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Decade Long Trends in the Magnitude, Treatment, and Outcomes of Patients Aged 30 to 54 Years of Age Hospitalized with ST Segment and Non-ST Segment Elevation Myocardial Infarction

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Abstract

Although acute myocardial infarction (AMI) occurs primarily in the elderly, this disease also affects young adults. Few studies have, however, presented data on relatively young patients hospitalized with AMI. The objectives of this population-based study were to examine recent trends in the magnitude, clinical characteristics, management, and in-hospital and long-term outcomes associated with ST-segment elevation acute myocardial infarction (STEMI) and non-ST-segment elevation acute myocardial infarction (NSTEMI) in patients 30–54 years old. We reviewed the medical records of 955 residents of the Worcester (MA) metropolitan area between the ages of 30 and 54 years who were hospitalized for an initial STEMI or NSTEMI in 6 annual periods between 1999 and 2009 at 11 greater Worcester medical centers. Between 1999 and 2009, the proportion of young adults hospitalized with an STEMI decreased from approximately two-thirds to two-fifths of all patients with an initial AMI. Patients with STEMI were less likely to have a history of heart failure, hypertension, hyperlipidemia, and kidney disease than NSTEMI patients. Both groups received similar effective medical therapies during their acute hospitalization. In-hospital clinical complications and mortality were low and no significant differences in these endpoints were observed between STEMI and NSTEMI patients or with regards to 1 year post-discharge death rates (1.9% vs. 2.8%). The present results demonstrate

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recent decreases in the proportion of relatively young patients diagnosed with an initial STEMI. Patients with STEMI and NSTEMI had similar in-hospital outcomes and long-term survival. Trends in these and other important outcomes warrant continued monitoring.

Keywords

STEMI and NSTEMI; Young patients

Introduction

Using data from the population-based Worcester Heart Attack Study,[1–4] we examined overall differences, and decade long trends, in the clinical characteristics, management, and in-hospital and long-term-outcomes associated with ST segment elevation myocardial infarction (STEMI) and non-ST segment elevation myocardial infarction (NSTEMI) in young adults between the ages of 30 and 54 years who were hospitalized with a first acute myocardial infarction (AMI) at all greater Worcester (MA) medical centers in 6 biennial periods between 1999 and 2009.

Methods

The Worcester Heart Attack Study (WHAS) is an ongoing population-based clinical/epidemiologic investigation describing long-term trends in the incidence rates, hospital management practices, and death rates of greater Worcester, MA, residents hospitalized with AMI at all 11 metropolitan Worcester medical centers.[1–4] For the present study we limited our sample to adults 30 to 54 years of age who were hospitalized with an independently validated initial AMI during 1999, 2001, 2003, 2005, 2007, and 2009. These years were selected due to funding availability and because we were interested in the surveillance of acute coronary disease in this central MA population on a biennial basis. This study was approved by the Committee for the Protection of Human Subjects at the University of Massachusetts Medical School.

The methods used in this coronary disease surveillance study have been described elsewhere in detail.[1–7] In brief, the medical records of potentially eligible residents of central Massachusetts who were hospitalized with discharge diagnoses consistent with the possible presence of AMI at all central MA medical centers were identified through the review of computerized hospital databases. Based on the independent review of previous and current hospital medical records by trained nurse and physician abstractors, patients with a prior history of AMI were excluded from the present population since we were interested in descriptive the descriptive epidemiology of patients with a first AMI in the present study. Diagnoses of STEMI and NSTEMI were made using standardized criteria.[6,8] Since 2003, in the absence of electrocardiographic abnormalities, a diagnosis of NSTEMI was accepted when elevations in various cardiac biomarker assays, including troponin, were accompanied by typical clinical symptomatology and acute presentation.[6,8]

Trained study physicians and nurses abstracted clinical, demographic, and treatment related data from the medical records of patients with confirmed AMI.[1–7] Receipt of cardiac

medications, cardiac catheterization, percutaneous coronary intervention (PCI), and coronary artery bypass surgery, as well as development of important clinical complications during the patient's index hospitalization, were determined using pre-established criteria.[1–7] Survival status after hospital discharge was determined through a review of hospital records and a search of death certificates for residents of the Worcester metropolitan area. Follow-up was continued through 2011.

Short and long-term outcomes in each period were examined by calculating inhospital, 1 year, and 2 year case-fatality rates; trends in these endpoints were examined through the use of chi-square tests for trend. Logistic regression modeling was used to assess the significance of 1 and 2-year post discharge all-cause death rates in patients with STEMI versus NSTEMI while controlling for several potentially confounding demographic and clinical characteristics of prognostic importance.

Results

A total of 955 residents of the Worcester metropolitan area aged 30 to 54 years were hospitalized with an initial confirmed AMI at all 11 medical centers in central Massachusetts during the 6 years under study. The average age of this population was approximately 47 years and three quarters were men (Table 1). Overall, 52% of all young adults hospitalized for AMI were diagnosed with STEMI during the years under study. The percentage of patients with STEMI declined significantly between 1999 and 2009. In 1999, approximately two-thirds of all initial AMIs in our young adult population were STEMI in nature, whereas by 2009, two-fifths of all first AMIs in young adults had evidence of electrocardiographic ST-segment elevation.

Overall, patients with NSTEMI (n=454) were more likely to be obese and to have a history of heart failure, hypertension, and hyperlipidemia in comparison to patients with STEMI (n=501) (Table 1). Individuals hospitalized for NSTEMI were less likely to have presented to all central MA hospitals with chest pain, left arm pain, and diaphoresis while patients with STEMI tended to seek medical care sooner after the onset of acute coronary symptoms.

In all patients, the proportion of those with a history of angina decreased markedly during the period under study, particularly among STEMI patients (Table 1). Patients with STEMI were also less likely to have presented with diabetes over time. On the other hand, patients with NSTEMI had a marked increase in the prevalence of hypertension and hyperlipidemia during the years under surveillance.

There were no significant differences between our respective comparison groups in the proportion of patients who were prescribed each of the effective cardiac medications examined. Throughout the study period, all patients were increasingly more likely to be prescribed each of the examined evidence-based cardiac medications while admitted to tall central MA hospitals (Figures 1A–B). A greater increase in the hospital use of ACE inhibitors/ARBs was noted among patients with STEMI over time, whereas a greater increase in the use of aspirin and beta-blockers was noted in patients with NSTEMI (Figures 1A–B).

Patients with STEMI were more likely to have undergone cardiac catheterization and a PCI during their index hospitalization in comparison to patients diagnosed with NSTEMI. The proportion of patients undergoing cardiac catheterization increased from 79% to 99% and from 70% to 91%, in patients with STEMI and NSTEMI, respectively, between 1999 and 2009. The proportion of patients receiving a PCI increased from 53% to 92%, and from 39% to 67%, in patients with STEMI and NSTEMI, respectively, during the years under study (Figures 2A–B). When PCI was performed, door-to-balloon time was approximately 3 hours for STEMI patients compared to 22 hours for patients hospitalized with NSTEMI.

There were no significant differences in the proportion of patients who developed several important hospital clinical complications, such as heart failure and atrial fibrillation, or who died during their index hospitalization, in patients with either an initial STEMI or NSTEMI (Table 2). Patients with STEMI were more likely to have developed cardiogenic shock, atrial fibrillation, and heart failure than patients with NSTEMI who were more likely to have developed acute stroke during their index hospitalization at all greater Worcester medical centers (Table 2).

In-hospital case-fatality rates for patients with STEMI remained relatively stable and low between 1999/01 and 2003/05, and increased slightly during the most recent study years. On the other hand, in-hospital death rates declined consistently in patients presenting with NSTEMI (Table 2).

Overall all-cause post-discharge death rates at 1 and 2 years in both patient groups were low. Death rates at 1 and 2 years were 0.6% and 0.7% for patients with STEMI, and 1.2% and 1.3% for those discharged after an NSTEMI, respectively (Table 3). Mortality remained relatively stable and low between 1999 and 2009 for STEMI patients while fluctuating somewhat for patients discharged from all central MA hospitals after an NSTEMI (Table 3). After controlling for several demographic and clinical factors of prognostic importance, the odds of dying at 1 (adjusted OR= 0.39; 95% CI 0.11;1.32) and 2 years (adjusted OR= 0.59; 95% CI 0.23;1.55) after hospital discharge for STEMI and NSTEMI patients were not significantly different, albeit consistently lower for those discharged after an initial STEMI.

Discussion

We found that the proportion of comparatively young residents of central MA hospitalized at all metropolitan Worcester medical centers with a first episode of STEMI decreased over time. The frequency of in-hospital clinical complications and hospital and post-discharge mortality were low and no significant differences in these endpoints were observed between patients with STEMI or NSTEMI.

Patients with NSTEMI presented with a higher frequency of most of the cardiovascular comorbidities examined at the time of their index hospitalization than patients who developed a STEMI. Similar results were reported in a study that combined data from 14 international randomized clinical trials with more than 120,000 patients with AMI.[9] In the younger NSTEMI patients, hypertension and hyperlipidemia were more frequently diagnosed as compared to patients with STEMI.[9] The prevalence of smoking was high in

our patient population. Similar results were reported in a multicenter observational study of patients with AMI admitted to 60 coronary care units throughout Spain in 2000.[10] These findings suggest a continuing need for interventions targeting smoking and other potentially preventable/treatable risk factors in young and middle-aged individuals to prevent the development of AMI.

The proportion of young patients diagnosed with an initial STEMI declined during the period under study. A similar change in the ratio of NSTEMIs to STEMIs was observed in the National Registry of Myocardial Infarction between 1990 and 2006.[11] One potential explanation for our findings, and for the observed decline in the percentage of patients hospitalized with STEMI during recent years, was likely due to changes in the diagnosis of AMI that have incorporated the results of the more sensitive troponin assays which has likely led to more patients being diagnosed with NSTEMI (vs. unstable angina) over time.

Patients with STEMI were more likely to have undergone a PCI compared to patients with NSTEMI during their index hospitalization. Following current guidelines, early revascularization with PCI is the preferred first choice for the treatment of patients presenting with an STEMI.[12] However, in a prospective study of 200 patients less than 35 years old hospitalized with AMI in 76 hospitals between 1997 and 2008, patients with NSTEMI were more likely to have received a PCI than those with STEMI.[13] Similar to our findings, in a study of more than 44,000 AMI patients admitted to 113 hospitals between 1999 and 2005, increases in the utilization of PCI from 17% to 35%, and from 32% to 64%, respectively, for NSTEMI and STEMI patients were observed.[14]

The inconsistencies between previously published results and the findings of the present investigation with regards to the use of coronary interventions during hospitalization for AMI are most likely related to the younger age of patients in our study, different years under study, geographic, and physician practice differences. There are also data that clearly support the benefit of early revascularization with PCI in patients with STEMI, whereas catheterization followed by early revascularization among patients with NSTEMI has shown less consistent positive results.[15]

We failed to find any significant differences in our principal hospital outcomes between patients hospitalized with an initial STEMI or NSTEMI. The low frequency of various in-hospital adverse events was not unexpected since there tend to be fewer comorbidities and better overall health status in relatively young adult populations.[16,17] Similar results have been reported from the Global Registry of Acute Coronary Events that described trends in the frequency of in-hospital events among comparatively young adults who were hospitalized with STEMI/NSTEMI between 1999 and 2007.[14]

In examining all-cause death rates during the first 2 years after hospital discharge for either STEMI or NSTEMI, no significant differences in post-discharge survival were observed between these two groups. Previous studies have reported similar findings on the long-term prognosis of patients with STEMI compared to patients with NSTEMI.[13,18] In a large prospective study that was carried out at 76 hospitals in Switzerland between 1997 and 2008, the in-hospital death rate for young patients was 2.1% for patients who developed a

STEMI and even lower for patients with an NSTEMI.[13] These findings suggest that mortality rates are low after an AMI in young hospitalized patients and little differences exist in these rates between young patients who develop either a STEMI or NSTEMI.

The strengths of our study include its population-based design, inclusion of all hospitals from a well characterized metropolitan area, and decade-long perspective into the characteristics, management, and in-hospital and long-term outcomes in young patients hospitalized with either a STEMI or NSTEMI. Our study also has several limitations. Possible changes in the definition of AMI subtypes during the years under study may have contributed to the findings observed. The nonrandomized nature of our study precluded adjustment for the receipt of various treatment practices. We were unable to analytically control for other potentially important factors that may have influenced prognosis after AMI, including infarct size, serum lipid or blood pressure levels, or presence of adverse lifestyle practices.

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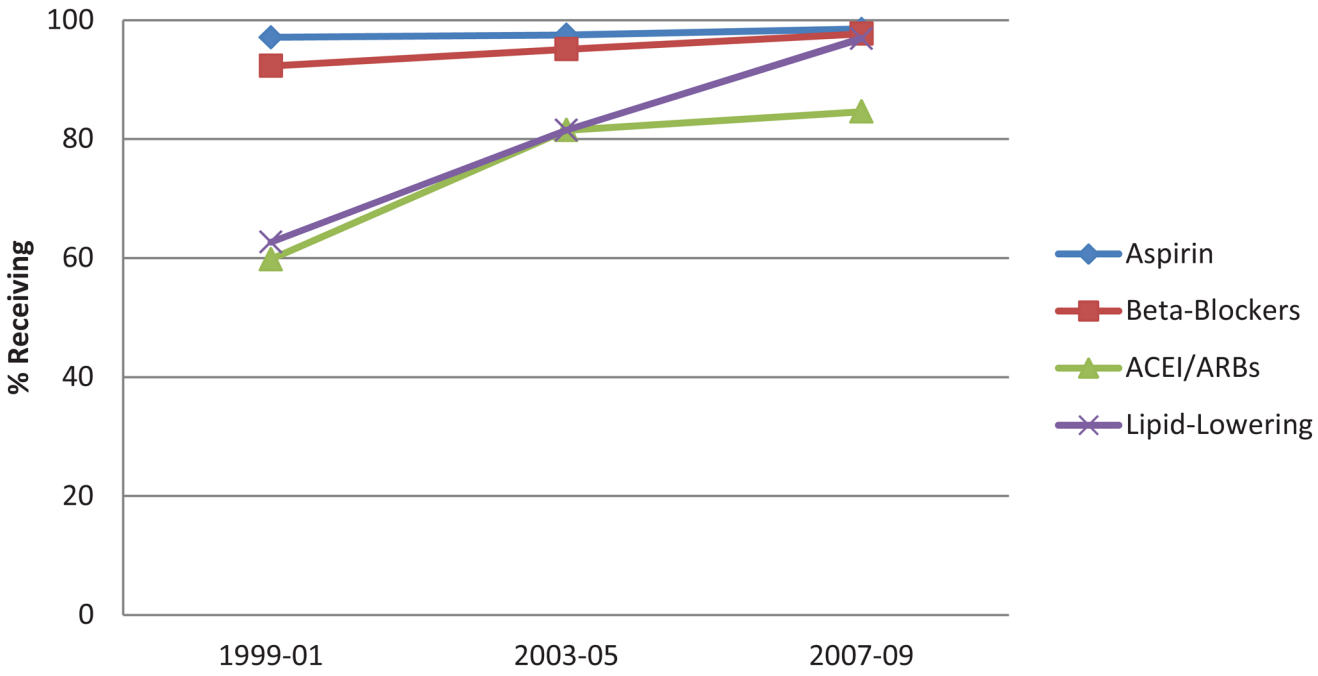
Figure 1A



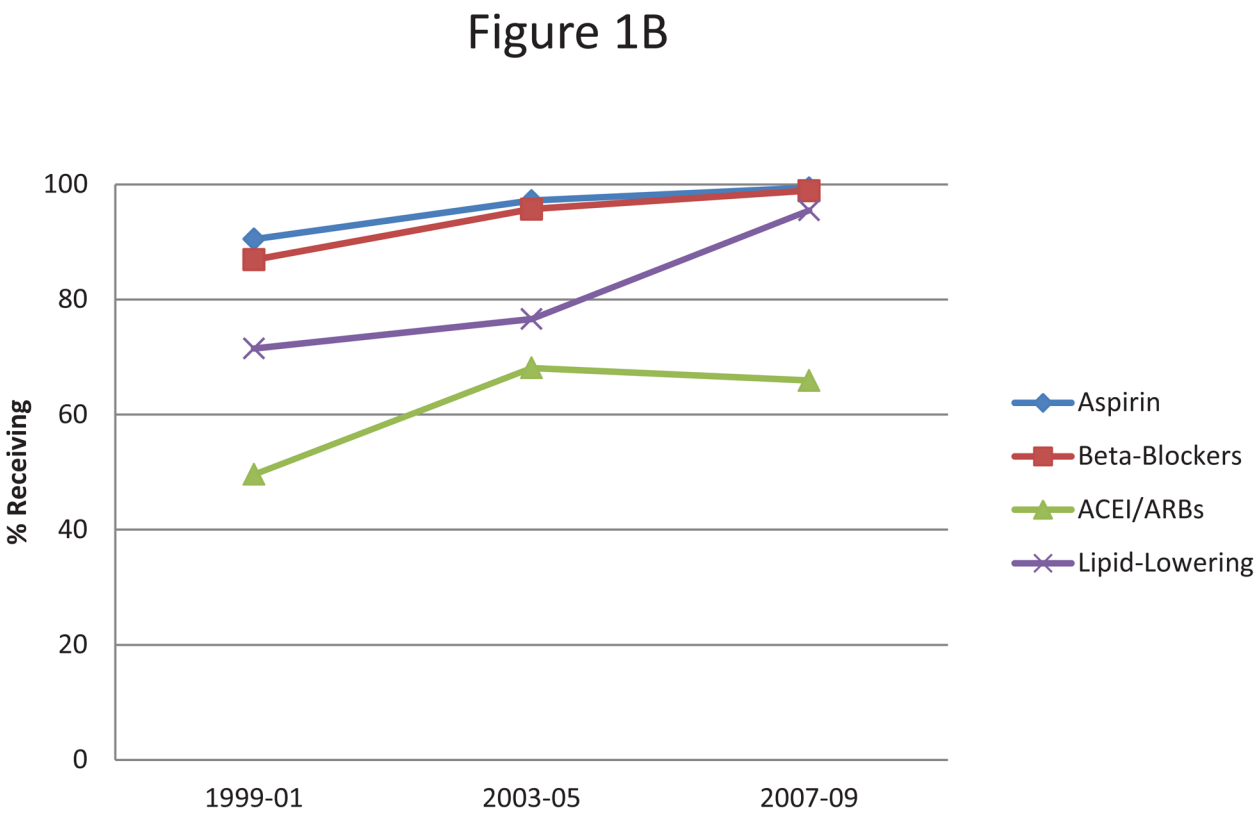


Figure 1.

Figure 1A Receipt of hospital medical therapies in patients with an initial STEMI

Figure 1B Receipt of hospital medical therapies in hospitalized patients with an initial NSTEMI

Figure 2A

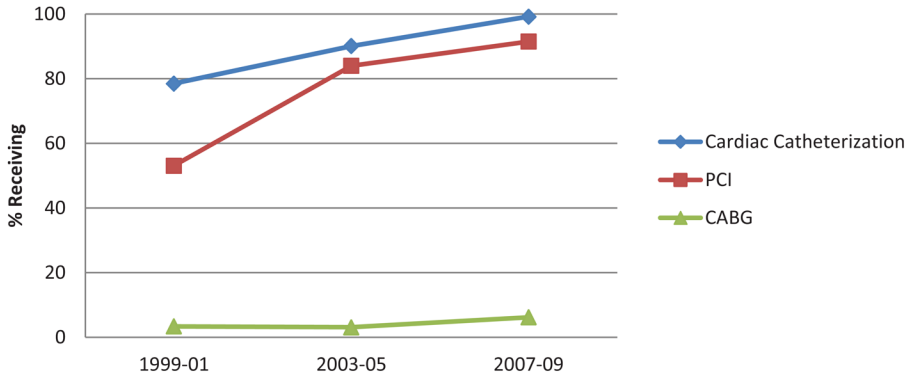


Figure 2B

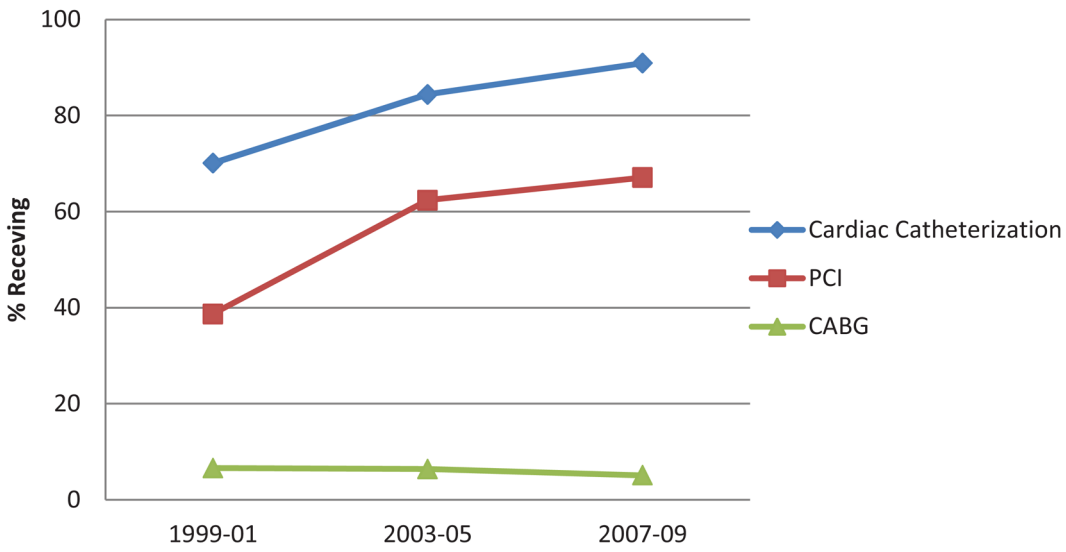


Figure 2.

Figure 2A Receipt of cardiac interventions in patients hospitalized with an initial STEMI

Figure 2B Receipt of cardiac interventions in patients hospitalized with an initial NSTEMI

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Table 1

Characteristics of young patients hospitalized with an initial acute myocardial infarction

	STEMI				NSTEMI			
Variable	**Total (n=501)**	**1999/2001 (n=209)**	**2003/2005 (n=162)**	**2007–2009 (n=130)**	**Total (n=454)**	**1999/2001 (n=137)**	**2003/2005 (n=162)**	**2007–2009 (n=176)**
Age (years) mean ± SD								
47.3 ± 5.1	47.3 ± 5.3	46.9 ± 5.3	48.0 ± 4.7	47.8 ± 5.2	48.1 ±4.9	47.8 ± 5.1	47.6 ± 5.5	
Male	397 (79.4%)	169 (80.9%)	129 (79.6%)	99 (76.2%)	342 (75.3%)	110 (80.3%)	101 (71.6%)	131 (74.4%)*
White	435 (93.2%)	185 (94.3%)	137 (91.3%)	113 (93.4%)	378 (88.5%)	118 (90.1%)	115 (88.5%)	145 (87.4%)*
Pre-hospital delay (median hours)	1.5	1.5	1.5	1.6	2.0	2.0	2.0	2.1
Angina pectoris	39 (7.8%)	26 (12.4%)	11 (6.8%)	2 (1.5%)	46 (10.1%)	16 (11.7%)	18 (12.8%)	12 (6.8%)
Current smoker	261 (52.1%)	98 (46.9%)	87 (53.7%)	76 (58.5%)	228 (50.2%)	66 (48.2%)	78 (55.3%)	84 (47.7%)*
Diabetes mellitus	93 (18.6%)	35 (16.8%)	34 (21.0%)	24 (18.5%)*	112 (24.7%)	28 (20.4%)	37 (26.2%)	47 (26.7%)*
Heart failure	19 (3.8%)	8 (3.8%)	8 (4.9%)	3 (2.3%)*	40 (8.8%)	11 (8.0%)	15 (10.6%)	14 (8.0%)
Hyperlipidemia[1]	278 (55.5%)	105 (50.2%)	92 (56.8%)	81 (62.3%)	275 (60.6%)	75 (54.7%)	72 (51.1%)	128 (72.7%)*
Hypertension[2]	229 (45.7%)	88 (42.1%)	76 (46.9%)	65 (50.0%)*	254 (56.0%)	65 (47.5%)	83 (58.9%)	106 (60.2%) **
Body mass index (kg/m^2)								
25–29.9	177 (35.5%)	55 (26.3%)	65 (40.1%)	57 (43.9%)	138 (30.4%)	35 (25.6%)	43 (30.5%)	60 (34.1%)
>30	245 (48.9%)	120 (57.4%)	75 (46.3%)	50 (38.5%)	244 (53.7%)	91 (66.4%)	66 (46.8%)	87 (49.4%)
Presenting symptoms								
Abdominal pain	19 (3.8%)	12 (5.7%)	5 (3.1%)	2 (1.5%)	21 (4.6%)	4 (2.9%)	8 (5.7%)	9 (5.1%) **
Back pain	82 (16.4%)	39 (18.7%)	28 (17.3%)	15 (11.5%)	63 (13.9%)	18 (13.1%)	24 (17%)	21 (11.9%)
Chest pain	429 (85.6%)	162 (77.5%)	147 (90.7%)	120 (92.3%)	376 (82.8%)	101 (73.7%)	118 (83.7%)	157 (89.2%)

* p< 0.05;

** p< 0.001

Footnote: Hyperlipidemia[1]: Serum total cholesterol > 240 mg/dl; Hypertension[2]: Systolic blood pressure > 140 mm Hg and/or Diastolic blood pressure >90 mm Hg

Table 2

Risk of developing selected hospital complications in young patients hospitalized with an initial acute myocardial infarction

	STEMI				P-Value	NSTEMI				P-Value
Complication	**Total (n = 501)**	**1999/01 (n =209)**	**2003/05 (n = 162)**	**2007/09 (n = 130)**		**Total (n = 454)**	**1999/01 (n = 137)**	**2003/05 (n = 141)**	**2007/09 (n = 176)**	
Atrial fibrillation	26 (5.2%)	12(5.7%)	9 (5.6%)	5 (3.9%)	0.26	15 (3.3%)	7 (5.1%)	6 (4.3%)	2 (1.1%)	0.24
Heart failure	85 (17.0%)	42 (20.1%)	14 (8.6%)	29 (22.3%)	0.28	51 (11.2%)	20 (14.6%)	17 (12.1%)	14(8.0%)	0.20
Cardiogenic shock	23 (4.6%)	12 (5.7%)	2 (1.2%)	9 (6.9%)	0.18	7 (1.5%)	5 (3.7%)	2 (1.4%)	0	0.18
Death	17 (3.4%)	6 (2.9%)	4 (2.5%)	7 (5.4%)	0.22	12 (2.6%)	5 (3.7%)	5 (3.6%)	2 (1.1%)	0.11
Length of Stay (median; days)	3.0	4.0	3.0	3.0	0.27	3.0	3.0	3.0	3.0	0.88

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Table 3

Mortality rates at selected post-discharge time points in young patients hospitalized with an initial acute myocardial infarction

Study period	Overall	1999/01	2003/05	2007/09	P-Value*
STEMI					
1-year	1.5%**	0.6%	2.1%	1.9%	0.81
2-year	2.4%	2.4%	2.8%	1.9%	0.63
NSTEMI					
1-year	4.1%	2.8 %	6.6 %	2.8%	0.46
2-year	5.1%	4.2%	8.2 %	2.8%	0.36

* p for trend

** p<0.01 when comparing 1-year overall mortality rates between STEMI and NSTEMI