Primary Percutaneous coronary intervention in acute ST elevation myocardial infarction in Al-Nasiriya heart center: A single center experience

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Abstract

Background: ST segment elevation myocardial infarction is a dangerous manifestation of coronary artery disease. Reperfusion therapy is the cornerstone in the management of STEMI patients. Both European and American guidelines state that primary percutaneous coronary intervention is the preferred reperfusion option in STEMI patients when it can be performed in the appropriate time and by experienced operators.

Aim of the study: To evaluate the angiographic and procedural success and in hospital outcome and mortality predictors of primary PCI at Al Nasiriya Heart Center.

Methods: In our prospective study, all patients who underwent primary PCI for acute STEMI with chest pain less than 12 hours duration from the 7th of July 2013 to the 15th of January 2014 in Al Nasiriya Heart Center were enrolled. On admission brief clinical evaluation was performed. ECG and Bedside echocardiography were done on admission. Coronary angiography was done and if the anatomy amenable for revascularization, intervention then done with the standard techniques.

Result: Among 73 patients, primary PCI was successful in 63 patients (86%). During hospitalization 6 patients died (8.4%). Acute limb ischemia occurred in one patient, door to balloon time was 61.89 ± 21.46

Conclusion: Primary PCI is logistically feasible in Al Nasiriya Heart Center with good clinical and angiographic outcomes even in patients with high risk for clinical events. Cardiogenic shock, diabetes, multivessels disease and procedural failure are independent predictors of in hospital mortality.

Keyword: primary percutaneous coronary intervention, in hospital outcome.


Introduction

Coronary artery disease is the leading cause of death worldwide. In Europe STEMI accounts for 66 hospital admission per 100,000.(1) In USA STEMI accounts for 55 admission per 100,000. (2)

Reperfusion therapy is the cornerstone in treatment of STEMI. (3) The two available strategies of reperfusion are thrombolytic and primary percutaneous coronary intervention (PCI). Both European and American guidelines state that PCI is the recommended method of reperfusion in STEMI patients when it can be performed in appropriate time by experienced operators. (1, 2)

Evolution of primary PCI
Primary PCI is emergent percutaneous catheter intervention of the culprit artery within 12 hours of symptom onset without previous fibrinolytics therapy. (1) It was first performed in 1979. (4) In 1986 and 1987, 6 single center experiences results show patency rate of 78 to 95%, with low inhospital death (1.5 to 9%) and slight improvement of left ventricular ejection fraction. The results was superior to that of thrombolitics studies, despite being non randomized controlled studies. (3)

3 large scale randomized controlled trials, PAMI (Primary Angioplasty in Myocardial Infarction) (5), Zwolle et al. (6) and GUSTOIIb Angioplasty substudy (7) compare primary PCI versus fibrinolytic therapy. These 3 studies show consistent superiority of primary PCI in reduction of inhospital death, repeat revascularization, intracerebral bleeding, long term survival, duration of hospitalization, reinfarction and recurrent ischemia. (5, 6, 7) Metaanalysis of 23 randomized trials comparing primary PCI with intravenous fibrinolysis show decrease in mortality, nonfatal reinfarction and hemorrhagic stroke in favor of PCI. (8)

Primary PCI evolve and with availability of new intervention techniques that make intervention of complex lesions feasible, availability of new P2Y12 inhibitors, IV glycoprotein IIb/IIIa inhibitor primary PCI may further improve clinical outcome in acute STEMI patients. (9)

**Primary PCI versus fibrinolytic therapy**

Fibrinolytic therapy significantly reduce mortality in the setting of acute STEMI, however bleeding complication and lower patency rate of the infarct related artery are the major limitation. (3, 10) Intracerebral bleeding occur in 0.5 to 1% in most studies and up to 0.9 to 3.4 when aggressive regimen has been used, and it has been associated with higher mortality. (10, 11)

Due to low coronary perfusion in the setting of cardiogenic shock, fibrinolytic therapy appear to be not effective in these patients. (3) Finally reinfarction and need for repeat target vessel revascularization is another concern with fibrinolytic therapy.

Primary coronary intervention compared with fibrinolytic therapy achieve higher patency rate of infarct related artery, achieve TIMI 3 flow and higher access site complication, lower rate of mortality, reinfarction, major bleeding, emergency revascularization, earlier discharge and earlier return to daily activity. This superiority is related to lower major bleeding risk and higher chance of obtaining TIMI 3 flow (90% in primary PCI versus 50% in fibrinolytic therapy). (12)

In addition total economic burden is cost effective in primary PCI. (3)

**Culprit versus Multivessels PCI in STEMI**

Approximately 45 to 65% of patients with acute STEMI have 2 or more coronary arteries lesion and this associated with poor clinical outcome compare with single vessel lesion. (13) There is controversy whether to intervene the non culprit artery or not. Some cardiologist suggest that treating non culprit vessel may prevent future adverse event, other believe that treatment with antiplatelets, statin and risk factor modification is enough and risk of preventive PCI outweighs the benefit. (14, 15, 16, 17, 18) Possible explanation for poor outcome with multivessel PCI in acute STEMI is that increase thrombotic tendency and activated inflammatory system associated with higher complication in the setting of STEMI compared with PCI done on elective basis, in addition the objective evidence of ischemia of non
culprit vessels cannot be determined at time of primary PCI. PRAMI trial, states that intervention of the non culprit vessel associated with lower mortality, angina and non fatal MI.

Aim of the study

1. Assess the angiographic, procedural success rates and the in hospital outcomes of acute ST segment elevation MI patients treated with primary PCI at Al Nasiriya Heart Center.
2. Identify the predictors of mortality in STEMI patients undergoing primary PCI.

Materials and methods

All eligible patients who had undergone primary PCI for acute STEMI from the 7th of July 2013 to 15th of January 2014 at Al Nasiriya Heart Center were enrolled. Inclusion criteria were the presence of symptom consistent with ischemia, positive cardiac biomarkers (troponin) and new ST segment elevation or new left bundle branch block. ST segment elevation defined as elevation at the J point in two or more contiguous leads. Patients who received thrombolytic therapy and those present beyond 12 hours with resolved symptom were excluded. Informed consent provided by competent patient, or by his relative in patients cannot provide consent.

On admission brief history was taken from the patients or his relative, physical examination was done, ECG and bedside echocardiography was performed. The patients were loaded with 600 mg clopidogril (Plavix) and aspirin 300 mg as soon as possible provided no contraindication. Diagnostic coronary angiography was done immediately and if coronary intervention was decided, intravenous heparin 5000 to 10000 units was administered, PCI was done by standard technique. If the infarct related artery can be determined by electrocardiographic criteria, angiography of the non-infarct related artery performed first. A guiding catheter can be used to perform the initial angiograms of the infarct artery, eliminating the time required to switch catheters. Flow in the culprit vessel before and after intervention was assessed according to the TIMI group definition.

A procedural success defined as achieving angiographic success in the absence of major adverse event (e.g. mortality, cerebrovascular events, MI, emergency CABG).

Angiographic success in balloon angioplasty was defined as the reduction to a minimum stenosis of 50% stenosis with TIMI 3 flow (angiographic visual assessment) without side branch jeopardization, dissection that interfere with flow, or angiographic thrombus. For coronary stents,ke minimum stenosis diameter of 10% with an optimal goal of as close to 0% as possible (angiographic visual assessment) is benchmark of an optimal angiographic result.

A procedural success defined as achieving angiographic success in the absence of major adverse event (e.g. mortality, cerebrovascular events, MI, emergency CABG).

Time between restoring coronary blood flow and arrival of the patient to the center defined as door to balloon time. Total ischemic time was defined as the time between beginning of symptoms and restoring coronary flow.
History of CAD was defined as history of CAD, unexplained cardiac death before the age of 55 in men and 65 in women in parent, sibling, or children related by blood.

Systolic blood pressure less than 90 mm Hg for 30 minutes and more or requirement of support to maintain systolic blood pressure more than 90 mm Hg plus evidence of poor tissue perfusion (cold extremities and reduced urine output less than 30 ml per hour) defined as cardiogenic shock.

**Statistical analysis**

Statistical analysis was carried out with the Statistical Package for the Social Sciences version 21. Categorical variables expressed as percentage. Correlation between categorical variable assessed using chi square or fisher exact test. Continuous variable expressed as mean ± standard deviation or a cut off value has been taken. Regarding ejection fraction a cut off value of 40% had been chosen as this value frequently used in heart failure study. For ischemic time an arbitrary cut off values of 3 and 6 has been chosen dividing the variable into 3 groups; short less than 3 hours, intermediate 3to 6 hours and long ischemic time more than 6 hours. To assess the independency of different patient’s clinical and angiographic characteristics impact on mortality multivariate logistic regression analysis was used. Relative risks were calculated with 95% confidence Intervals. Correlation between continuous variable was assessed using Annova test. P value less than 0.05 considered significant.

**Results**

73 patients were enrolled in this study.

Table (1) shows the clinical characteristics of the patient. The majority of interventions (69 patients) 94.5% were performed via femoral artery access and (4 patients) 5.5 % via radial artery access. The choice of the vascular access was on the discretion of operators. During hospitalization six patients died (8.2%). Stroke, pulmonary embolism and reinfarction did not occur during hospitalization. One patient had acute renal failure post intervention. No patients had undergone emergency CABG. Acute limb ischemia occurred in one patient during hospitalization and respond to conservative treatment. No other major vascular complication occurred during hospitalization. No major or intracranial hemorrhage occurred.

Table (2) shows the angiographic characteristics, angiographic results of the patients. Angiographic success with of TIMI flow 3 post intervention achieved in 63 patients (86%). Of those 63 patients with angiographically successful reperfusion, two patients died and one develop acute limb ischemia so the procedural success achieved in 60 patients (82%). Angiographic failure was due to inability to achieve TIMI 3 flow post procedure (no reflow). Intravenous glycoprotein 2b/3a inhibitors used in a dose adjusted regimen in 54 patients (73.9%) depending on the thrombus burden. Aspiration thrombectomy catheter used only in 3 patients during earlier part of the study because unavailability of the catheter in the center for subsequent patients of the study.

Drug eluting stents were used in 71(97.2%) patients; bare metal stents were used in 2(2.3%) patients. Intraaortic balloon counterpulastion used in 6 patients, temporary pacemaker was inserted in 7 patients for complete heart block all of them associated with inferior STEMI.

Table (3) shows the correlation between baseline angiographic characteristics and the inhospital mortality.
- No significant association between age and in hospital mortality.
- Death was significantly higher in patients with cardiogenic shock (37.5% versus 4.6% with P < 0.05)
- Angiographically successful PCI significantly reduce in hospital mortality (4.7% versus 30% with P < 0.05)
- Mean (door to balloon time) was significantly associated with the death during hospitalization with p value less than 0.05. In our study 65 patients (89.04 %) had (door to balloon time) within 90 minutes.
- The presence of Multivessels disease significantly associated with in hospital mortality (28.5% versus 2.3%) and p value less than 0.05.

Table (4) shows that association between total ischemic time expressed as categorical variable and mortality is statistically significant with p value less than 0.05. Among those patients who died 4 (66.7%) present 6 hours or later after the onset of symptom versus 2 (33.3%) present within 3 hours of symptom onset.

Table (5) shows the result of univariate and multivariate logistic analysis. In multivariate analysis only diabetes, cardiogenic shock, Multivessels disease and procedural success are independent predictors of mortality. Treadmill test was done prior to discharge in 2 patients for assessment of critical lesion in non culprit artery identified at time of primary PCI and the results were negative.

### Tables

#### Table (1)

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>73</td>
</tr>
<tr>
<td>Age mean ± SD</td>
<td>55.15± 9.77 years</td>
</tr>
<tr>
<td>Range</td>
<td>33 to 73 years</td>
</tr>
<tr>
<td>Male / female</td>
<td>44/29</td>
</tr>
<tr>
<td>DM %</td>
<td>19 (26%)</td>
</tr>
<tr>
<td>HPT %</td>
<td>20 (27.3%)</td>
</tr>
<tr>
<td>Smoker %</td>
<td>32 (43.8%)</td>
</tr>
<tr>
<td>prior CAD %</td>
<td>8 (10.9%)</td>
</tr>
<tr>
<td>Prior CABG %</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>prior PCI%</td>
<td>1 (1.3%)</td>
</tr>
<tr>
<td>Hyperlipidemia %</td>
<td>4(5.47%)</td>
</tr>
<tr>
<td>Family history of IHD %</td>
<td>6(8.2%)</td>
</tr>
<tr>
<td>Cardiogenic shock %</td>
<td>8(10.9%)</td>
</tr>
<tr>
<td>Anterior STEMI %</td>
<td>42(57.5%)</td>
</tr>
<tr>
<td>Inferior STEMI %</td>
<td>31(42.5%)</td>
</tr>
<tr>
<td>Death %</td>
<td>6(8.2%)</td>
</tr>
</tbody>
</table>
### Basic angiographic characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infarct related artery</strong></td>
<td></td>
</tr>
<tr>
<td>LAD</td>
<td>42 (57.534%)</td>
</tr>
<tr>
<td>LCX</td>
<td>4 (5.479%)</td>
</tr>
<tr>
<td>RCA</td>
<td>27 (36.986%)</td>
</tr>
<tr>
<td><strong>Multivessels disease</strong></td>
<td>14 (19.17%)</td>
</tr>
<tr>
<td><strong>TIMI flow prior to PCI</strong></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>55 (75.34%)</td>
</tr>
<tr>
<td>1</td>
<td>13 (17.80%)</td>
</tr>
<tr>
<td>2</td>
<td>3 (4.10%)</td>
</tr>
<tr>
<td>3</td>
<td>2 (2.73%)</td>
</tr>
</tbody>
</table>

Table 2

Almostafa (2019): ST segment elevation  October 2019  Vol. 22(VI)
LAD: left anterior descending. LCX: left circumflex  
RCA: right coronary artery.  TIMI: thrombolysis in myocardial infarction

### Table 3
Association between patient’s characteristics and in hospital mortality

<table>
<thead>
<tr>
<th>variable</th>
<th>In hospital mortality</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes(6)</td>
<td>No(67)</td>
</tr>
<tr>
<td>Age (mean ± SD) years</td>
<td>60.33 ± 7.202</td>
<td>54.69 ± 9.311</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>3(37.5%)</td>
<td>3(4.6%)</td>
</tr>
<tr>
<td>Angiographic failure</td>
<td>3(30%)</td>
<td>3(30%)</td>
</tr>
<tr>
<td>Door to balloon time</td>
<td>71.76 ± 16.33</td>
<td>53.76 ± 16.681</td>
</tr>
<tr>
<td>Multivessels disease</td>
<td>4 (28.5%)</td>
<td>2 (3.3%)</td>
</tr>
</tbody>
</table>

### Table 4
Association between ischemic time and in hospital mortality

<table>
<thead>
<tr>
<th>Inhospital mortality</th>
<th>Total ischemic time</th>
<th>total</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 3 hrs</td>
<td>3 – 6 hrs</td>
<td>More than 6 hrs</td>
</tr>
<tr>
<td>Yes (6)</td>
<td>2 (33.3%)</td>
<td>0 (0%)</td>
<td>4 (66.7%)</td>
</tr>
<tr>
<td>No (67)</td>
<td>9 (13.4%)</td>
<td>36 (53.8%)</td>
<td>22 (32.8%)</td>
</tr>
<tr>
<td>Total (73)</td>
<td>11 (15%)</td>
<td>36 (49.3%)</td>
<td>26 (35.7%)</td>
</tr>
</tbody>
</table>
Table 5

The result of univariate and multivariate logistic regression analysis for prediction of In hospital death

<table>
<thead>
<tr>
<th>variable</th>
<th>Unadjusted RR</th>
<th>P value</th>
<th>95 % CI</th>
<th>Adjusted RR</th>
<th>P value</th>
<th>95 % CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>6.933</td>
<td>0.034</td>
<td>1.15 – 41.11</td>
<td>2.44</td>
<td>0.022</td>
<td>1.34 – 34.56</td>
</tr>
<tr>
<td>Shock</td>
<td>12.4</td>
<td>0.007</td>
<td>1.96 – 78.19</td>
<td>10.8</td>
<td>0.008</td>
<td>2.37 – 56.78</td>
</tr>
<tr>
<td>Multivessels disease</td>
<td>11.4</td>
<td>0.009</td>
<td>1.83 – 70.75</td>
<td>3.67</td>
<td>0.035</td>
<td>1.27 – 116.5</td>
</tr>
<tr>
<td>Ischemic time</td>
<td>1.2</td>
<td>0.045</td>
<td>1.76 – 12.77</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>HPT</td>
<td>6.37</td>
<td>0.042</td>
<td>1.06 – 38.1</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Procedural failure</td>
<td>12.88</td>
<td>0.006</td>
<td>2.05 – 80.9</td>
<td>6.06</td>
<td>0.034</td>
<td>3.54 – 34.12</td>
</tr>
</tbody>
</table>

RR: relative risk, CI: confidence interval, DM: diabetes, HPT: hypertension

Discussion

This study revealed that the overall in hospital mortality was 8.4% and the angiographic success rate was 86%. The 2nd international registry of myocardial infarction (NRMI2) reported an in hospital mortality of 5.2%. (24) Ali Doosti et al described their experience of 83 primary angioplasty based on single center registry at Tehran Heart Center and within 12 hours of symptom onset. (25) Their reported in hospital mortality was 8.2% and success rate was 95%. Ali Reza Khosraviet al described 2 center experiences of 93 primary angioplasty in the Isfahan Province. The reported in hospital mortality was 5.4% and success was 83 %. (26) Muhammad Tariq Farman et ala single center registry in Pakistan reported an in hospital mortality of (6 %) and success of 98 % in 113 patients treated with primary angioplasty. (27) Our in hospital mortality is comparable to these above registries and to some extent to the international data provided by NRMI 2. (24)

Despite this study reported a slightly lower angiographic success rate it still comparable with the overall mean success rate. This slightly lower success rate can be explained by small sample volume and lower use of aspiration catheter (only in 3 patients). Muhammad Tariq Farman et al registry report the use of export catheter in 79% of patients with success rate of 98% versus 23.8% of patients in Ali Reza Khosravi et al registry with success rate of 83 %. A recent meta-analysis demonstrate that the use of aspiration catheter achieving higher rate of TIMI 3 flow post intervention (84.9% vs 78.9%, OR=1.51, 95% CI 1.21–1.89, p=0.0005). (28) The most common cause of unsuccessful PCI was inability to achieve TIMI 3 post procedure.
Our study revealed high in hospital mortality in cardiogenic shock (37.5%) and cardiogenic shock on presentation is independent predictor for death during hospitalization (RR: 10.8, P value: 0.008, 95% CI 2.37 – 56.78). This again in agreement with Tehran heart center registry (25) (50%), Isfahan province registry (27) (33%). The result also agree with the international data (32% in NRMI 2) (24) 46.4% in shock registry (29), and 59.1% in American College of Cardiology-National Cardiovascular Data Registry (ACCNCDR). (30) Cardiogenic shock is a major contributor to death in patients with STEMI. Extensive infarction, mechanical complications, including papillary muscle rupture, ventricular septal rupture, freewall rupture with tamponade, and RV infarction is the possible cause of cardiogenic shock in STEMI patient. In our study mechanical complication and tamponade had been already excluded by echocardiography.

The in hospital mortality of patient with successful versus failed angioplasty was 5% and 42.8% respectively and PCI failure is also an independent predictor of death during hospitalization irrespective on the presence or absence of other confounders (RR: 6.06, P value: 0.034, 95% CI 3.54 – 34.12). In the study of Ali Doosti et al, the in hospital death rates were higher in those patients with failed PCI (5% versus 75 % p value less than 0.05). (25) Levi A et al evaluate 1725 STEMI patients underwent primary PCI from 2001 to 2010. Their reported angiographic failure was 5.4% and they demonstrate that angiographic failure is predictors of higher short and long term mortality (for in hospital mortality 22% in the failure group versus 4.2 % in successful group p value < 0.001). (31) This study also demonstrated a significant association between total ischemic time and in hospital mortality in univariate analysis but not in multivariate. The data were conflicting as to whether there is (32) or is not (33) a significant association between mortality and the time from beginning of symptoms to reperfusion. A new Croatian study evaluate 1190 STEMI patients show a statistically significant difference at multivariate analysis with highest in hospital mortality in the subgroup of patients with longest onset to balloon time (4.5 vs. 2.6 vs. 5.7%; p = 0.04). (34)

Possible explanations for the absence of clear evidence to support a relationship between better outcomes and shorter time between symptom onset and PCI include the period of intermittent thrombotic obstruction of the artery associated with stuttering of symptoms before total occlusion (lack of clarity as to what percent of the time is unstable angina) and patients with later presentation being less ill or survivor cohort effect. (35) Door to balloon time is exclusively related to health management standards, and it is a predictor of the quality of patient care. (25) It has been said that achieving the ideal door to balloon time is only possible in the ideal world scenario. The median door to balloon time in Pakistan was reported to be 115 minutes with only 40% of patients having PCI done within 90 minutes. (26) In China the median door to balloon time was 132 min, only 22% of patients had PCI done within 90 minutes. (36) In Germany time median door to balloon time was 60 minutes. (37) The door to balloon time in our study was very promising with mean of 60.89 ± 22.58 minutes with 65 patients (89.04 %) receive treatment within the recommended time. Primary angioplasty has been performed for the 1st time in al Nasiriya heart center in 2009 and the local health system has been established and well developed to deal with primary angioplasty in acute STEMI.

A significant correlation between death and door to balloon time had been observed. The door to balloon time has been relatively well studied and is predictive of in hospital mortality. In a report of (29,222) STEMI patients in the
NRMI 3 and 4 registries (1999 to 2002) who were treated with PCI within six hours of symptoms onset, longer door to balloon were significantly associated with increased incidence of inhospital death. Patients with door to balloon >90 minutes had a significant increase in mortality compared to those with door to balloon ≤90 minutes (odds ratio 1.42, after adjusting for patient characteristics). In a systematic evaluation of 1440 STEMI patients who received primary PCI during 2006 to 2007 in Quebec, Canada, door to balloon time exceeded 90 minutes in 68 percent; death or readmission for MI or heart failure at one year occurred in 13.6 percent. Mortality at 30 days and one year occurred significantly less frequently in those with door to balloon time ≤90 minutes compared to those with longer door to balloon time (3.4 versus 6.1 percent; odds ratio [OR] 1.87, 95% CI 1.02-3.41 and 5.5 versus 9.1 percent; OR 1.71, 95% CI 1.06-2.76 respectively). In contrast to these observations, one- and six month mortality in the Stent PAMI trial was similar in patients with a door to balloon less than or more than two hours (3.4 versus 3.5 percent). The reasons for the discrepant findings are not clear.

LIMITATION

1. The main limitation of the study was that while multicenter primary angioplasty trials included many thousands of acute STSEMI patients undergoing primary PCI, this study included 73 patients only from a single center.
2. A consequence of small sample volume is that the incidence of adverse clinical events other than death was very low so its statistical significance in association with other variables cannot be assessed.

Conclusion

1. Angiographic, procedural success and in hospital mortality in Al Nasiriya Heart Center is comparable with the international study.
2. Diabetes, cardiogenic shock, multivessels disease and angiographic success are independent predictors of in hospital mortality.

Recommendation

We recommend a larger multicenter prospective study including larger number of patients to assess the results of primary PCI in multicenter study with a longer time of follow up.

References


