Journal of the Saudi Heart Association

Volume 34 | Issue 4 Article 2

2022

Cardiogenic Shock Among Patients with Acute Myocardial Infarction in a middle eastern Country: A Single-centre experience

Recommended Citation
Shalaby, Ghada; Niazi, Azmat Khadija; and Khaled, Sheeren (2022) "Cardiogenic Shock Among Patients with Acute Myocardial Infarction in a middle eastern Country: A Single-centre experience," *Journal of the Saudi Heart Association*: Vol. 34 : Iss. 4 , Article 2.
Available at: https://doi.org/10.37616/2212-5043.1323

ORIGINAL ARTICLE

Cardiogenic Shock Among Patients with Acute ST-Segment Elevation Myocardial Infarction in a Middle Eastern Country: A Single-Center Experience

Ghada Shalaby[1,*], Azmat K. Niazi, Sheeren Khaled[2]

Cardiac Center, King Abdullah Medical City, Muzdallfa Road, Makkah, Saudi Arabia

Abstract

Background: **Cardiogenic Shock (CS) remains the most common cause of death in hospitalized acute ST-segment elevation myocardial infarction (STEMI) patients. Predictors of outcomes in those patients include clinical, laboratory, radiologic variables, and management strategies. The present study aimed to evaluate the incidence, characteristics, predictors of cardiogenic shock and mortality among acute ST-segment elevation myocardial infarction patients in our center.**

Methods: **This was a retrospective, single-center study conducted at KAMC, Makkah during 2015−2020. All acute ST-segment elevation myocardial infarction patients during this era were divided into two groups CS group and non-CS group.**

Results: **In this study total 3074 acute ST-segment elevation myocardial infarction patients of which 132(4.3%) patients had CS. CS group tended to have higher ages than non-CS group. Pilgrims were more complicated by CS than non-pilgrims. Subsequently, CS patients had a highly significant ($p < 0.001$ for all) increase in the incidence of in-hospital complications including pulmonary oedema, cardiac arrest and ventilation. There was a significant increase in hospital stay length and in-hospital mortality among CS patients. Renal impairment, peak troponin level, haemoglobin drop≥3 gm/dl, and Left ventricular ejection fraction (EF) were significant independent predictors of cardiogenic shock among our patients. However, STEMI type, left main disease, and EF was the independent predictors of CS among our patients with diabetes with EF cut-off value of 35% with a sensitivity of 74.6% and a specificity of 65.3%. Age was the only independent predictor of mortality among CS patients. Though age, female gender, and diabetes were found to be the independent predictors for in-hospital mortality among our patients.**

Conclusion: **High-income middle eastern countries have comparable outcomes to Europe and USA among patients with acute ST-segment elevation myocardial infarction patients with higher improvement of medical care in the last 2 to 3 decades. Renal impairment, peak troponin, severe bleeding and ejection fraction were significant independent predictors of CS in acute ST-segment elevation myocardial infarction patients. However, STEMI type, left main disease, and ejection fraction were the independent predictors of CS in acute ST-segment elevation myocardial infarction patients with diabetes. Age was the only independent predictor of mortality among CS patients.**

Keywords: Predictors, Cardiogenic shock, Mortality, Diabetes, Acute myocardial infarction

1. Introduction

Cardiogenic shock(CS) continues to be associated with high rates of morbidity and mortality, posing a therapeutic challenge for cardiologists [1]. Despite the expansion of cardiac critical care units, development of reperfusion networks and progress of mechanical circulatory support.

In-hospital mortality of acute myocardial infarction patients with cardiogenic shock decreased from 62.2% in 1997 to 36.3% in 2017, this is mostly

Received 14 October 2022; revised 20 November 2022; accepted 16 December 2022.
Available online 20 January 2023

* Corresponding author.
E-mail address: ghadashalaby10@gmail.com (G. Shalaby).
[1] Ghada Shalaby is affiliated with Zagazig University, Zagazig, Egypt.
[2] Sheeren Khaled is affiliated with Banha University, Banha, Egypt.

https://doi.org/10.37616/2212-5043.1323

attributed to the growth in primary PCI. Yet, cardiogenic shock patients who survive to reach hospital discharge still have a higher rate of mortality post-discharge [2].

Cardiogenic shock occurs in 5%–10% of patients presenting with acute myocardial infarction [3]. Patients presenting with ST-elevation myocardial infarction are 2-fold more likely to present with CS than those presenting with non-STEMI (5.9% vs 2.9%) [4].

Some of the independent predictors of 1-year survival were described in several studies to be advanced age, LVEF, peak serum creatinine, [5] Killip class IV on admission, low systolic blood pressure on admission, peripheral arterial disease, and stroke [4]. Multiple risk scores have been created using these and other clinical characteristics such as absence of revascularization, the use of mechanical ventilation, levels of C-reactive protein and interleukin-6 to identify patients at the highest risk for short and long-term adverse outcomes [6–8].

Significant areas of uncertainty still remain regarding clinical profile, risk stratification and management of these complex patients [9].

Cardiogenic shock progresses about 2–3 times higher among diabetics as among nondiabetic patients with acute myocardial infaraction [10]. unfortunately, those patients have greater risks of mortality and adverse cerebrovascular events than non-diabetic patients [11].

Diabetes is commonly associated with obesity, hypertension and dyslipidemia which magnify its risk for adverse cardiac events. Still, diabetes' impact on the prognosis of patients with cardiogenic shock needs further studies for clarification [11].

Understanding the treatment characteristics and clinical outcomes in this subset of patients at our center may give valuable insights into the existing practices and unmet needs in our regional systems of care for those patients presenting with CS and STEMI especially if they were diabetic. Consequently, we aimed in this study to evaluate the incidence, characteristics, predictors of cardiogenic shock and mortality among STEMI patients with special consideration for diabetes. Also to evaluate standard of care of CS patients in one of high income middle eastern Countries.

Abbreviation

3VD	3 Vessel Disease
AMI	Acute Myocardial Infarction
BMI	Body Mass Index
BUN	Blood urea nitrogen
CS	Cardiogenic shock
CVA	Cerebro- Vascular Accidents
DM	Diabetes Mellitus
EF	Ejection Fraction
HTN	Hypertension
IHD	Ischemic Heart Disease
LBBB	left bundle branch block
LM	Left Main
LV	Left ventricle
MI	Myocardial infarction
PCI	Percutaneous coronary intervention
STEMI	ST-elevation myocardial infarction
VS	Versus

2. Methods

This retrospective study was held at the only public sector cardiothoracic center of the Holy Makkah region providing tertiary level cardiac services. A total of 3074 acute ST-segment elevation myocardial infarction patients were selected from Makkah STEMI registry from 2015 to 2020 and included all patients who presented with acute ST-segment elevation myocardial infarction who underwent 1ry PCI, rescue PCI, post thrombolysis (within 1 week of thrombolysis) or late presenting myocardial infarction for routine coronary angiography with or without PCI then divided into two groups CS group and non-CS group.

Group 1:(Cardiogenic shock group)

CS was defined as: 1) hypotension (systolic blood pressure <90 mm Hg for at least 30 min or the need for pharmacological support to maintain systolic blood pressure above 90 mm Hg); and 2) signs and symptoms of end-organ hypoperfusion.

Well perfused hypotensive patients and patients with transient episodes of hypotension reversed with intravenous fluid or atropine did not establish cardiogenic shock. [12] CS patients included patients who developed criteria of cardiogenic shock early <24 or late ≥24 h of acute ST-segment elevation myocardial infarction during in-hospital course. [13] Patients with CS on admission were excluded.

Group 2:(Non cardiogenic shock group)

Patients with acute myocardial infarction with normal blood pressure.

2.1. Data collection

Acute ST-segment elevation myocardial infarction patients are referred to this centre for further management. The patient's data comprised of those who sustained myocardial infarction and were brought for either primary PCI, post thrombolysis (within 1 week of thrombolysis) or late presenting myocardial infarction for routine coronary angiography with or without PCI. Demographic, clinical outcomes and hemodynamic data were obtained from the electronic and medical records. Patients with diabetes, hypertension or known smokers were identified from history and case notes. Acute myocardial infarction was defined as acute ST-segment elevation myocardial infarction in initial electrocardiogram.

EF was taken out from echocardiography which was done on admission or directly after coronary angiography for patients who underwent primary or rescue PCI first before echocardiography. STEMI type referred to acute myocardial infarction ECG patterns.

This study outcome included short term in-hospital outcomes as mortality, bleeding, pulmonary oedema, cardiac arrest, ventilation, new renal impairment, length of hospital stay.

2.2. Statistical analysis

The statistical analysis was performed using SPSS version 20. Data presented as mean, standard deviation for continuous data and percentages for categorical variables. Baseline and in-hospital characteristics were compared in both groups according to the outcomes data. Univariate analysis was done using t-test or chi-squared test for continuous and categorical variables respectively. A p value <0.05 was considered significant. A multivariate logistic regression was performed for independent predictors of mortality and shock.

A receiver operating characteristic (ROC) curve analysis was performed to evaluate for LVEF as a predictor of mortality in diabetic patients. The overall performance was assessed by the Total area under the curve and the cut-off values were determined based on the best trade-off between the sensitivity and specificity.

3. Results

In this study incidence of cardiogenic shock equals (4.3%) among our patients who had a mean age 57.92 ± 11.8, with about 88% were males,60% were diabetic, 59% were hypertensive and 60% were obese. Arabic speaking represents 58%, South Asian were 34% and 58% of our population were pilgrims (Table 1). Mortality among CS group was 30.3% (Table 3).

Table-1,2,3 describes the various quantitative factors compared in patients with and without cardiogenic shock. A high number of factors significantly (p-value <0.05) associated with cardiogenic shock were BMI, haemoglobin at admission and discharge, serum Sodium and Potassium level, 1st and 2nd creatinine, BUN, 1st and 2nd Troponin, length of hospital stay and ejection fraction.

CS group tended to have higher ages than non-CS group (58 ± 11.8 vs. 56 ± 11.9, p = 0.06, in CS and non-CS patients respectively). Pilgrims with STEMI were more complicated by CS than non-pilgrims (58% vs. 30%, p-value = 0.003). While CS patients had significantly lower BMI in comparison to non-CS patients (27 ± 4.7 vs. 27.9 ± 5.2, p < 0.05, respectively) which may be denoted as obesity paradox. Regarding demographic characters of our patients, (gender, smoking, diabetes, hypertension, dyslipidaemia and cerebro-vascular accidents), there was no significant difference (p > 0.05 for all) between both groups. Table 1.

Serum creatinine pre and post coronary angiography had significantly higher values in CS group, the same had serum troponin level on admission and peak values. While CS patients had significantly lower levels of potassium and haemoglobin on admission and discharge with more percentage of haemoglobin drop≥3 gm/dl among CS patients (20% vs. 5%, p < 0.001) (Table 2).

Frequency of various factors compared in patients with and without cardiogenic shock. Haemoglobin drop≥3, left main disease, three vessels coronary artery disease, hospital death, pulmonary oedema, cardiac arrest, ejection fraction ≤30, trans radial and intubation and ventilation were the significant factors associated with cardiogenic shock (Table 3).

Table 1. Comparison of demographic data and risk factors between CS and non-CS group.

Variable	CS number % 132 (4.3%)	Non-CS number % 2942(95.7%)	P-value
Age Mean ± SD	57.92 ± 11.83	55.97 ± 11.850	0.065
Male	116 (87.88%)	2460(83.62%)	0.199
BMI (kg/m2) Mean ± SD	27 ± 4.72	27.862 ± 5.18	0.045
BMI≥30	79 (59.85%)	832(28.28)	0.003
DM	79 (59.85%)	1590 (54.04%)	0.190
HTN	78 (59.09%)	1565 (53.2%)	0.184
Smoking	79 (59.85%)	973 (33.07%)	0.950
Dyslipidemia	20 (15.15%)	425(14.45%)	0.822
CVA	5(3.79%)	72(2.45%)	0.335
History of IHD	28(21.21%)	588(19.99%)	0.731
Previous revascularization	9(6.82%)	205(6.97%)	0.947
Pilgrims	76(57.57%)	858(29.16%)	0.003
Arabic speaking	76(57.57%)	2460(83.62%)	0.505
South Asian	45(34.10%)	858(29.16%)	0.239

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 CS and non CS group.

Variable	CS number % 132 (4.3%)	Non-CS number % 2942(95.7%)	P-value
Hb on admission (mg∖dl)	13.19 ± 2.69	13.86 ± 2.02	<0.001
Hb on discharge (mg∖dl)	11.94 ± 2.45	13.4 ± 2.02	<0.001
Hb drop≥3(%)	27 (20.6%)	141 (4.8%)	<0.001
MCV(fl)	9.85 ± 2.41	11.94 ± 1.94	0.433
HBA1c	7.34 ± 2.28	7.69 ± 2.91	0.132
Glucose (mg∖dl)	201.2 ± 82.2	174.52 ± 78.64	0.103
Creatinine on admission (mg∖dl)	1.92 ± 2.39	1.24 ± 3.26	0.021
Creatinine on discharge (mg∖dl)	2.27 ± 1.954	1.22 ± 1.17	<0.001
Troponin on admission (mg∖dl)	200.51 ± 347.61	87.93 ± 247.08	<0.001
Peak troponin (mg∖dl)	213.01 ± 358.59	90.97 ± 218.08	<0.001
BUN (mg∖dl)	22.99 ± 14.58	17.07 ± 9.4	<0.001
Sodium (mEq∖L)	138.19 ± 6.04	136.52 ± 5.29	0.001
Potassium (mmol∖L)	4.03 ± 0.71	4.17 ± 0.89	0.032

Hb: Hemoglobin; MCV: Mean Corpuscular Volume; HBA1c: Glycosylated Hemoglobin; BUN: Blood Urea Nitrogen.

Although most patients of CS group underwent coronary angiography through radial approach, they needed significantly larger contrast volumes with prolonged radiation time during coronary angiography. While there was no significant difference between the two groups regarding the need for thrombus aspiration or tirofiban use. Multivessel and left main coronary artery disease (28% vs. 15%, $p < 0.001$ for multivessel and 9% vs. 3% $p = 0.001$ for left main disease) had higher prevalence among CS patient in comparison to the other group thus they need multivessel stents deployment (Table 3).

Subsequently, CS patients had highly significant ($p < 0.001$ for all) increase in incidence of in-hospital complications including pulmonary oedema, ventilation and cardiac arrest but left ventricular ejection fraction was significantly lower in CS patients (31 ± 13.6, vs. 41 ± 10.4, $p < 0.001$). There was highly significant increase in-hospital mortality in CS patients (30% vs 2%, $p < 0.001$) (Table 3).

Peak creatinine, and troponin, haemoglobin drop≥3 gm/dl (p value 0.002, 0.009, 0.04 respectively), and left ventricular ejection fraction ($p < 0.001$) were significant independent predictors

Table 3. Comparison of coronary angiographic results, in-hospital outcomes, and mortality between CS and non-CS group.

Variable	CS number % 132 (4.3%)	Non-CS number % 2942(95.7%)	P-value
AWMI	69 (52.3%)	1599 (54.35%)	0.693
IWMI	56(42.4%)	1207 (41.03%)	0.693
Trans-radial CAG	57(43.2%)	2315(78.7%)	<0.001
EF	31.31 ± 13.57	41.37 ± 10.38	<0.001
Contrast(ml)	150.56 ± 67.68	128.87 ± 75.03	0.001
fluoroscopic time(minute)	15.64 ± 50	13.34 ± 9.71	0.04
Thrombus Aspiration	19 (14.4%)	359 (12.2%)	0.3
Tirofiban	29 (21.97%)	719 (24.44%)	0.731
3VD	37(28.03%)	443(15.24%)	<0.001
LM disease	11 (8.5%)	79(2.7%)	<0.001
Number of stents	1.55 ± 0.89	1.3 ± 0.81	0.002
LV thrombus	28 (21%)	576(19.58%)	0.907
Pulmonary edema	43(32.58%)	98(3.33%)	<0.001
Ventilation	77 (58.3%)	70 (2.4%)	<0.001
Cardiac Arrest	71 (53.79%)	98 (3.33%)	<0.001
Length of stay (days)	9.06 ± 10.48	5.51 ± 7.73	<0.001
In-hospital Mortality	40 (30.3%)	55 (1.87%)	<0.001

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

Table 4. : Regression analysis of predictors of CS among STEMI patients.

	B	S.E.	Wald	df	Sig.	Exp(B)
HbA1C	−0.138	0.076	3.311	1	0.069	0.871
Gender	−0.384	0.423	0.823	1	0.364	0.681
AWMI	0.278	1.059	0.069	1	0.793	1.321
IWMI	0.799	1.061	0.567	1	0.451	2.223
Hb_drop≥3	−0.793	0.397	3.995	1	0.046	0.452
First Creatinine	−0.174	0.117	2.199	1	0.138	0.840
Peak Creatinine	0.307	0.098	9.817	1	0.002	1.360
Peak Troponins	0.001	0.000	6.778	1	0.009	1.001
LM	−0.828	0.506	2.678	1	0.102	0.437
3VD	0.006	0.337	0.000	1	0.986	1.006
EF	−0.074	0.012	36.025	1	0.000	0.928
DM	−0.216	0.312	0.477	1	0.490	0.806
Age	0.000	0.012	0.000	1	0.997	1.000
BMI	−0.069	0.044	2.412	1	0.120	0.933
Constant	5.871	2.305	6.485	1	0.011	354.580

HBA1c: Glycosylated Hemoglobin, AWMI: Anterior wall myocardial infarction; IWMI; Inferior wall myocardial infarction; LM: left main; 3VD; 3 vessel disease; LVEF: Left ventricular ejection fraction; Hb: Hemoglobin; DM: diabetes Mellitus; BMI; Body mass index.

Table 5. Regression analysis for predictors of mortality in CS patients with diabetes.

	B	S.E.	Wald	df	Sig.	Exp(B)
BMI	−0.064	0.041	2.420	1	0.120	0.938
HbA1C	−0.122	0.085	2.057	1	0.152	0.885
Male	0.379	0.506	0.561	1	0.454	1.461
Smoking	−0.628	0.382	2.705	1	0.100	0.534
HTN	−0.200	0.404	0.244	1	0.621	0.819
STEMI type	0.723	1.147	11.579	2	0.003	0.857
Hb_drop≥3	−0.477	0.589	0.657	1	0.418	0.620
Peak Creatinine	−0.137	0.349	0.155	1	0.694	0.872
Peak Troponin	0.000	0.000	2.167	1	0.141	1.000
LM	−1.413	0.566	6.231	1	0.013	0.243
3VD	0.002	0.421	0.000	1	0.997	1.002
EF	−0.100	0.017	34.059	1	0.000	0.905
Constant	6.649	2.376	7.827	1	0.005	771.821

HBA1c: Glycosylated Hemoglobin, AWMI: Anterior wall myocardial infarction; IWMI; Inferior wall myocardial infarction; LM: left main; 3VD; 3 vessel disease; LVEF: Left ventricular ejection fraction; Hb: Hemoglobin; DM: diabetes Mellitus; BMI; Body mass index.

of cardiogenic shock in ST-segment elevation myocardial infarction patients (Table 4). However, STEMI type, left main disease (p value 0.003,0.01 respectively), and ejection fraction ($p < 0.001$) were the independent predictors of cardiogenic shock in ST-segment elevation myocardial infarction patients with diabetes (Table 5) with ejection fraction cut-off value of 35% with sensitivity of 74.6% and specificity of 65.3%. Fig. 1.

Age was the only independent predictor of mortality ($p = 0.03$) among CS patients (Table 6). Although age, female gender, and diabetes were found to be the independent predictors for in-hospital mortality among ST-segment elevation myocardial infarction patients (P = 0.002, 0.04 and 0.05 respectively) (Table 7).

4. Discussion

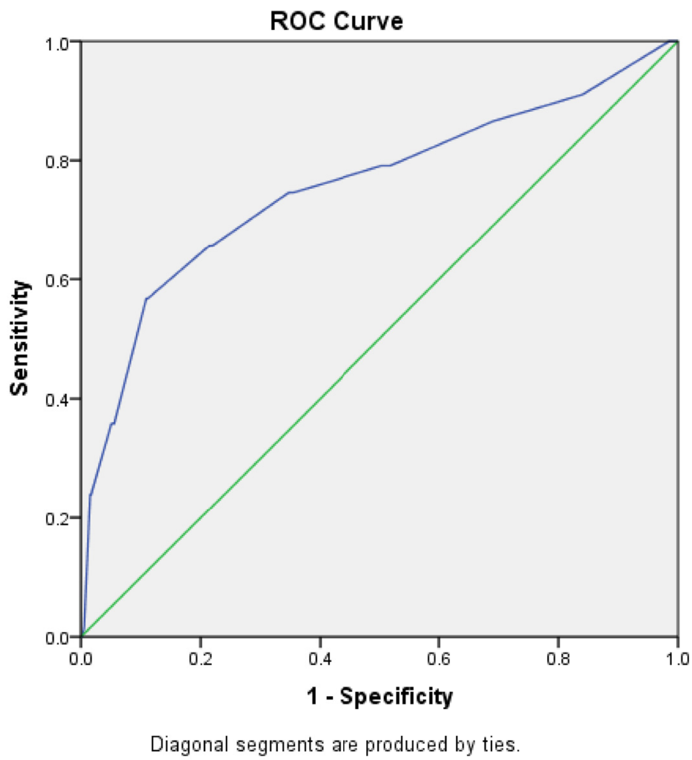
Cardiogenic shock among acute myocardial infarction patients most commonly occurs as a consequence of severe left ventricular dysfunction and it continues to be the most common cause of death in patients hospitalized with acute myocardial infarction. Various related factors have been nominated to be the important predictors for cardiogenic shock.

Here we describe the prevalence, characteristics and in-hospital outcomes of ST-segment elevation myocardial infarction patients with CS admitted to the coronary care unit of a middle eastern tertiary medical centre specialized in cardiovascular diseases in Saudi Arabia, a high income country in the middle east. Our study findings showed the overall prevalence rates for CS associated with ST-segment elevation myocardial infarction were similar to those reported in the large registries in Europe and the USA with a very good prognosis when compared with similar studies conducted in high-income countries in Europe and the USA which reflects improved medical care during last 2 decades in Saudi Arabia [14,15].

In present study, age was the only significant independent predictor of mortality among CS patients.CS group tended to have higher ages than non-CS group however difference was insignificant. Various studies have presented age as poor predictor of CS [16]. Early revascularization also have been reported to lack the benefit for obstructed coronaries among CS patients aged ≥75 years. On the other hand, early revascularization has been reported to have a significant better survival response. Various unfavourable features consisting poor intra-aortic balloon pumping and lower left ventricle ejection fraction are also presented among elderly groups of pilgrims undergoing revascularization [17].

Pilgrims presenting with ST-segment elevation myocardial infarction were more complicated by CS than non-pilgrims (58% vs. 29%, p-value = 0.003) in this study. Similarly, patients with CS had significantly lower body mass index as compared to those without it. There was no significant difference ($p > 0.05$ for all) between both groups regarding gender, predisposing factors for coronary artery disease including smoking, diabetes, hypertension, dyslipidaemia and cerbro-vascular accidents in present study. A recent study revealed higher ages of pilgrims posing lower cardiovascular risk factors and less likely to take thrombolytic therapy thus to show lesser presentations of acute myocardial infarction, higher left ventricular dysfunction following acute myocardial infarction and possess critical anatomy of coronary artery disease in angiography. Poor hospital outcomes are also revealed among pilgrims having acute myocardial infarction despite primary PCI procedure and undergo CS, pulmonary oedema, cardiac arrest, mechanical ventilation and hospital mortality. Likewise, the study posed two independent mortality predictors following acute myocardial infarction among which pilgrims is one of them and existence of left ventricular systolic dysfunction is the other one [18]. Thus the findings are comparable to the present results where age, female gender and diabetes were found to be the independent predictors for in-hospital mortality among our patients.

Results of another recent study are in agreement to the present findings which undertook a trend of CS hospitalization along mortality in United States.



Cut-off value of 35%, sensitivity 74.6% , specificity of 65.3%

Area Under the Curve

Test Result Variable(s):

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.756	.037	.000	.684	.828

Fig. 1. ROC curve for EF as a predictor of mortality in diabetic patients.

The study revealed a stable surge in CS hospitalization ranging 122 to 408 per 100,000 from 2004 to 2018 respectively. On the other hand, this increase was allied with steady decline in hospital mortality from 49% to 37% through adjusted trends of overall population during 2004–2018 respectively. Similarly, continuous tendencies abridged mortality among patients of CS and non-CS with acute myocardial infarction were reported among men, women, variable ethnicity and different capacity hospitals, regardless of the teaching status of hospital [19]. An overall 30% in-hospital mortality among CS patients in present study is also in agreement to the above study.

Serum creatinine pre and post coronary angiography had significantly higher values in CS group; the same had serum troponin level on admission and peak values. Results are comparable with the study which recorded 47.5% patients having acute kidney injury and statistically significant recovery was reported after intervention which is in concomitant to present findings. [20] While CS patients had significantly lower levels of potassium and haemoglobin on admission and discharge with more percentage of haemoglobin drop of ≥3 gm\dl among CS patients. A systematic review suggested the association of both lower and higher serum potassium levels with high risk of mortality among acute myocardial infarction patients [21]. A study reported significantly higher incidence of CS among mild and severe electrolyte decline groups while reduction in electrolytes is also indicated to early demise as compared to normal [22]. Higher haemoglobin levels have been suggested as protective

Table 6. Regression analysis for predictors of mortality in CS among STEMI patients.

Variables in the Equation	B	S.E.	Wald	df	Sig.	Exp(B)
Age	0.107	0.052	4.285	1	0.038	1.113
Male	0.132	1.880	0.005	1	0.944	1.142
BMI	0.042	0.119	0.122	1	0.727	1.042
Smoking	−1.899	1.302	2.125	1	0.145	0.150
HTN	−0.044	1.043	0.002	1	0.967	0.957
CVA	−1.955	1.622	1.452	1	0.228	0.142
Hb_drop≥3	0.846	1.513	0.313	1	0.576	2.330
EF	−0.055	0.044	1.603	1	0.205	0.946
LMS	−2.065	1.341	2.370	1	0.124	0.127
3VD	−1.324	1.107	1.430	1	0.232	0.2666
Constant	−26.131	40,193.103	0.000	1	0.999	0.000

HBA1c: Glycosylated Hemoglobin; LM: left main; 3VD; 3 vessel disease; LVEF: Left ventricular ejection fraction; Hb: Hemoglobin; DM: diabetes Mellitus; BMI; Body mass index.

factor among acute cardiac syndrome patients having complications of CS is also in agreement with the findings of present study [23].

Contrast volume, fluoroscopic time and radial approach during coronary angiography remained significantly high in CS group. Although, there was no significant difference between groups regarding thrombus aspiration and tirofiban infusion but CS patients had highly significant more complex coronary artery disease in the form of multivessel, left main coronary artery affection and consequently significant higher number of intracoronary stents displacement in present study. Comparable findings were revealed by a study concluding percutaneous coronary interventions through radial route are significantly associated to radiation exposure but diagnostic coronary angiography using radial access was not associated with higher exposure to radiation [24]. Contrary findings were reported by another recent study which reported significantly lower fluoroscopic time and lesser contrast volume in trans-femoral route [25].

Subsequently, CS patients had highly significant increase in incidence of acute myocardial infarction complications including pulmonary oedema, ventilation and cardiac arrest but Left ventricular systolic function was significantly lower in CS patients. Findings are in concomitant to the study presented high rates of complications with median ejection fraction of 30% among CS patients [25]. Left ventricular systolic function and kidney function were similarly documented to be predictive of in-hospital CS[26].

Table 7. Regression analysis for predictors of mortality in STEMI patients.

	B	S.E	Wald	df	sig	Exp(b)
Age	0.033	0.011	8.876	1	0.003	1.034
Female	−0.570	0.291	3.845	1	0.050	0.565
BMI	0.002	0.025	0.004	1	0.951	1.002
DM	0.530	0.313	2.861	1	0.050	1.698
Smoking	−0.269	0.0323	0.693	1	0.405	0.764
HTN	0.129	0.284	0.205	1	0.651	1.137
HBA1C	−0.047	0.058	0.651	1	0.420	0.954

BMI: Body Mass Index; DM: Diabetes Mellitus; HBA1C: Glycosylated Hemoglobin.

Global Burden of Disease estimates documented a global increase in the incidence of diabetes mellitus which reached close to 23 million worldwide in 2017 [27]. Diabetic patients have a 2–3 times greater risk of cardiogenic shock than non-diabetic patients [10].

A large meta-analysis documented that diabetes in the setting of acute myocardial infaraction and cardiogenic shock increases the risk for both in-hospital long term mortality as well as rises the risk of adverse cerebrovascular events [11].

Although the underlying mechanisms of increased mortality with diabetes are still unclear, multiple explanations can be advocated. Diabetes induces extensive micro- and macrovascular alterations with multivessel involvement [28], which promote larger infarct size as well as reduced reperfusion and predispose to ventricular arrhythmias [29].

Diabetes induced hyperglycaemia increased possibility of heart failure, cardiogenic shock, and death as it activates stress response with associated leucocytosis which was estimated as a risk factor for mortality in ST-segment elevation myocardial infarction patients. [30] Impaired left ventricular function also shares in poor outcomes in patients with diabetes which can be explained by the low left ventricular functional reserve caused by diabetic cardiomyopathy [31].

Consistent with The Heart Failure Association of the European Society of Cardiology, cardiogenic shock management should reflect an appropriate union of health services, and therapies must be timely directed to properly selected patients while avoiding iatrogenic maltreatment. This association also indicated that more research is needed to detect the new pathophysiological targets and high-quality research should facilitate the integration of more targeted interventions aimed at improving outcomes for specific patients [32].

4.1. Limitations

AS our interest was prevalence and general characteristics of cardiogenic shock patients in the setting of acute ST-segment elevation myocardial infarction who were admitted to our centre, we compared CS and non CS and did not highlight intensive care management presented to CS group including medications and mechanical circulatory support which has crucial role in prognosis. Another study on critical care management of cardiogenic shock patients who were admitted to coronary care unit is still ongoing in our centre.

5. Conclusion

High income middle eastern countries have comparable outcomes to Europe and USA among patients with ST-segment elevation myocardial infarction with the higher improvement of medical care in the last 2 to 3 decades.

Renal impairment, peak troponin, severe bleeding, and ejection fraction were significant independent predictors of cardiogenic shock in patients with ST-segment elevation myocardial infarction. However, STEMI-type left main disease and ejection fraction were the independent predictors of CS in ST-segment elevation myocardial infarction patients with diabetes. Age was the only independent predictor of mortality among CS patients. While age, female gender, and diabetes were found to be the independent predictors for in-hospital mortality among STEMI patients.

These findings highlighted the significance of close and cautious monitoring of ST-segment elevation myocardial infarction with associated CS patients. More studies are needed to pinpoint optimal management strategies for better outcomes of such patients especially with associated diabetes.

Author contribution

Conception and design of Study: GS. Literature review: GS. Literature review: GS. Acquisition of data: GS. Analysis and interpretation of data: GS, AKN, SK. Research investigation and analysis: GS, AKN, SK. Data collection: GS, AKN, SK. Drafting of manuscript: GS,SK. Revising and editing the manuscript critically for important intellectual contents: GS. Data preparation and presentation: GS. Supervision of the research: GS; Research coordination and management: GS. Funding for the research: GS.

Conflict of interest

Authors declare no conflict of interest exists.

References

[1] Kunkel KJ, Fuller BS, Basir MB. Management of cardiogenic shock in patients with acute myocardial infarction. Interv Cardiol Clin 2021;10(3):345. https://doi.org/10.1016/j.iccl.2021.03.006.

[2] Henry TD, Tomey MI, Tamis-Holland JE, Thiele H, Rao SV, Menon V, et al. Invasive management of acute myocardial infarction complicated by cardiogenic shock: a scientific statement from the American heart association. Circulation 2021;143(15). https://doi.org/10.1161/cir.0000000000000959.

[3] Hunziker L, Radovanovic D, Jeger R, Pedrazzini G, Cuculi F, Urban P, et al. Twenty-year trends in the incidence and outcome of cardiogenic shock in AMIS plus registry. Circulation: Cardiovascular Interventions 2019;12(4):e007293. https://doi.org/10.1093/eurheartj/ehy563.p3677.

[4] De Luca L, Olivari Z, Farina A, Gonzini L, Lucci D, Di Chiara A, et al. Temporal trends in the epidemiology, management, and outcome of patients with cardiogenic shock complicating acute coronary syndromes. Eur J Heart Fail 2015;17(11):1124–32. https://doi.org/10.1002/ejhf.339.

[5] Shah RU, de Lemos JA, Wang TY, Chen AY, Thomas L, Sutton NR, et al. Post-hospital outcomes of patients with acute myocardial infarction with cardiogenic shock: findings from the NCDR. J Am Coll Cardiol 2016;67(7):739–47. https://doi.org/10.1016/j.jacc.2015.11.048.

[6] Harjola VP, Lassus J, Sionis A, Køber L, Tarvasmäki T, Spinar J, et al. Clinical picture and risk prediction of short-term mortality in cardiogenic shock. Eur J Heart Fail 2015;17(5):501–9. https://doi.org/10.1002/ejhf.260.

[7] Katz JN, Stebbins AL, Alexander JH, Reynolds HR, Pieper KS, Ruzyllo W, et al. Predictors of 30-day mortality in patients with refractory cardiogenic shock following acute myocardial infarction despite a patent infarct artery. Am Heart J 2009;158(4):680–7. https://doi.org/10.1016/j.ahj.2009.08.005.

[8] González-Pacheco H, Manzur-Sandoval D, Gopar-Nieto R, Álvarez-Sangabriel A, Martínez-Sánchez C, Eid-Lidt G, et al. Cardiogenic shock among patients with and without acute myocardial infarction in a Latin American country: a single-institution study. Global Heart 2021;16(1). https://doi.org/10.5334/gh.988.

[9] Llaó I, Ariza-Solé A. Cardiogenic shock: approaching the truth. Journal of Geriatric Cardiology: JGC 2022;19(2):95. https://doi.org/10.1093/ehjacc/zuab048.

[10] Lindholm MG, Boesgaard S, Torp-Pedersen C, Køber L. TRACE registry study group. Diabetes mellitus and cardiogenic shock in acute myocardial infarction. Eur J Heart Fail 2005 Aug;7(5):834–9. https://doi.org/10.1016/j.ejheart.2004.09.007. PMID: 16051520.

[11] Luo C, Chen F, Liu L, Ge Z, Feng C, Chen Y. Impact of diabetes on outcomes of cardiogenic shock: a systematic review and meta-analysis. Diabetes Vasc Dis Res 2022 Sep-Oct;19(5):14791641221132242. https://doi.org/10.1177/14791641221132242. PMID: 36250870; PMCID: PMC9580099.

[12] Anderson HV, Weintraub WS, Radford MJ, Kremers MS, Roe MT, Shaw RE, et al. Standardized cardiovascular data for clinical research, registries, and patient care: a report from the Data Standards Workgroup of the National Cardiovascular Research Infrastructure project. J Am Coll Cardiol 2013;61(18):1835–46. https://doi.org/10.1016/j.jacc.2012.12.047.

[13] Webb JG, Sleeper LA, Buller CE, Boland J, Palazzo A, Buller E, et al. Implications of the timing of onset of cardiogenic shock after acute myocardial infarction: a report from the SHOCK Trial Registry. J Am Coll Cardiol 2000;36(3):1084–90. https://doi.org/10.1016/S0735-1097(00)00876-7.

[14] Goldberg RJ, Makam RC, Yarzebski J, McManus DD, Lessard D, Gore JM. Decade-long trends (2001–2011) in the incidence and hospital death rates associated with the in-hospital development of cardiogenic shock after acute myocardial infarction. Circ Cardiovasc Qual Outcomes 2016;9:117–25. https://doi.org/10.1161/CIRCOUTCOMES.115.002359.

[15] Dauriz M, Morici N, Gonzini L, Lucci D, Di Chiara A, Boccanelli A, et al. Fifteen-year trends of cardiogenic shock and mortality in patients with diabetes and acute coronary

syndromes. Am J Med 2020 Mar 1;133(3):331–9. https://doi.org/10.1002/ejhf.339.

[16] Wayangankar SA, Bangalore S, McCoy LA, Jneid H, Latif F, Karrowni W, et al. Temporal trends and outcomes of patients undergoing percutaneous coronary interventions for cardiogenic shock in the setting of acute myocardial infarction: a report from the CathPCI Registry. Cardiovascular Interventions 2016;9(4):341–51. https://doi.org/10.1016/j.jcin.2015.10.039.

[17] Acharya D. Predictors of outcomes in myocardial infarction and cardiogenic shock. Cardiol Rev 2018;26(5):255. https://doi.org/10.1097/crd.0000000000000190.

[18] Khaled S, Ahmed WE, Shalaby G, Alqasimi H, Ruzaizah RA, Haddad M, et al. Disparities of demographics, clinical characteristics, and hospital outcomes of AMI pilgrims vs non-pilgrims—tertiary center experience. The Egyptian Heart Journal 2020;72(1):1–8. https://doi.org/10.1186/s43044-020-00068-y.

[19] Osman M, Syed M, Patibandla S, Sulaiman S, Kheiri B, Shah MK, et al. Fifteen-year trends in incidence of cardiogenic shock hospitalization and in-hospital mortality in the United States. J Am Heart Assoc 2021;10(15):e021061. https://doi.org/10.1161/jaha.121.021061.

[20] Upadhyaya VD, Alshami A, Patel I, Douedi S, Quinlan A, Thomas T, et al. Outcomes of renal function in cardiogenic shock patients with or without mechanical circulatory support. J Clin Med Res 2021;13(5):283. https://doi.org/10.14740/jocmr4449.

[21] Xi H, Yu R-H, Wang N, Chen X-Z, Zhang W-C, Hong T. Serum potassium levels and mortality of patients with acute myocardial infarction: a systematic review and meta-analysis of cohort studies. European Journal of Preventive Cardiology 2019;26(2):145–56. https://doi.org/10.14740/jocmr4449.

[22] Ren Y, Yue Z, Li X. Relationship between admission electrolyte level and short-term prognosis of patients with acute ST-segment elevation myocardial infarction after percutaneous coronary intervention. Evid base Compl Alternative Med 2021;2021. https://doi.org/10.1155/2021/4664965.

[23] Xu T, Liang D, Wu S, Zhou X, Shi R, Xiang W, et al. Association of hemoglobin with incidence of in-hospital cardiac arrest in patients with acute coronary syndrome complicated by cardiogenic shock. J Int Med Res 2019;47(9):4151–62. https://doi.org/10.1177/0300060519857021.

[24] Üreyen ÇM, Coşansu K, Vural MG, Şahin SE, Kocayiğit İ, Pabuccu MT, et al. Is trans-radial approach related to an increased risk of radiation exposure in patients who underwent diagnostic coronary angiography or percutaneous coronary intervention?(The SAKARYA study). Anatol J Cardiol 2019;22(1):5. https://doi.org/10.14744/anatoljcardiol.2019.06013.

[25] Hasrat S, Hussain S, Ahmed Z, Naeem H, Khan MS, Rauf S, et al. Comparison of mean fluoroscopic time and mean contrast volume used in patients undergoing coronary angiography by the transfemoral versus transradial route. Cureus 2020;12(11). https://doi.org/10.7759/cureus.11700.

[26] Yang JQ, Ran P, Li J, Zhong Q, Smith Jr SC, Wang Y, et al. A risk stratification scheme for in-hospital cardiogenic shock in patients with acute myocardial infarction. Frontiers in Cardiovascular Medicine 2022;9. https://doi.org/10.3389/fcvm.2022.793497.

[27] Lin X, Xu Y, Pan X, Xu J, Ding Y, Sun X, et al. Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. Sci Rep 2020;10(1). https://doi.org/10.1038/s41598-020-71908-9.

[28] Gregg EW, Sattar N, Ali MK. The changing face of diabetes complications. Lancet Diabetes Endocrinol 2016;4:537–47. https://doi.org/10.1016/s2213-8587(16)30010-9.

[29] Kataja A, Tarvasmäki T, Lassus J, Cardoso J, Mebazaa A, Køber L, et al. The association of admission blood glucose level with the clinical picture and prognosis in cardiogenic shock – results from the CardShock Study. Int J Cardiol 2017;226:48–52. https://doi.org/10.1016/j.ijcard.2016.10.033.

[30] Alegria JR, Miller TD, Gibbons RJ, Yi Q-L, Yusuf S. Infarct size, ejection fraction, and mortality in diabetic patients with acute myocardial infarction treated with thrombolytic therapy. Am Heart J 2007;154(4):743–50. https://doi.org/10.1016/j.ahj.2007.06.020.

[31] Ha J-W, Lee H-C, Kang E-S, Ahn C-M, Kim J-M, Ahn J-A, et al. Abnormal left ventricular longitudinal functional reserve in patients with diabetes mellitus: implication for detecting subclinical myocardial dysfunction using exercise tissue Doppler echocardiography. Heart 2006;93(12):1571–6. https://doi.org/10.1136/hrt.2006.101667.

[32] Chioncel O, Parissis J, Mebazaa A, Thiele H, Desch S, Bauersachs J, et al. Epidemiology, pathophysiology and contemporary management of cardiogenic shock-a position statement from the Heart Failure Association of the European Society of Cardiology. Eur J Heart Failure 2020;22(8):1315–41. https://doi.org/10.1002/ejhf.1922.