ORIGINAL ARTICLE

Primary Percutaneous Coronary Intervention for ST elevation myocardial infarction complicated by Cardiogenic Shock

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Abstract

Objective: To determine the outcomes of primary percutaneous coronary intervention for ST elevation myocardial infarction complicated by cardiogenic shock.

Methods: The retrospective study was conducted at the Tabba Heart Institute, a private-sector facility in Karachi. It reviewed the medical records of 56 consecutive patients between January 2009 and June 2011 with acute ST elevation myocardial infarction complicated by cardiogenic shock and subjected to primary percutaneous coronary intervention. The primary end point was in-hospital mortality and its predictors. SPSS 14 was used for statistical analysis.

Results: The mean age of the study patients was 63±11.7 years; 38 (68%) were male; 32 (57%) were hypertensive; and 39 (69%) were diabetic. Most infarcts were anterior in location (n=36; 64%). Besides, 33 (59%) required ventilatory support. Intra-aortic balloon pump was placed in 30 (54%), and 33 (59%) patients had multivessel coronary artery disease. In-hospital mortality occurred in 26 (46%). Multivariate logistic regression analysis showed that age >60 years (p= 0.05), diabetes (p <0.01) and left ventricular ejection fraction <40% (p= 0.01) were independent predictors of in-hospital mortality.

Conclusions: Results emphasise the need of aggressive management of patients with cardiogenic shock utilising primary percutaneous coronary intervention as a reperfusion strategy to improve clinical outcomes.

Keywords: Percutaneous coronary intervention, Myocardial infarction, Reperfusion, Shock, Intra-aortic balloon pump. (JPMA 63: 490; 2013)

Introduction

Out of all potential compilations of acute myocardial infarction (AMI), cardiogenic shock carries the worse prognosis.[1] AMI is complicated by cardiogenic shock in 7-10% of patients.[2] However, it is difficult to assess the actual number as a certain proportion of patients die before reaching the hospital.

In SHOCK trial registry, more than half the patients developed shock within a day of presenting to the hospital.[3] Early shock, defined as shock developing within 24 hours of AMI, was found in 74.1% of the patients.[4]

Shock develops within hours of the onset of massive ischaemia and infarction. A relatively small infarction superimposed on extensive previous damage may also precipitate cardiogenic shock.

Left ventricular dysfunction is the most frequent cause of cardiogenic shock followed by acute mitral regurgitation, ventricular septal rupture, right ventricular infarction and cardiac rupture.[5]

In SHOCK trial registry, anterior myocardial infarction was the most common location associated with the development of cardiogenic shock (55%) followed by inferior location. Angiographic data had shown that nearly 60% of the patients with cardiogenic shock had triple vessel disease. Left anterior descending artery was the most commonly involved vessel in patients who developed cardiogenic shock.[3]

Presence of predispositions like advanced age, diabetes, anterior myocardial infarction, prior infarcts, and reduced left ventricular ejection fraction (LVEF) can predict the development of cardiogenic shock.[6]

Despite marked advances in medical management, revascularisation and mechanical support during the past decade, cardiogenic shock is still the most common cause of hospital mortality associated with AMI.[7] Mortality rate is exceedingly high and reaches 70-80% in those treated conservatively. Large thrombolytic trials demonstrate 60% mortality with the most effective thrombolytic agent.[8]

In a primary percutaneous coronary intervention (PPCI) registry from Germany, 14.2% of the patients with AMI presented with cardiogenic shock. The in-hospital mortality was 46.1%. Predictors of in-hospital mortality were post-procedural thrombolysis in myocardial

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infarction (TIMI) flow, advanced age and longer ischaemic time.[9] National registry of myocardial infarction reported in-hospital mortality of 47.9%.[10] Another study from Nepal showed in-hospital mortality of 50% in shock patients undergoing PPCI.[11]

A local study done to assess the in-hospital outcomes of patients with ST elevation myocardial infarction (STEMI) complicated by cardiogenic shock found an overall mortality of 54.7%. However, the study population included patients managed conservatively and those who received thrombolytic therapy.[12]

No local study was found after extensive literature search looking exclusively at the outcomes and its predictors in patients of cardiogenic shock treated with PPCI. This provides a very strong rationale to conduct such a study in our population and evaluate short-term outcomes.

Patients and Methods

The study retrospectively reviewed the medical records of 56 consecutive patients who presented to Tabba Heart Institute, Karachi, from June 2009 to June 2011 with STEMI (defined as electrocardiographic evidence of ST segment elevation of ≥1mm in ≥2 contiguous leads or new left bundle branch block) who developed cardiogenic shock (defined as presence of systolic blood pressure <90mmHg or need of parenteral inotropic agents with evidence of systemic hypoperfusion like cold clammy skin, cerebral obtundation) within 36 hours of the onset of STEMI, and underwent PPCI within 18 hours of the onset of the shock.

All patients in the emergency department (ED) received aspirin 300mg, clopidogril 600mg, parenteral inotropic agents, initial weight-based bolus of unfractionated heparin and endotracheal intubation as per patient's clinical condition.

Right radial or femoral access was used for diagnostic angiogram followed by PPCI of the infarct-related artery depending upon the presence or absence of radial artery pulsation. Coronary stenting was performed as per the judgment of the operators. Dual anti-platelet therapy was continued as per standards. All patients were initially monitored in the coronary care unit (CCU) and once clinically stable, they were shifted to the coronary step-down unit.

For data collection, a proforma was designed related to age, gender, history of diabetes (defined as a fasting glucose ≥126mg/dl or on treatment), hyperlipidaemia (fasting total cholesterol ≥200mg/dl or on treatment), hypertension (systolic blood pressure ≥140/90mmHg or on treatment), smoking, left ventricular function (visually estimated, using either echocardiography or left ventriculography) and need of mechanical ventilation.

Timing variables were computed, including time to presentation, which is defined as the time from symptom onset until arrival at the hospital. Door-to-balloon time was the time from arrival at the hospital until first balloon inflation in cardiac catheterisation laboratory.

Angiographic and procedural details (culprit vessel, use of coronary stents, use of intra-aortic balloon pump and glycoprotein [GP] IIb/IIIa inhibitors) were also collected. Procedural success (defined as achievement of vessel patency to a residual ≤30% stenosis) and in-hospital mortality was also recorded.

All the variables were entered into SPSS 14 for data analysis. Descriptive statistics were computed and presented as means and standard deviations were calculated for continuous variables like age, LVEF, onset of pain to ED in minutes, and door-to-balloon time in minutes. Categorical variables were reported in frequencies and percentages for the gender, hypertension, diabetes mellitus, hyperlipidaemia, angiographic, procedural detail, procedural success and in-hospital mortality. Multivariate logistic regression analysis was used to identify the combination of single variables that were independent predictors of in hospital mortality. Significant variables analysed were reported with their respective odds ratios and 95% confidence intervals (CI).

Results

The mean age of the 56 patients in the study was 63±11.7 years; 38 (68%) were male; 39 (69%) were diabetics; and 32 (57%) were hypertensive. Besides, 25 (44%) were smokers and 8 (14%) had prior history of myocardial infarction. The median time from the onset of symptoms to presentation was 135 minutes and median door-to-balloon time was 70 minutes. Of the patients 35 (62%) received GP IIb IIIa inhibitor; 33 (59%) required mechanical ventilation; 31 (55%) had LVEF of <40% (Table-1).

Nineteen (34%) procedures were performed by transradial approach and 37 (66%) via transfemoral approach. Left anterior descending (LAD) artery was the most common infarct-related artery (n=36; 64%) followed by right coronary artery (n=14; 25%), and left circumflex artery (n=6; 11%) respectively.

Procedure was successful in 47 (84%) patients. Stents were deployed in 45 (80%), and of them 35 (78%)

Table-1: Baseline characteristics.

Baseline Demographic and Clinical characteristics:	N= 56 (%)
Mean age (Years)	63 ±11.7
Male (Gender)	38(68)
Past Medical history:	
Hypertension	32 (57)
Diabetes Mellitus	39 (69)
Smokers	25 (44)
Hyperlipidaemia	28 (50)
Family history of coronary artery disease	32 (57)
Prior myocardial infarction	8 (14)
Admission characteristics:	
Left ventricular failure	24 (43)
Required intubation	33 (59)
Anterior myocardial infarction	36 (64)
Inferior with RV infarction	9 (15)
Left ventricular ejection fraction (LVEF) <40%	31 (55)
Glycoprotein IIb / IIIa inhibitors used	35 (62)
Timing variables:	
Onset of pain to ED time (minutes) median	135
Door-to-Balloon time (minutes) median	70

RV: Right Venticle. ED: Emergency Department.

Table-2: Angiographic and procedural characteristics.

Procedural characteristics & Outcomes:	N=56 (%)
Transradial Approach	19 (34)
Transfemoral Approach	37 (66)
Left Anterior Descending	36 (64)
Left Circumflex	6 (11)
Right Coronary Artery	14 (25)
Multivessel CAD	33 (59)
Multivessel PCI	15 (27)
Procedural success	47 (84)
Use of coronary stent	45 (80)
BMS (n=45)	35 (78)
DES (n=45)	10 (22)
Intra-Aortic Balloon Pump (IABP)	30 (54)
In-hospital Outcomes:	
Death in hospital (all patients)	26 (46)
Table death	8 (14)
Death in hospital (patient with IABP) n=30	14 (47)
Death in hospital (patient without IABP) n=26	12 (46)
In-hospital CABG	1(1.8)
Stent thrombosis	1(1.8)
Groin haematoma	2 (3.5)

CAD: Coronary Artery Disease. PCI: Percutaneous Coronary Intervention. CABG: Coronary Artery Bypass Grafting. BMS: Bare Metal Stent. DES: Drug Eluting Stents.

received bare metal and 10 (22%) received drug eluting stents. Of the remaining 9 (16%) patients in whom the procedure was unsuccessful, 8 (8.88%) patients died and 1 (12.12%) underwent successful coronary artery bypass grafting (CABG).

Table-3: Predictors of in-hospital mortality.

Predictive factors	OR (95% CI)	p-value
Age >60 years	7.3 (0.96 to 55.8)	0.05
Diabetes	44.2 (2.98 to 655.9)	<0.01
LVEF < 40%	0.15 (0.012 to 0.57)	0.01

CI: Confidence interval. OR: Odds ratios. LVEF: Left Ventricular Ejection Fraction.

Moreover, 26 (46%) patients died during hospitalization, including 8 (14%) table deaths. Intra-aortic balloon pump (IABP) was placed in 30 (54%) of the patients. In-hospital mortality was 14 (53.84%) in those who received IABP, and 12 (46%) in patients managed without IABP. One (1.8%) patient was referred for emergency CABG, and one (1.8%) had in-hospital stent thrombosis. Groin haematoma was observed in 2 (3.5%) patients (Table-2).

Multivariate logistic regression analysis showed that age >60 years (p <0.05), diabetes (p <0.01) and LVEF <40% (p <0.01)) were independent predictors of in hospital mortality (Table-3).

Discussion

Among various clinical complications that are associated with STEMI, cardiogenic shock is potentially the most devastating. A growing body of evidence suggests the use of more aggressive therapeutic interventions in patients with cardiogenic shock to restore patency of infarct-related artery and to salvage ischaemic myocardium.[13]

Meta analysis of 23 large randomised trials have shown that primary PCI is superior to thrombolysis for management of STEMI due to more effective restoration of coronary patency, less recurrent myocardial ischaemia, improved residual left ventricular function and better clinical outcome.[14]

American College of Cardiology (ACC) and the American Heart Association (AHA) recommend early mechanical reperfusion for patients <75 years of age with STEMI who develop cardiogenic shock within 36 hours of the onset of AMI and are suitable for revascularisation that can be performed within 18 hours of the onset of shock.[15]

The landmark SHOCK trial compared emergent revascularisation with medical stabilisation. Revascularisation was performed either surgically or by PPCI. No difference in mortality was found between revascularisation and medical management group at 30 days (46.7% vs. 56.0%; p= 0.11) but at 6 months, significantly increased survival rates were observed in patients treated with revascularisation (50.3% vs. 63.1%; p <0.027).[16] SHOCK trial registry and SHOCK trial

also showed that diabetics have similar improved outcomes as non-diabetics with early revascularization.[17]

IABP has been widely used in clinical practice since 1968. It is used to treat patients with complications of AMI such as cardiogenic shock and for high-risk patients undergoing angioplasty and CABG.[18] Clinical trials showed variable results regarding the net benefit of IABP therapy. SHOCK trial showed that the placement of IABP significantly reduced in-hospital mortality ($p<0.0001$).[8] However, a meta-analysis of nine randomised trials comparing STEMI patients with cardiogenic shock who were treated either with additional IABP therapy or no IABP therapy showed that in thrombolysis studies adjunctive IABP was associated with 18% absolute reduction in 30-day mortality. On the contrary, PPCI studies showed that IABP therapy was associated with 6% absolute increase in 30-day mortality.[19] Euro Heart Survey on PPCI showed that IABP was used in one quarter of patients with cardiogenic shock and no significant difference was noted in mortality with and without IABP.[20]

A study showed procedural success of 87% and in-hospital mortality of 37% in patients with cardiogenic shock undergoing PPCI.[21] A study from China showed an overall mortality of 62% in patients with STEMI complicated by cardiogenic shock. Old age, anterior infarction, diabetes and LVEF <40% were independent predictors of mortality.[22]

Another study form China showed a procedural success rate of 91%. In-hospital mortality was 42.4% in patients who underwent PPCI for STEMI complicated by cardiogenic shock. Delay in revascularisation was found to be the independent predictor of in-hospital mortality.[23] A local study aimed at determining the outcomes of PPCI, found 44% in-hospital mortality in STEMI complicated by cardiogenic shock.[24]

A study from Turkey showed a procedural success of 84%, in-hospital mortality of 64% in cardiogenic shock patients treated with PPCI. Unsuccessful procedure and diabetes were found to be the predictors of in-hospital mortality.[25]

In our study in-hospital mortality was 46% (n=26) in patients with cardiogenic shock treated with PPCI. Multivariate logistic regression analysis showed that age >60 years (OR 7.3; 95% CI 0.96 to 55.8; $p<0.05$, diabetes (OR 44.2; 95% CI 2.98 to 655.9; $p<0.01$ and LVEF <40% (OR 0.15; 95% CI 0.012 to 0.57; $p<0.01$), were independent predictors of in-hospital mortality. Our study reflects the outcomes of PPCI for cardiogenic shock complicating STEMI from a single cardiac centre. We need a multi-centre study with larger sample size to validate our findings.

Conclusion

The study had results comparable to international data. The study emphasised the need of aggressive management of patients presenting with cardiogenic shock utilising PPCI as a reperfusion strategy to improve clinical outcomes in this potentially fatal clinical scenario.

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