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Original Research Article

A Hospital-Based Study to Evaluate the in-Hospital Mortality in AMI Patients According to DM Status and its Duration

Mani Shankar Pandey

Consultant, Department of Cardiology, Ruban Memorial Hospital, Patna, Bihar, India

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Corresponding author: Dr. Mani Shankar Pandey
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Abstract

Aim: The aim of the present study was to evaluate the in-hospital mortality in AMI patients according to DM status and its duration.

Methods: The present study was conducted in the Department of Cardiology for the period of one year. Our study included a population registry with demographic data of all residents and detailed information on hospital records. Our study comprised 5000 and 2000 DM and No-DM patients, respectively.

Results: Patients with DM had more cardio-cerebro- vascular comorbidities and were treated with a higher proportion of chronic cardiovascular medications in comparison with those without DM. Comorbidities and exposure to insulin and cardiovascular medications increased in parallel with DM duration. Patients with DM, especially those with the longest DM duration, developed more complications than patients without DM (all $p < 0.0001$).

Conclusion: Our study demonstrated that the duration of DM parallels mortality risk in patients hospitalized with AMI, highlighting that DM duration should be considered as an important early prognostic risk factor in patients with AMI.

Keywords: Acute myocardial infarction, Diabetes mellitus, Diabetes duration, In-hospital mortality, 1-year mortality

Introduction

The most frequent cause of mortality and morbidity is cardiovascular disease (CVD) [1] and the greatest burden of diseases worldwide belongs to ischemic heart disease. [2] Coronary artery disease (CAD) is a common condition that affects several million adults. Despite a reduction in the CVD rate in developed countries, ischemic heart disease is still high in developing countries. Acute myocardial infarction (MI) encompasses ST-segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (NSTEMI). Although in-hospital mortality is higher in SETMI than NSTEMI, the chance of 30 days and 1-year mortality is higher in NSTEMI compared to STEMI. [3] The global prevalence of diabetes mellitus (DM) in 2019 is estimated to be 9.3%, rising to 10.2% by 2030 and 10.9% (700 million) by 2045. [4] DM is an established risk factor for CAD. [5] Moreover, diabetic patients with MI have adverse cardiovascular effects and higher in-hospital morbidity and mortality rates. [6]

Previous studies have focused on mortality in patients with NSTEMI and indicated that DM is one of the major risk factors. [7] DM also leads to a worse prognosis based on long-term follow- up. The Global Use of Strategies to open occluded coronary arteries in acute coronary syndromes (GUSTO-IIb) clinical trial showed statistically higher 30-day and 6-month mortality in patients with STEMI and DM compared to those without. [8] Similar conclusions were drawn from the Donahoe et al [9] analysis of 11 studies: DM increased the 30-day and 1-year risk of death. Furthermore, it was observed that DM predisposes patients to CS, as do the following: older age, anterior wall MI, low left ventricular ejection fraction (LVEF), extensive infarction, advanced coronary artery atherosclerotic changes, congestive heart failure and prior MI. [10]

In the second Euro Heart Survey on Acute Coronary Syndrome (EHS-ACS-II), there was a two-fold higher incidence of CS in patients with DM. In multivariate analysis, DM was an independent factor that increased the risk of CS. [11] It appears that the presence of DM with MI complicated by CS may further worsen the prognosis. However, the reports on this subject are scarce and ambiguous and are based on analyses of relatively small and selected groups of patients. [12,13] Timely access to coronary revascularisation strategies is a critical determinant of mortality outcomes in SSA among

patients with acute coronary syndromes (ACS). However, several factors contribute to the mortality burden, including lack of patient education, delayed health-seeking behaviour, unequal healthcare systems, inappropriate triage, incomplete revascularisation, and limited access to primary percutaneous coronary intervention (PCI). [14]

The aim of the present study was to evaluate the in-hospital mortality in AMI patients according to DM status and its duration.

Materials and Methods

The present study was conducted in the Department of Cardiology, Ruban Memorial Hospital, Patna, Bihar, India for the period of one year. Our study included a population registry with demographic data of all residents and detailed information on hospital records. Our study comprised 5000 and 2000 DM and No-DM patients, respectively.

The pharmacy prescription database contains the medication name and anatomic therapeutic chemical classification code (ATC), quantity, and date of dispensation of drugs reimbursed by the NHS. The hospital database contains information on date of admission, discharge, death, primary diagnosis, and up to five co-existing clinical conditions and procedures performed. The diagnoses, uniformly coded according to the 9th International Code of Diseases (ICD-9-CM) and standardized in all Italian hospitals, are compiled by the hospital specialists directly in charge of the patients and are validated by hospitals against detailed clinical-instrumental data.

A unique identification code allows linkage of all data- bases. To ensure privacy, each identification code was automatically converted into an anonymous code before we received the dataset. In Italy studies using retrospective anonymous data from administrative databases that do not involve direct access by investigators to identification data do not require Ethics Committee/IRB approval or notification or patient informed consent signing.

Study Cohorts

Patients 50 years and older with a hospitalization due to AMI (both ST-elevation [STEMI] and non-ST-elevation [NSTEMI] myocardial infarction [ICD-9-CM codes 410.x]) were included in the analyses. Patients were divided in two groups according to DM status at time of hospitalization for AMI. DM was defined as chronic exposure to anti-hyperglycemic agents (at least two prescriptions of ATC code A10 within the same calendar year). Patients with DM were stratified into three groups according to disease duration, estimated using first expo- sure to anti-hyperglycemic agents: <5 years, 5–10 years, and > 10 years. Index date for cohort entering was the date of AMI.

Study Variables

The most prevalent complications during AMI hospitalization and the history of comorbidities of interest in the ten years before the index date were retrieved using hospital records (up to six co-existing diagnosis and procedures). Exposure to anti-hyperglycemic drugs and other medications of interest in the 12 months before index date were also retrieved.

Study Outcomes and Follow-Up

The primary outcome of the study was in-hospital mortality. As DM patients with AMI continue to be at increased risk of death after hospital discharge, particularly in the first year[15-17], we also analyzed one-year all- cause mortality from index date as secondary outcome. Patients were followed-up from the index date until death, migration or up to the end of one-year follow-up.

Statistical Analysis

Baseline characteristics were evaluated using descriptive statistics. Categorical variables were described using frequencies and percentages and compared using Chi-square test; continuous variables were described using mean and standard deviation (SD) and compared using Student's t-test. Baseline characteristics were also reported according to the duration of DM (< 5 years, 5–10 years, and > 10 years) in the overall AMI population and in patients with STEMI and NSTEMI considered separately. The effect of the DM duration was assessed using p for trend. All the analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA).

Results

Table 1: Baseline characteristics of patients hospitalized with acute myocardial infarction according to diabetes mellitus status

	No-DM Patients No. (2000)	DM PatientsNo. (5000)	P Value
Variables			
Age (years), mean ± SD	73.8 ± 12.8	70.6 ± 8.4	<0.0001
Age groups (years), n (%)			
50–64	560 (28)	1200 (24)	<0.0001
65–80	800 (40)	2600 (52)	
>80	640 (32)	1200 (24)	
Gender (female)	720 (36)	1900 (38)	<0.0001

AMI type			
STEMI	2400 (48)	1750 (35)	<0.0001
NSTEMI	2600 (52)	3250 (65)	<0.0001
History of comorbidities, n (%)			
Cerebrovascular disease	200 (10)	900 (18)	<0.0001
Prior myocardial infarction	80 (4)	700 (14)	<0.0001
Chronic ischemic heart disease	240 (12)	1400 (28)	<0.0001
Prior PCI or CABG	200 (10)	1100 (22)	<0.0001
Chronic heart failure	40 (2)	200 (4)	<0.0001
Atrial fibrillation	120 (6)	500 (10)	<0.0001
Peripheral vascular disease	80 (4)	800 (16)	<0.0001
Lower limb complication	10 (0.50)	250 (5)	<0.0001
Renal disease	100 (5)	550 (11)	<0.0001
COPD	120 (6)	400 (8)	<0.0001
Cancer	300 (15)	800 (16)	<0.0001
Insulin	0	1800 (36)	<0.0001
Other AHAs	0	4900 (98)	<0.0001
ACE-I/ARBS	960 (48)	3600 (72)	<0.0001
Beta blockers	560 (28)	2400 (48)	<0.0001
Diuretics	360 (18)	1850 (37)	<0.0001
Ca-antagonists	440 (22)	1900 (38)	<0.0001
Lipid lowering drugs	480 (24)	2900 (58)	<0.0001
Antiplatelet drugs	600 (30)	2900 (58)	<0.0001
Oral anticoagulant drugs	120 (6)	500 (10)	<0.0001

Patients with DM had more cardio-cerebro- vascular comorbidities and were treated with a higher proportion of chronic cardiovascular medications in comparison with those without DM. Comorbidities and exposure to insulin and cardiovascular medications increased in parallel with DM duration.

Table 2: In hospital complications and procedures of patients hospitalized with acute myocardial infarction according to diabetes mellitus status

	No-DM Patients No. (2000)	DM PatientsNo. (5000)	P Value
Variables			
In-hospital complications			
Atrial fibrillation	200 (10)	600 (12)	<0.0001
Cardiogenic shock	80 (4)	200 (4)	<0.0001
Acute heart failure	40 (2)	150 (3)	<0.0001
Acute renal failure	40 (2)	160 (3.20)	<0.0001
In-hospital procedures			
PCI	1200 (60)	2700 (54)	<0.0001
CABG	40 (2)	100 (2)	0.7442
Insertion of drug-eluting coronary artery stent(s)	920 (46)	2100 (42)	<0.0001
Single coronary vessel PCI	800 (40)	1700 (34)	<0.0001
Multivessel PCI	200 (10)	500 (10)	0.0143
Cardiac retraining	180 (9)	450 (9)	<0.0001

Patients with DM, especially those with the longest DM duration, developed more complications than patients without DM (all $p < 0.0001$).

Discussion

Diabetes mellitus (DM) is a frequent comorbidity among patients hospitalized with acute myocardial infarction (AMI). [18-20] Despite evidence for major improvements in outcomes over the past 40 years in the general AMI population, regardless of DM status, a two- fold higher in-hospital mortality rate in DM patients has been consistently reported across decades. [21,22]

The Current guidelines have recently considered a long duration of DM (≥10 years) as a critical modifier when assessing cardiovascular risk in DM patients. [23] However, whether DM duration, by summarizing the patient's burden of DM-related comorbidities, reflects in-hospital mortality of patients with AMI has never been investigated yet. Furthermore, given the different in-hospital mortality risk between patients with ST-elevation myocardial infarction (STEMI) and non-ST-

elevation myocardial infarction (NSTEMI). [24] Patients with DM had more cardio-cerebro- vascular comorbidities and were treated with a higher proportion of chronic cardiovascular medications in comparison with those without DM. Comorbidities and exposure to insulin and cardiovascular medications increased in parallel with DM duration. Patients with DM, especially those with the longest DM duration, developed more complications than patients without DM (all $p < 0.0001$).

The previously reported lower incidence rate of IHD could be explained by underdiagnosis and paucity of research data reporting outcomes in STEMI patients residing in SSA, particularly those treated in state-owned hospitals. Limited access to diagnostic tools such as cardiac biomarkers reflecting myocardial injury, ECGs, and coronary angiography may result in the under-diagnosis of STEMI. [25] Furthermore, the incidence and prevalence rates of IHD reported in SSA in older research studies may be inaccurate, partly due to patients demising before arrival in hospitals equipped with catheterisation laboratories. [26] The association between DM duration and in-hospital mortality in AMI patients may be explained by the progressive increase in microvascular and macrovascular complication burden that usually parallels disease duration. Indeed, consistently with prior reports, our analysis found that the prevalence of renal disease, peripheral, cerebrovascular and coronary artery disease, and insulin use are associated at baseline with longer DM duration. [23,27-29]

Moreover, a longer DM duration has been previously associated with a greater burden of coronary artery disease, as assessed by coronary angiography [30] and with a higher prevalence of vulnerable coronary plaques. [31] Therefore, it can be inferred that the duration of DM mirrors patients' frailty during the acute cardiac event. The finding of a higher mortality risk in STEMI than in NSTEMI patients for the same DM duration does on the one hand reflect the greater hemodynamic impairment typically associated with STEMI, and, on the other hand, support the detrimental interplay among patients' frailty (DM duration), AMI severity (STEMI vs. NSTEMI), and in-hospital mortality risk in DM patients.

Conclusion

Our study demonstrated that the duration of DM parallels mortality risk in patients hospitalized with AMI, highlighting that DM duration should be considered as an important early prognostic risk factor in patients with AMI.

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