rates in our patient population are unknown, increases in the use of effective in-hospital treatments that have become the standard of care for patients hospitalized with AMI likely were one of the major reasons for the present findings. Another potential explanation is the more effective and rapid diagnosis of smaller infarctions since the introduction of troponin assays during the most recent years under study (1).

Our study has several strengths including our population-based design and inclusion of only validated cases of AMI. On the other hand, since this central New England community is predominately white, the generalizability of our findings to other race/ethnicities may be limited. We did not collect information on patient's socioeconomic status, cognition, or other factors that have been shown to affect long-term prognosis after AMI. Additionally, we did not collect information on patient's adherence to any prescribed treatments or lifestyle practice changes after being discharged from the hospital.

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Figure 1.
Receipt of cardiac medications during hospitalization for acute myocardial infarction by time

Figure 2. Receipt of 0, 1, 2, 3 or more medications during hospitalization for acute myocardial infarction by time

Figure 3.
Receipt of cardiac interventions during hospitalization for acute myocardial infarction by time

Table 1

Study Population Characteristics

Variable	Total Population (n=2,142)	Study Period		
		1975–1986 (n=642)	1988–1995 (n=607)	1997–2007 (n=893)
Age (years), mean $\pm$ SD	47.4 $\pm$ 5.0	47.7 $\pm$ 5.0	46.8 $\pm$ 5.0	47.6 $\pm$ 4.8
Men	80.4%	82.1%	80.2%	79.4%
Angina Pectoris	15.5%	20.9%	16.6%	10.8%
Hypertension	42.9%	39.4%	39.4%	47.8%
Stroke	2.4%	2.0%	1.3%	1.4%
Heart Failure	3.9%	2.7%	3.0%	5.4%
Diabetes Mellitus	17.4%	15.0%	15.2%	20.7%
Admission Serum Glucose (mean $\pm$ SD) (mg/dl)	157.3 $\pm$ 75.9	N/A	156.3 $\pm$ 7.6	157.4 $\pm$ 76.1
Total Cholesterol (mean $\pm$ SD) (mg/dl)	213.6 $\pm$ 49.8	237.1 $\pm$ 46.9	220.8 $\pm$ 44.6	193.0 $\pm$ 46.7
Length of Stay (median $\pm$ SD) (days)	6.0 $\pm$ 7.6	13.0 $\pm$ 7.6	7.0 $\pm$ 6.5	3.0 $\pm$ 5.2
STEMI	N/A	N/A	N/A	55.0%
Initial AMI	79.5%	79.3%	80.2%	79.1%

STEMI = ST-elevation myocardial infarction; AMI = acute myocardial infarction

Table 2

Development of Hospital Clinical Complications Overall and by Study Period

Complication	Total Population	1975–1986	1988–1995	1997–2007	P Values
Atrial Fibrillation	5.0%	4.7%	6.3%	4.4%	N.S.
Heart Failure	17.2%	20.9%	18.5%	13.7%	<0.01
Stroke	0.5%	2.0%	0%	0.7%	<0.01
Cardiogenic shock	2.7%	1.9%	0.9%	2.9%	N.S.

N.S. = not statistically significant

Table 3

Odds of dying after hospital discharge in younger patients hospitalized with acute myocardial infarction

Study Period	Unadjusted ORs			Multivariable Adjusted ORs*		
	3-months	1-year	2-years	3-months	1-year	2-years
1975–1986	--	--	--	--	--	--
1988–1995	0.33 (0.12;0.89)	0.41 (0.23;0.73)	0.51 (0.33;0.81)	0.24 (0.08;0.71)	0.38 (0.20;0.73)	0.50 (0.30;0.83)
1997–2007	0.80 (0.41;1.59)	0.63 (0.40;1.00)	0.66 (0.45;0.97)	0.72 (0.32;1.61)	0.71 (0.41;1.23)	0.69 (0.43;1.10)

* Adjusted for age, sex, medical history, hospital length of stay, and hospital clinical complications.

OR = odds ratios