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Predictors of prolonged hospital stay and in-hospital mortality in female patients with acute myocardial infarction with specific reference to diabetes

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ABSTRACT

This study aimed to determine predictors of prolonged length of stay (LOS) and mortality in female STEMI patients with diabetes in comparison to female STEMI patients without diabetes. This retrospective single-center study was conducted between 2015 and 2020 as part of the STEMI registry in our center and included all STEMI patients.

Results: Out of 3081 STEMI patients, 16% (N = 498) were female, and 64% (n = 318) of them had diabetes. Diabetic patients were less commonly presented with anterior wall myocardial infarction (AWMI) (47% vs 65%, p = 0.001), but tended to have a higher prevalence of left main (LM) significant disease compared to non-diabetic patients (4% vs 1%, p = 0.06). Of the patients, 36% had prolonged LOS (≥5 days), and they were more obese with a higher incidence of hemoglobin drop ≥ 3 g/dL, higher admission troponin, and peak creatinine. 22% of patients with prolonged LOS came to the hospital after receiving lytic therapy and showed a higher prevalence of multivessel stenosis. Prolonged LOS patients had a higher incidence of pulmonary edema and cardiac arrest, which necessitated ventilation, although they did not show a significant difference in mortality from the group with LOS < 5 days. Our study found a significant negative correlation between glycosylated hemoglobin (HbA1c) and left ventricular ejection fraction (LVEF) (p = 0.02), but a positive correlation was noticed between HbA1c and LOS (p < 0.001). Regression analysis showed that diabetes mellitus, hemoglobin drop, creatinine level, and LVEF were significant predictors of prolonged LOS among females, although HbA1c, BMI ≥ 30, STEMI type, and peak creatinine level were independent predictors of prolonged LOS among female diabetic patients. Age ≥ 65 years and LVEF were significant independent predictors of mortality (p = 0.04, 0.02 respectively) in STEMI female patients.

Conclusions: Diabetes mellitus, bleeding, renal impairment, and LVEF were found to be significant independent predictors of prolonged LOS among STEMI females. Age ≥ 65 years and LVEF were significant predictors of mortality among STEMI female patients.

Abbreviations: 3VD, 3 Vessel Disease; ACS, acute coronary syndrome; AMI, Acute Myocardial Infarction; AWMI, Anterior wall myocardial infarction; BMI, Body Mass Index; CAD, Coronary Artery Diseases; CVA, Cerebro- Vascular Accidents; CVD, Cerebro-vascular disease; CS, Cardiogenic shock; DM, Diabetes Mellitus; EF, Ejection Fraction; HBA1c, Glycosylated hemoglobin; HTN, Hypertension; IHD, Ischemic Heart Disease; LBBB, left bundle branch block; LDL, Low-density lipoprotein; LOS, Length of stay in hospital; LM, Left Main; LVEF, Left ventricular ejection fraction; MVD, Multivessel disease; PCI, Percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction; VS, Versus; WC, waist circumference.

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1. Background

Despite advanced cardiac interventions, acute myocardial infarction (AMI) is still one of the universal principal causes of death [1] with increasing incidence of ST-elevation myocardial infarction (STEMI), it accounts for 40% of all acute coronary syndrome(ACS) hospital admissions [2].

Women have higher long-term mortality compared with men after percutaneous coronary intervention (PCI). The explanation of these results is not well understood [3,4].

Sex difference in mortality in the venue of STEMI is suggested to be related to in-hospital presentation delay among females, making them more susceptible to prolonged ischemia complications as they were left with no treatment [5].

A large study of 31,620 patients with ACS from 7 Arabian Gulf registries concluded that women aged ≤65 years with STEMI were less likely to receive guideline-based in-hospital medical and revascularization therapy than younger men also they had higher in-hospital and 1-year death rates [6].

Combination of both female gender and type 2 diabetes as predictors of bad prognosis and delayed medical response should be in the spot of care of health care providers. Diabetes represents a growing problem worldwide, the universal prevalence of diabetes among adults in 2014 was 8.5% with 422 million suffering from the disease [8]. Diabetic patients should receive rapid and specific care in the venue of STEMI as they have a higher risk of morbidity and mortality and represent about one-third of ACS patients. Poor prognosis among those patients may be related to atypical symptoms which cause delayed treatment [9,10].

In addition to the delayed medical response, one of the vital concerns in the management of ACS patients, particularly in developing countries, is bed management. The high expenses of these beds require optimum utilization which is essential to deliver proper and needed services to patients. The variety of factors affecting LOS such as comorbidities, age, etc., detection of these factors has led the investigators to formulate a lot of studies to approach them [7].

Although the European Society of Cardiology (ESC) 2017 guidelines on managing STEMI patients recommend considering a hospital discharge within 48–72 h in low-risk individuals, results of some registries are showing that LOS is usually prolonged with a great discrepancy between different regions and centers around the world [7–9]. Pointless hospitalization, absence of discharge protocols, wrong admission of cases outside the coronary care units, and keeping patients of medication dose adjustment, all are factors, which are not included in typical risk scores but might contribute to prolonged LOS in STEMI patients.

Determining the causes of prolonged LOS will help improve bed availability and lessen the health system load to improve the quality of given medical care especially in bad outcomes high risk groups like females and diabetic patients. So we aimed in this study to delineate the predictors of prolonged LOS and its relation to in-hospital mortality in female patients with STEMI in comparison to female STEMI patients without diabetes also spot light over added influences of diabetes on LOS and outcomes of those patients.

2. Methods

2.1. Study design

This is a single-center, non-randomized, retrospective cohort study which did not require informed consent for data collection for this registry. IRB committee approval in our center was obtained.

2.2. Patient selection

Patients were selected from the STEMI registry conducted in our center which it is the only tertiary center capable of primary PCI in Makkah region. This study included all patients who presented with STEMI between 2015 and 2020.

2.3. Inclusion and exclusion criteria

2.3.1. Inclusion criteria

AMI Patients who have chest pain lasting >30 min along with ECG criteria of AMI [11]:

1-New ST-segment elevation at the J point in 2 contiguous leads with the cutoff point as >0.1 mV in all leads other than V2 or V3.

2-In leads V2-V3 the cutoff point is >0.2 mV in men older than 40 years old and >0.25 in men younger than 40 years old, or >0.15 mV in women.

3-Patients with a pre-existing left bundle branch block can be further evaluated using Sgarbossa's criteria [12,13]:

ST-segment elevation of 1 mm or more that is concordant with (in the same direction as) the QRS complex.

ST-segment depression of 1 mm or more in lead V1, V2, or V3.

ST-segment elevation of 5 mm or more that is discordant with (in the opposite direction) the QRS complex.

2.3.2. Exclusion criteria

There were no exclusion criteria other than standard contraindications for coronary angiography including patient refusal.

2.4. Groups definition

The female patients were divided into two groups diabetic and nondiabetic depending on their medical history of diabetes but did not include those with new-onset diabetes during hospitalization.

Prolonged hospital stay was defined when it is ≥5 days. The mean of patients' LOS in this study and some other studies were about 5 days. As there was no identified cut-off point, 5 days was selected as our study cut-off point.

The study compared the studied groups regarding demographic (eg., age, gender, smoking, etc), laboratory (eg hemoglobin, troponin, creatinine, etc). echocardiography (LVEF was measured using Simpson technique), angiography data, and in-hospital complications (eg shock, pulmonary edema, etc). All labs were recorded on admission. Troponin and creatinine peak levels also were documented during in-hospital stay, hemoglobin was verified on admission and discharge.

2.5. Statistical analysis

The SPSS software was used for data analysis. Continuous and categorical data of every two groups were compared using a simple *t*-test and chi-squared test respectively, Pearson's correlation was also performed. The risk factors for mortality and prolonged LOS were subjected to multivariate logistic regression analysis, and OR and 95%CI values were calculated. Variables included in the models were represented by main known risk factors for mortality in STEMI patients (age, DM, hypertension, creatinine, troponin,LV-EF and CAD extension). A p-value <0.05 was considered significant and not significant if it is >0.05).

3. Results

The study included a total of 3081 STEMI patients, 16%($N = 498$) were female 64%($n = 318$) of them were diabetics and 36% ($n = 180$) had prolonged LOS ≥5 days.

3.1. Comparison of patients' data in reference to diabetes

3.1.1. Demographics and risk factors

Diabetic patients tend to present with STEMI at a younger age (59.5 ± 11 VS 60.9 ± 11.4, $P = 0.06$ for diabetic and non-diabetic patients respectively) with a higher prevalence of hypertension (78% vs 45%, p

< 0.001), obesity (40% vs 28%, $p = 0.006$), dyslipidemia (25% VS 14%), $P = 0.02$) and past history of IHD (ischemic heart disease) (25% VS 13%, $p = 0.003$). Table 1.

There were no significant recorded differences($p > 0.05$) among the two groups regarding smoking, previous history of cerebrovascular accident(CVA), Pilgrims numbers, the South Asian ethnicity, and previous history of revascularization. Table 1.

3.1.2. Laboratory data

Diabetic females had higher lipid profiles including LDL (115.8 ± 50 vs 115.3 ± 35, $p = 0.02$), total cholesterol (186.3 ± 56 vs 179 ± 40, p = 0.02), and triglycerides (149 ± 108 vs 119 ± 76, $p = 0.04$), more troponin leak (262 ± 88 vs 156 ± 75,p = 0.04), and a higher incidence of renal impairment(1.2 ± 1.5 vs 1 ± 0.7,p = 0.003) although they had a lower incidence of hemoglobin drop (3% vs 8%,p = 0.02). Table 2.

No significant difference was found concerning hemoglobin on admission and discharge, admission creatinine and troponin, sodium, and potassium levels. Table 2.

3.1.3. Coronary angiography data

Diabetic patients are less commonly presented by AWMI (47% vs 65%, $p = 0.001$), however, they tend to have a higher prevalence of LM stenosis in comparison to non-diabetic patients (4% vs 1%, $p = 0.06$). Table III, However, no difference was there per flurotime, contrast volume, intracoronary thrombus, need for tirofiban, the number of stents, and prevalence of the multivessel disease. Table 3.

3.1.4. In-hospital outcomes

Hospital outcomes including mortality, pulmonary edema, ventilation, cardiogenic shock, and cardiac arrest had no significant differences between the two groups ($p > 0.05$ for all), the same was noticed regarding LVEF and LOS. Table 3.

3.2. Comparison of patients' data in reference to LOS

36% of our patients had prolonged LOS ≥5 days, and about 26% of them was known ischemic heart disease. Those patients had higher BMI than the group with LOS <5 days (29 ± 6.2 VS 28 ± 5.1, $p = 0.04$). There was no significant difference between the 2 groups regarding age, hypertension, diabetes, smoking, and previous CVA history. Table 4.

The prolonged LOS group had a higher incidence of hemoglobin drop≥3 g (10% VS 2%, $p < 0.001$), higher admission troponin, peak creatinine, and blood urea nitrogen(BUN). Table 5.

22% of Patients with prolonged LOS received thrombolytic therapy versus 11% of the comparing group, $p = 0.003$ along with a higher prevalence of multivessel stenosis (21% vs 12%, $p = 0.007$ respectively). Table 6.

Regarding in-hospital complications, there was a significant difference between the 2 groups of LOS regarding pulmonary edema (9% vs 3%, p = 0.003) and cardiac arrest (7% vs 3%, $p = 0.02$) which necessitates ventilation (11% vs 4%, $p = 0.005$) with higher incidence documented in the prolonged LOS group. However, there was no significant difference was found between the 2 groups regarding mortality (5% vs 3%, $p = 0.3$). Table 6.

3.3. Correlations and multivariate logistic regression analysis

A negative correlation was detected between HBA1c and LVEF (p = 0.02) but a highly significant positive correlation was noticed between HBA1c and LOS ($p < 0.001$).

Table 1
Comparison of demographic data and risk factors between the diabetic and non-diabetic female STEMI patients.

Variable	Diabetic number % 318 (64%)	Non-diabetic number % 180(36%)	P-value
Age Mean ± SD	59.5 ± 11	60.9 ± 11.4	0.06
BMI (kg/m2) Mean ± SD	28.8 ± 5.3	28 ± 6.2	0.07
BMI ≥ 30	127(40%)	50 (28%)	0.006
HTN	248 (78%)	81 (45%)	<0.001
Smoking	19 (6%)	7 (4%)	0.6
Dyslipidemia	80 (25%)	25(14%)	0.02
CVA	13(4%)	5(3%)	0.7
History of IHD	80(25%)	23(13%)	0.003
Previous revascularization	13(4%)	9(5%)	0.4
Pilgrims	136(43%)	86(48%)	0.2
Arabic speaking	181(57%)	99(55%)	0.8
South Asian	92(29%)	45(25%)	0.3

BMI: Body Mass Index; DM: Diabetes Mellitus; HTN: Hypertension; CVA: Crebro-Vascular Accidents;IHD: Ischemic Heart Disease; CAD: Coronary Artery Disease.

Table 2
Comparison of laboratory data between the diabetic and non-diabetic female STEMI patients.

Variable	Diabetic number % 318 (64%)	Non-diabetic number % 180(36%)	P-value
Hb on admission(mg\dl)	12 ± 1.7	12.3 ± 2	0.1
Hb on discharge(mg\dl)	11.6 ± 1.7	11.8 ± 1.9	0.1
Hb drop≥3	10(3)	14(8)	0.02
MCV(fl)	10 ± 1.8	9.8 ± 2.4	0.3
HBA1c	9.2 ± 4.8	6.5 ± 1.9	<0.001
Glucose(mg\dl)	213 ± 9.2	140.5 ± 50.6	<0.001
Creatinine on admission (mg\dl)	1.1 ± 1.4	0.9 ± 0.7	0.3
Creatinine on discharge(mg \dl)	1.2 ± 1.5	1 ± 0.7	0.003
Troponin on admission(mg \dl)	109 ± 457	125 ± 383	0.5
Peak troponin (mg\dl)	262 ± 88	156 ± 75	0.04
BUN(mg\dl)	18 ± 11	16.4 ± 8.2	0.006
Sodium(mEq\L)	136 ± 4.8	137 ± 4.9	0.05
Potassium(mmol\L)	4.3 ± 2.2	4.1 ± 0.6	0.1
HDL(mg\dl)	41 ± 11	45.6 ± 11.4	0.8
LDL(mg\dl)	115.8 ± 50	115.3 ± 35	0.02
TG(mg\dl)	149 ± 108	119 ± 76	0.04
TC(mg\dl)	186.3 ± 56	179 ± 40	0.02

Hb: Hemoglobin; MCV: Mean Corpuscular Volume; HBA1c: Glycosylated Hemoglobin; BUN: Blood Urea Nitrogen; LDL: Low-Density Lipoprotein;HDL: High-Density Lipoprotein; TG: Triglyceride; TC: total Cholesterol.

Table 3
Comparison of coronary angiographic results, in-hospital outcomes and mortality between the diabetic and non-diabetic female STEMI patients.

Variable	Diabetic number % 318 (64%)	Non-diabetic number % 180(36%)	P-value
AWMI	149 (47%)	117 (65%)	0.001
NON-AWMI	229(72%)	50 (28%)	<0.001
Thrombolysis	57(18%)	27(15%)	0.2
LVEF	40.8 ± 10.7	41.3 ± 10.8	0.1
Contrast(ml)	125 ± 76.5	126.8 ± 75	0.8
Fluro-time(minute)	24.8 ± 21	10 ± 7.5	0.3
Thrombus Aspiration	38 (12%)	18 (10%)	0.3
Tirofiban	70 (22%)	40 (22%)	0.5
3VD	54(17%)	23(13%)	0.1
LM disease	13 (4%)	2(1%)	0.06
Number of stents	1.34 ± 0.86	1.24 ± 0.8	0.2
LV thrombus	2 (0.9%)	1(0.8%)	0.8
Pulmonary edema	16(5%)	7(4%)	0.3
Cardiogenic shock	13 (4%)	5(3%)	0.4
Ventilation	19 (6%)	10 (6%)	0.5
Cardiac Arrest	16 (5%)	7 (4%)	0.2
Length of stay (days)	5.9 ± 6.9	5.4 ± 7	0.4
In-hospital Mortality	16 (5%)	7 (4%)	0.4

AWMI: Anterior Wall Myocardial Infarction; LV: Left Ventricular; EF: Ejection Fraction; LM: Left Main; 3VD:3 Vessel Disease.

Table 4
Comparison of demographic data and risk factors between female STEMI patients with reference to in-hospital stay.

Variable	In-hospital stay ≥5 number % 180(36%)	In-hospital stay <5 number % 318 (64%)	P-value
Age Mean ± SD	59.8 ± 10.8	59.9 ± 11.4	0.8
BMI (kg/m2) Mean ± SD	29 ± 6.2	28 ± 5.1	0.04
BMI ≥ 30	72(40%)	101 (32%)	0.06
DM	111(62%)	203 (64%)	0.3
HTN	128 (71%)	200 (63%)	0.06
Smoking	5 (3%)	19 (6%)	0.1
Dyslipidemia	25 (14%)	32(10%)	0.06
CVA	7 (4%)	6(2%)	0.2
History of IHD	47(26%)	54 (17%)	0.01
Previous revascularization	9(5%)	16(5%)	0.8
Pilgrims	77(43%)	153(48%)	0.06
Arabic speaking	71(63%)	165(52%)	0.06
South Asian	68(38%)	165(52%)	0.2

BMI: Body Mass Index; DM: Diabetes Mellitus; HTN: Hypertension; CVA: Cerebro- Vascular Accidents; IHD: Ischemic Heart Disease; CAD: Coronary Artery Disease.

Table 5
Comparison of laboratory data between female STEMI patients with reference to in-hospital stay.

Variable	In-hospital stay ≥5 number % 180(36%)	In-hospital stay <5 number % 318 (64%)	P-value
Hb on admission(mg \dl)	12 ± 1.8	12.3 ± 1.9	0.1
Hb on discharge(mg \dl)	11.3 ± 1.7	11.9 ± 1.8	< 0.001
Hb drop≥3	18(10)	6(2)	<0.001
MPV(fl)	10 ± 1.8	9.8 ± 2.4	0.3
HBA1c	8.6 ± 6.4	8 ± 2.3	0.3
Glucose(mg\dl)	182.6 ± 88.5	193.2 ± 87.3	0.5
Creatinine on admission(mg\dl)	1.3 ± 1.8	1.5 ± 8.7	0.7
Creatinine on discharge(mg\dl)	1.4 ± 1.9	0.9 ± 0.7	0.001
Troponin on admission (mg\dl)	169 ± 687.8	83 ± 186	0.05
Peak troponin (mg\dl)	88 ± 196	75.3 ± 195	0.4
BUN(mg\dl)	19 ± 11.4	16.5 ± 8.8	0.006
Sodium(mEq\L)	136.4 ± 4.6	136.4 ± 5	0.9
Potassium(mmol\L)	4.3 ± 3	4.2 ± 2.4	0.5
HDL(mg\dl)	43 ± 11	42 ± 11	0.9
LDL(mg\dl)	116 ± 43	115.8 ± 45	0.09
TG(mg\dl)	151.9 ± 109	126.8 ± 87	0.8
TC(mg\dl)	184 ± 4.7	183 ± 51.6	0.1

Hb: Hemoglobin; MCV: Mean Corpuscular Volume; HBA1c: Glycosylated Hemoglobin; BUN: Blood Urea Nitrogen; LDL: Low-Density Lipoprotein;HDL: High-Density Lipoprotein; TG: Triglyceride; TC: total Cholesterol.

The multivariate logistic regression analysis indicated that DM, hemoglobin drop, creatinine level, and LVEF were significant predictors of prolonged LOS ≥ 5 days in female STEMI patients (Table 7) but HBA1c, BMI ≥30, STEMI type, and peak creatinine level were the independent predictors of prolonged LOS in between female diabetic patients. Table 8.

However, LOS was not a significant indicator of in-hospital death as age ≥ 65 years and LVEF were the significant independent predictors of mortality ($p = 0.04,0.02$ respectively) in diabetic female STEMI patients. Table 9.

4. Discussion

According to the International Diabetes Federation Diabetes Atlas (8th edition), Saudi Arabia is among the top 10 countries in diabetes prevalence [14].

Diabetes is considered an independent risk factor for increased mortality and morbidity in CAD patients. In Saudi Arabia, the prevalence of diabetes among ACS patients reaches up to 56% with poor outcomes following revascularization by both percutaneous and surgical techniques. The mortality rate among diabetic patients with CAD is more than doubled in men and increased more than fourfold in women compared to non-diabetic CAD patients [15].

The present study provides a rough estimation of the prevalence of diabetes among female STEMI patients, with diabetic female patients representing about 64% of the study population, and with more prevalence of HTN, obesity, and dyslipidemia as risk factors for coronary artery disease [16].

Our results concluded that DM and HBA1c were predictors of mortality in female STEMI and female STEMI with DM, respectively.

Table 6
Comparison of coronary angiographic results, in-hospital outcomes and mortality between female STEMI patients with reference to in-hospital stay.

Variable	In-hospital stay ≥5 number % 180(36%)	In-hospital stay <5 number % 318 (64%)	P-value
AWMI	99 (55%)	165 (52%)	0.6
NON-AWMI	76(42%)	146 (46%)	0.6
Thrombolysis	40(22%)	35(11%)	0.003
LVEF	39.9 ± 11.3	41.7 ± 10.3	0.04
Contrast(ml)	125 ± 76.5	126.8 ± 75	0.8
Fluro-time (minute)	26.8 ± 21	13 ± 7.5	0.3
Thrombus Aspiration	23 (13%)	38 (12%)	0.3
Tirofiban	41 (23%)	60 (19%)	0.2
3VD	38(21%)	38(12%)	0.007
LM disease	5 (3%)	6(2%)	0.4
Number of stents	1.29 ± 0.96	1.3 ± 0.8	0.7
LV thrombus	2 (1.2%)	10(0.3%)	0.2
Pulmonary edema	16(9%)	10(3%)	0.003
Cardiogenic shock	7 (4%)	6(2%)	0.2
Ventilation	20 (11%)	22 (4%)	0.005
Cardiac Arrest	13 (7%)	10 (3%)	0.02
Length of stay (days)	11.3 ± 9	2.5 ± 1	<0.001
In-hospital Mortality	9 (5%)	10 (3%)	0.3

AWMI: Anterior Wall Myocardial Infarction; LV: Left Ventricular; EF: Ejection Fraction; LM: Left Main; 3VD:3 Vessel Disease.

Table 7
Multivariate logistic regression analysis for a prolonged hospital stay in female STEMI patients.

	P value	OR
Age	0.535	0.990
DM	0.047	0.223
BMI	0.937	1.003
HTN	0.329	0.703
Smoking	0.272	0.679
Dyslipidemia	0.209	2.075
Post-PCI_EF	0.035	0.964
First Troponin	0.294	0.999
Peak Troponins	0.936	1.000
Hb drop ≥ 3	0.027	11.524
STEMI Type	0.109	1.683
Glucose	0.987	1.000
Peak Creatinine	0.019	3.485
Admission Creatinine	0.053	0.363
HbA1C	0.893	1.012
3VD	0.084	2.212
LM	0.969	0.967
Number of Stents	0.494	0.872

Table 8
Multivariate logistic regression analysis for a prolonged hospital stay in diabetic female STEMI patients.

	P value	OR
Age	0.392	0.972
BMI	0.090	0.810
BMI ≥ 30	0.006	0.015
Smoking	0.381	0.363
HTN	0.162	0.273
CVA	0.999	959,677,023.55
Dyslipidemia	0.586	0.485
STEMI Type	0.105	
AWMI	0.050	0.014
Non-AWMI	0.034	0.010
Thrombolysis	0.259	0.401
Late_presenting_24hr	0.725	1.393
Hb drop ≥ 3(1)	0.998	0.000
HbA1C	0.044	1.424
Peak Creatinine	0.022	2.634
Admission Troponin	0.245	1.003
Peak Troponins	0.910	1.000
LMS	0.999	7,244,839.108
3VD	0.187	0.183
Aspiration	0.288	2.560
Pulmonary Edema	0.187	0.076
Cardiogenic Shock	0.998	0.000
Ventilation	0.999	0.000
Cardiac Arrest	1.000	0.027
LVEF	0.970	1.001
LV thrombus	0.212	0.207

Table 9
Multivariate logistic regression analysis for in-hospital mortality in diabetic female STEMI patients.

	P value	OR
Age ≥ 65 years	0.048	0.353
LVEF	0.026	0.838
Admission Troponin	0.242	1.003
Peak Troponins	0.238	1.002
Hb drop ≥ 3	0.999	0.000
STEMI Type	0.168	5.233
BMI	0.481	0.877
HTN	0.336	0.256
Smoking	0.991	0.000
Dyslipidemia	0.998	0.000
Glucose	0.749	1.003
Peak Creatinine	0.162	9.181
Admission Creatinine	0.220	0.091
HbA1C	0.760	1.079
3vCAD	0.632	0.381
LMS	0.061	20.901
No of Stents	0.741	1.227

Furthermore, uncontrolled diabetes was correlated with prolonged LOS and myocardial dysfunctions.

It is hypothesized that hyperglycemia contributes to worse outcomes during AMI incidents because it causes an initial rise in cortisol and catecholamine levels because of sympathetic nervous system activation, which is a physiological reaction to stress [17]. More importantly, the acute increase of ABG level activates inflammation and oxidative stress, exacerbates endothelial dysfunction and microcirculatory disturbance, induces a prothrombotic state, and then leads to coronary flow impairment, increased infarct size, and poor cardiac function, which are closely related to long-term prognosis [18–21]. For example, Timmer et al. reported that hyperglycemia was a strong predictor of no reperfusion before primary PCI (odds ratio 2.6, 95%CI 1.5–4.5) [22].

Our study showed that diabetic patients were less commonly presented by AWMI, which might be the cause of the non-significant difference between the 2 groups regarding LVEF but tend to have a higher prevalence of more complex CAD in the form of left main significant disease [17]. In-hospital complications including pulmonary edema, ventilation, cardiogenic shock, cardiac arrest, and mortality had numerically higher incidence among diabetic females but there were no statistically significant differences detected between diabetic and non-diabetic groups which can be justified by the younger age of female diabetics and less presentation by AWMI with minor Impairment of LVEF.

Hospital stay post-AMI has been efficiently decreased over the years. In the 1970s, seven days of hospitalization were considered a short hospital stay [23,24]. Numerous risk assessment scores have been used for patients with AMI [25–28]. Guidelines recommended 48–72 h hospitalization for low-risk patients [29].

Early invasive techniques can predict a shorter hospital stay, but patients' demographic and clinical features expect only 6% of the difference in-hospital stay.

The quality, type of health facility, and occurrence of in-hospital complications explained about 27% of the variance. Financial and organizational factors also would possibly have an effect on hospitalization period variations [30].

Vejdaniet al., in a study on 3330 elderly patients, showed that the mean of patients' LOS in all wards and the CCU ward was 4.8 and 5.1 days, respectively, which is in line with our results. Concerning the factors correlated to LOS, there was no relationship between sex and LOS, but there was a direct relationship between age and LOS in the hospital [31].

In agreement with our study, in 2018, Wegiel et al.'s study showed that in a multivariate analysis, patients' age, LVEF, and the presence of ST-elevation MI and MVD were independent predictors of hospitalization for ≥8 days [30]. Similarly A study on 267 STEMI patients determined that DM, LVEF, multiple CAD, and Killip classification are the most important predictors of LOS in the study [32].

According to Swaminathan et al., long-term discharge predictors for 33,920 STEMI patients included high age, female gender, patients with cardiogenic shock, and several CAD [33].

Age is a strong predictor of outcome in myocardial infarction and was recognized as 1 of the 5 prognostic factors in the GUSTO-1 study [34]. Likewise other studies found that age was one of the most significant predictors of 30-day mortality for STEMI patients [35,36].

Lower LV-EF correlates with both in-hospital and long-term mortality. The acute drop in LV function occurs because of both transient stunned and hibernating myocardium which could be reversible when blood flow is reestablished. In the incident of STEMI, LVEF depression commonly concurs with CS (cardiogenic shock) at admission [37,38].

In 2022, Barbieri et al. studied a total of 283 STEMI patients during the COVID-19 pandemic and determined that age and reduced EF remained the only independent predictors of mortality among STEMI patients, regardless of gender [39].

Our study aimed to spotlight STEMI females, especially diabetics, as a high-risk group for complications and mortality who need more efforts directed to give the best effective care in the shortest periods. More studies should be dedicated to detecting factors that prolong hospitalizations in those patients as shorter hospital stays decrease the risk of nosocomial hospital-acquired infections and grant low cost with rapid return of the patient to his normal.

5. Conclusions

DM, bleeding, renal impairment and LVEF were discovered to be significant independent predictors of prolonged LOS among females although HBA1c, BMI ≥30, STEMI type, and peak creatinine level were the independent predictors of prolonged LOS among female diabetic patients. Prolonged LOS cannot predict mortality as age ≥ 65 years and LVEF were found to be the significant predictors of mortality among STEMI female patients. Uncontrolled DM significantly correlated with LVEF and LOS although it cannot independently expect prolonged LOS or mortality.

5.1. Study limitations

- Being a retrospective, a non-randomized study has the usual limitations which characterize observational studies. Also, the nature of a single center. Validation in a multicenter larger population with longer follow-up is highly recommended.
- Reality of a tertiary care center, our data and results could be affected by the high chance to receive more severe cases.
- A lot of administrative issues delaying patients' discharges can also affect LOS which should be studied in parallel with patient clinical data.

CRediT authorship contribution statement

Ghada Shalaby: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Sameh Sabri:** Data curation, Investigation, Methodology, Resources, Software. **Asma Nabat Safar Alsilami:** Data curation, Investigation, Resources. **Reem Yousef Alhassani:** Data curation, Investigation, Resources. **Suha Hashem Alsayed:** Data curation, Investigation, Resources. **Mohannd Amin Wasel Alhazmi:** Conceptualization, Investigation, Resources. **Mohamed Thabet Aoudallah:** Data curation, Investigation, Resources. **Sheeren Khaled:** Data curation, Formal analysis, Investigation, Resources, Software, Methodology.

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