Predictors of In-Hospital Mortality in Patients Admitted with Acute Myocardial Infarction in a Developing Country

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Abstract

Background: Limited data are available on the predictors of mortality in patients hospitalized with acute myocardial infarction (AMI) in developing countries. In this study, we analyze the predictors for in-hospital mortality in patients hospitalized with AMI (ST segment elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI)) in a large tertiary referral university hospital in Lebanon.

Methods: This was a retrospective study of 503 patients admitted to the American University of Beirut Medical Center with AMI (228 with STEMI and 275 with NSTEMI).

Results: The in-hospital mortality rate was 7.8%. The multivariate predictors of mortality in the overall population were similar to what has been reported in large registries in the USA and Europe. They included older age (> 65 years) (OR = 2.99, 95% CI = 1.22 - 7.36, P = 0.02), systolic blood pressure < 100 mm Hg (OR = 2.75, 95% CI = 1.12 - 6.76, P = 0.03), history of stroke (OR = 4.28, 95% CI = 1.29 - 14.17, P = 0.02), history of coronary artery bypass graft (CABG) (OR = 2.68, 95% CI = 1.15 - 6.23, P = 0.02), heart failure (OR = 3.92, CI = 1.62 - 9.49, P = 0.002) and ejection fraction (EF) < 35% (OR = 2.32, 95% CI = 1.05 - 5.14, P = 0.04). In a separate analysis of STEMI and NSTEMI patients, age, heart failure and a low EF continued to be multivariate predictors of mortality in both subgroups. In addition, prior stroke was an added predictor in STEMI patients, and prior CABG was an added predictor in NSTEMI.

Conclusion: Predictors of in-hospital mortality in patients hospitalized with AMI in a tertiary referral university hospital in the Middle East are similar to what has been reported in large registries in the USA and Europe.

Keywords: Myocardial infarction; Hospital mortality; Developing

countries; ST elevation myocardial infarction; non-ST elevation myocardial infarction

Introduction

Acute myocardial infarction (AMI), including both ST segment elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI), represent a major cause of morbidity and mortality worldwide [1]. Although healthcare systems have made marked improvements in developing systematic methods for early recognition and management of patients with AMI, short-term in-hospital mortality remains high.

Several studies in the USA and Europe have investigated the predictors of in-hospital mortality post-AMI [2-7]. Several variables were identified related to the clinical characteristics of the patients and their comorbidities [3, 4, 7-10]. Similar studies on AMI patients in developing countries are scarce [11], and little is known about the management and mortality rates of such patients in these countries [12]. The aim of our study is to investigate the predictors for in-hospital mortality in patients admitted with AMI at the American University of Beirut Medical Center (AUBMC), a tertiary referral university hospital in Lebanon.

Patients and Methods

This is a substudy of a large retrospective study that enrolled all patients (1,025) admitted with an acute coronary syndrome to AUBMC between January 1, 2002 and December 30, 2005 [13]. In this substudy, we focus on the subgroup of patients who had AMI (either STEMI or NSTEMI) with the appropriate clinical presentation, electrocardiograph (ECG) findings and rise in cardiac biomarkers as per published guidelines [14]. AUBMC is the largest tertiary referral university hospital in Lebanon with a 20 bed coronary care unit, two active cardiac catheterization laboratories and a busy cardiothoracic surgery program.

The clinical characteristics of patients as well as the occurrence of in-hospital death were collected retrospectively from medical chart review. Statistical analysis was performed using the Statistical Package for Social Sciences software (SPSS ver-

sion 15). Continuous variables are presented as mean ± SD and categorical variables are presented as frequencies and percentages. Comparison of baseline characteristics and in-hospital interventions and outcomes among the three groups of patients (All AMI, STEMI and NSTEMI) in Tables 1 and 2, were done using the analysis of variance (ANOVA) test (for continuous variables) or the χ^2 homogeneity test (for categorical variables). Logistic regression analysis was performed to determine the predictors of in-hospital mortality among the three groups.

Results

The clinical characteristics of the study population as well as the medications and interventions utilized are shown in Tables 1 and 2. The study included a total of 503 AMI patients (45% STEMI and 55% NSTEMI). The overall in-hospital mortality was 7.8% (7.9% in STEMI and 7.6% in NSTEMI).

In the total group of AMI patients, those who died were older (mean age of 77 ± 12 years versus 63 ± 13 years, P < 0.0001), had a higher percentage of women (39% versus 22%, P = 0.02) and a higher prevalence of prior coronary artery disease (CAD) (56% versus 36%, P = 0.01), congestive heart failure (CHF) (31% versus 9%, P < 0.0001), chronic kidney disease (CKD) (28% versus 9%, P < 0.001) and stroke (18% versus 3%, P < 0.001). They also had a lower mean systolic blood pressure on admission (120 ± 27 mm Hg versus 136 ± 29 mm Hg, P = 0.001), hemoglobin level (12 ± 2 g/dL versus 13 ± 2 g/dL, P = 0.001) and ejection fraction (28 ± 11% versus 48 ± 14%, P < 0.0001). In addition, they had a higher prevalence of decompensated heart failure on admission (36% versus 9%, P < 0.0001) and cardiogenic shock (10% versus 2%, P = 0.01). In terms of medical therapy, patients who died were more likely to be on inotropic support with dopamine or dobutamine, but they were less likely to receive other medications such as aspirin (80% versus 93%, P = 0.006), clopidogrel (49% versus 82%, P < 0.0001), statins (13% versus 61%, P < 0.0001) and beta blockers (28% versus 62%, P < 0.0001). Coronary angioplasty was less commonly utilized in those patients as well (12% versus 38%, P = 0.003), but the rates of coronary artery bypass graft (CABG) were similar. When separate analyses were done for STEMI and NSTEMI patients (also shown in Tables 1 and 2), similar patterns were noted in both groups.

Using multivariate logistic regression analysis (Table 3), the significant multivariate predictors of mortality in the overall AMI population were: older age (> 65 years), lower systolic blood pressure and CHF on admission, prior history of stroke or CABG and a lower ejection fraction. Age, CHF on admission and a lower EF continued to be multivariate predictors for both STEMI and NSTEMI subgroups. In addition, prior stroke was an added predictor in STEMI patients, and prior CABG was an added predictor in NSTEMI patients.

Discussion

This is one of the few studies that analyzed the predictors of

in-hospital mortality in a relatively large number of patients hospitalized with AMI in a tertiary referral university hospital in a developing country. The identified predictors were similar to those reported from large AMI registries in the USA and Europe. Older age has been a consistent predictor of mortality in multiple AMI studies. In a 20-year population study, Goldberg et al showed that the risk of death increased proportionally with age with patients older than 85 years of age having more than 10 times the mortality risk compared to patients ageing between 55 and 64 years [15]. Similar findings were reported by Rosengren et al from the EuroHeart survey [16]. Our findings are consistent with these studies where age was a significant predictor of in-hospital mortality in the overall AMI population as well as in each of the STEMI and NSTEMI subgroups. Multiple reasons have been proposed to explain this increased risk. Elderly people are expected to have more extensive coronary disease and yet they are less likely to receive the same intensive management as younger patients regarding revascularization procedures and anti-ischemic therapy [16-19]. Both the CRUSADE and EuroHeart studies showed that the revascularization rate decreased progressively as the patient's age increased [18].

Heart failure and low ejection fraction (< 35%) were also shown to be consistent predictors of mortality in our overall AMI population as well as in both STEMI and NSTEMI subgroups. The ESC guidelines have underscored the importance of these two variables in the management of patients with AMI in view of their association with high risk [20]. Killip class was determined to be an important predictor of mortality for more than 50 years now [21]. The importance of heart failure on admission was further illustrated in a large nationwide USA study (NRMI-2) that enrolled around 170,000 patients with AMI in which it was associated with a five-fold increase in mortality [22]. Similarly, the GRACE registry showed that heart failure on admission was associated with four-fold increase in mortality [2].

Prior history of stroke was an important predictor of mortality in our study as well. This goes hand in hand with various studies that found that patients who survive an initial stroke are more prone to die in the future from cardiac events such as myocardial infarction [23, 24]. The CRUSADE registry that enrolled around 43,000 patients with AMI showed that stroke was a strong predictor of long-term morality [25].

Patients with prior history of CABG have also been shown in multiple studies to be at increased risk of death following an AMI [26, 27], similar to what we found in our study. Finally, we found that the lack of utilization of clopidogrel was a significant predictor of mortality. The protective effect of clopidogrel has now been established in multiple randomized trials in a wide spectrum of patients with acute coronary syndromes [28-30]. However, because of the retrospective nature of our study, it is difficult to determine whether the lack of prescribing clopidogrel leads to the increased mortality or it was simply a marker of a higher risk population.

Strengths and limitations

This is one of the few studies that analyzes the predictors of

Table 1. Clinical Characteristic of the Study Population

	Total sample	All Patients			STEMI			NSTEMI		
		Survived patients	Deceased patients	P value	Survived patients	Deceased patients	P value	Survived patients	Deceased patients	P value
		N = 464	N = 39		N = 210	N = 18		N = 254	N = 21	
Demographic	Mean age	63 ± 13	77 ± 12	< 0.0001	59 ± 13	77 ± 12	< 0.0001	66 ± 13	76 ± 12	0.001
	Age > 65 years	216 (47%)	32 (82%)	< 0.0001	79 (38%)	14 (78%)	0.001	137 (54%)	18 (86%)	0.005
	Female gender	104 (22%)	15 (39%)	0.02	34 (16%)	5 (28%)	0.20	70 (28%)	10 (48%)	0.05
Cardiac risk factors	Hypertension	234 (50%)	20 (51%)	0.92	77 (37%)	8 (44%)	0.51	157 (62%)	12 (57%)	0.67
	Diabetes	142 (31%)	17 (44%)	0.09	48 (23%)	5 (28%)	0.58	94 (37%)	12 (57%)	0.07
	Hyperlipidemia	204 (44%)	13 (33%)	0.20	83 (40%)	3 (17%)	0.06	121 (48%)	10 (48%)	1.00
Previous cardiac diseases	h/o CAD	169 (36%)	22 (56%)	0.01	45 (21%)	8 (44%)	0.04	124 (49%)	14 (67%)	0.12
	h/o MI	54 (12%)	8 (21%)	0.13	13 (6%)	3 (17%)	0.12	41 (16%)	5 (24%)	0.36
	CHF	41 (9%)	12 (31%)	< 0.0001	3 (1%)	4 (22%)	0.001	38 (15%)	8 (38%)	0.01
Previous intervention	Angioplasty	34 (7%)	3 (8%)	1.00	14 (7%)	1 (6%)	1.00	20 (8%)	2 (9.5%)	0.68
	CABG	68 (15%)	12 (31%)	0.008	15 (7%)	3 (17%)	0.16	53 (21%)	9 (43%)	0.03
Comorbidities	COPD	21 (4.5%)	4 (10%)	0.12	4 (2%)	2 (11%)	0.07	17 (7%)	2 (9.5%)	0.65
	CKD	43 (9%)	11 (28%)	0.001	4 (2%)	3 (17%)	0.01	39 (15%)	8 (38%)	0.01
	Stroke	15 (3%)	7 (18%)	0.001	5 (2%)	4 (22%)	0.003	10 (4%)	3 (14%)	0.07
	PVD	22 (5%)	5 (13%)	0.05	4 (2%)	1 (6%)	0.34	18 (7%)	4 (19%)	0.07
Admission features	Sinus rhythm	427 (92%)	34 (87%)	0.36	201 (96%)	16 (89%)	0.21	226 (89%)	18 (86%)	0.72
	A-Fib	24 (5%)	2 (5%)	1.00	5 (2%)	0 (0%)	1.00	19 (7.5%)	2 (9.5%)	0.67
	AV block	3 (0.6%)	1 (3%)	0.28	1 (0.5%)	0 (0%)	1.00	2 (0.8%)	1 (5%)	0.21
	SBP (mm Hg)	136 ± 29	120 ± 27	0.001	133 ± 29	118 ± 32	0.04	138 ± 28	123 ± 21	0.01
	HR	84 ± 22	90 ± 17	0.12	81 ± 21	91 ± 15	0.04	87 ± 23	89 ± 18	0.72
	Cr > 2 mg/dL	29 (6%)	9 (23%)	0.001	5 (2%)	4 (22%)	0.003	24 (9%)	5 (24%)	0.04
	Hb (g/dL)	13 ± 2	12 ± 2	0.001	14 ± 2	13 ± 2	0.05	13 ± 2	11 ± 2	0.008
	Heart failure	40 (9%)	14 (36%)	< 0.0001	11 (5%)	6 (33%)	0.001	29 (11%)	8 (38%)	0.003
	Cardiogenic shock	8 (2%)	4 (10%)	0.01	6 (3%)	4 (22%)	0.004	2 (0.8%)	0 (0%)	1.00
	Anterior MI	132 (28%)	15 (39%)	0.09	88 (42%)	12 (67%)	0.23	44 (17%)	3 (14%)	0.19
	2 vessel CAD	153 (35%)	6 (18%)	0.007	74 (37%)	2 (13%)	0.02	79 (33%)	4 (22%)	0.19
	EF (%)	48 ± 14	28 ± 11	< 0.0001	49 ± 12	29 ± 11	< 0.0001	48 ± 15	28 ± 12	< 0.0001

CAD: coronary artery disease; MI: myocardial infarction; CHF: congestive heart failure; CABG: coronary artery bypass graft; CKD: chronic kidney disease; PVD: peripheral vascular disease; A-Fib: atrial fibrillation; AV block: atrioventricular block; SBP: systolic blood pressure; HR: heart rate; Hb: hemoglobin; EF: ejection fraction.

Table 2. In-Hospital Utilization of Medications and Interventions

		All patients			STEMI			NSTEMI		
	Total sample	Survived patients	Deceased patients	P value	Survived patients	Deceased patients	P value	Survived patients	Deceased patients	P value
		N = 464	N = 39		N = 210	N = 18		N = 254	N = 21	
In-hospital drugs	Aspirin	433 (93%)	31 (80%)	0.006	202 (96%)	13 (72%)	0.002	231 (91%)	18 (86%)	0.43
	Clopidogrel	382 (82%)	19 (49%)	< 0.0001	174 (83%)	6 (33%)	< 0.0001	208 (82%)	13 (62%)	0.04
	Beta blocker	289 (62%)	11 (28%)	< 0.0001	136 (65%)	2 (11%)	< 0.0001	153 (60%)	9 (43%)	0.12
	CCB	37 (8%)	5 (13%)	0.36	4 (2%)	1 (6%)	0.34	33 (13%)	4 (19%)	0.50
	Statin	282 (61%)	5 (13%)	< 0.0001	142 (68%)	0 (0%)	< 0.0001	140 (55%)	5 (24%)	0.006
	ACEI	202 (44%)	17 (44%)	0.10	97 (46%)	6 (33%)	0.29	105 (41%)	11 (52%)	0.33
	ARB	52 (11%)	3 (8%)	0.79	14 (7%)	0 (0%)	0.61	38 (15%)	3 (14%)	1.00
	Heparin	336 (72%)	24 (62%)	0.15	164 (78%)	11 (61%)	0.14	172 (68%)	13 (62%)	0.59
	LMWH	174 (38%)	17 (44%)	0.45	66 (31%)	5 (28%)	0.75	108 (43%)	12 (57%)	0.19
	GPIIb/IIIa	113 (24%)	3 (8%)	0.02	40 (19%)	1 (6%)	0.21	73 (29%)	2 (9.5%)	0.06
	Dopamine	24 (5%)	20 (51%)	< 0.0001	9 (4%)	7 (39%)	< 0.0001	15 (6%)	13 (62%)	< 0.0001
	Dobutamine	57 (12%)	25 (64%)	< 0.0001	26 (12%)	11 (61%)	< 0.0001	31 (12%)	14 (67%)	< 0.0001
	Amiodarone	83 (18%)	12 (31%)	0.05	30 (14%)	4 (22%)	0.32	53 (21%)	8 (38%)	0.10
In-hospital intervention	Thrombolytic	132 (28%)	2 (5%)	0.002	131 (62%)	2 (11%)	< 0.0001	-	-	-
	Angioplasty	166 (38%)	4 (12%)	0.003	101 (51%)	3 (20%)	0.02	65 (27%)	1 (6%)	0.05
	CABG	86 (20%)	6 (18%)	0.84	41 (21%)	3 (20%)	1.00	45 (19%)	3 (17%)	1.00
	Pace maker	7 (1.5%)	0 (0%)	1.00	4 (2%)	0 (0%)	1.00	3 (1%)	0 (0%)	1.00
	IABP	6 (1%)	2 (5%)	0.12	4 (2%)	2 (11%)	0.07	2 (0.8%)	0 (0%)	1.00

CCB: calcium channel blocker; ACEI: angiotensin-converting enzyme inhibitor; ARB: angiotensin receptor blocker; LMWH: low molecular weight heparin; GPIIb/IIIa: glycoprotein IIb/IIIa inhibitor; CABG: coronary artery bypass graft; IABP: intra-aortic balloon pump.

Table 3. Multivariate Predictors of Mortality

	Predictor	Adjusted OR (95% CI)	P value
All AMI patients	Age (> 65 years)	2.99 (1.22 - 7.36)	0.02
	SBP < 100 mm Hg	2.75 (1.12 - 6.76)	0.03
	Stroke	4.28 (1.29 - 14.17)	0.02
	CABG	2.68 (1.15 - 6.23)	0.02
	Admission CHF	3.92 (1.62 - 9.49)	0.002
	Plavix	0.25 (0.10 - 0.49)	< 0.0001
	EF < 35%	2.32 (1.05 - 5.14)	0.04
STEMI	Age (> 65 years)	3.56 (1.05 - 12.00)	0.041
	Admission CHF	5.11 (1.34 - 19.47)	0.017
	Stroke	10.43 (2.09 - 52.05)	0.004
	EF < 35 %	3.31 (1.03 - 10.62)	0.044
Non-STEMI	Age (> 65 years)	3.97 (1.08 - 14.54)	0.038
	Admission CHF	2.49 (0.86 - 7.24)	0.093
	CABG	2.42 (0.91 - 6.42)	0.077
	EF < 35 %	3.12 (1.13 - 8.66)	0.029

CHF: congestive heart failure; CABG: coronary artery bypass graft; EF: ejection fraction; SBP: systolic blood pressure.

in-hospital mortality among patients with AMI in a developing country. In view of the scarcity of similar data from these countries, our report fills an important gap of knowledge in the global perspective on AMI. The important limitations of the study are that it is a single-center initiative and it is retrospective. This limits the extrapolation of findings to other countries. We hope that more resources will be invested in these countries to perform multicenter prospective surveys that can more accurately characterize the population of AMI patients.

Conclusions

This is one of the few studies that analyzes the predictors of in-hospital mortality among patients hospitalized with AMI in a large tertiary referral university hospital in the Middle East. The identified predictors are similar to what has been reported in large registries in the USA and Europe. These included older age, heart failure, prior stroke or CABG, and a lower ejection fraction. Large multicenter prospective studies are needed to further characterize the population of AMI patients in these countries.

Conflict of Interest

The authors report no relationships that could be construed as a conflict of interest.

Author Contributions

HAD conceived the study and contributed to the design of the study. OMC, ASQ, MED and HH drafted the manuscript and

contributed with the data collection. HT contributed with the data analysis and the revision of the final manuscript. All authors read and approved the final version of the manuscript.

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