ORIGINAL ARTICLE

Primary Percutaneous Coronary Intervention in Acute ST-elevation Myocardial Infarction: The Experience of "Evagelismos" General Hospital of Athens

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ABBREVIATIONS

AMI = acute myocardial infarction
BMS = bare metal stents
CABG = coronary artery bypass grafting
DES = drug-eluting stents
ESC = European Society of Cardiology
IRA = infarct-related (coronary) artery
LVEF = left ventricular ejection fraction
PCI = percutaneous coronary intervention
STEMI = ST-elevation myocardial infarction
TIMI = thrombolysis in myocardial infarction (study group)

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ABSTRACT

BACKROUND: Primary percutaneous coronary intervention (PCI) has been shown to be a better reperfusion strategy in patients with ST-elevation myocardial infarction (STEMI) compared with thrombolysis, particularly when applied early. The objective of the present study was to report our experience from treating patients presenting to the emergency room of our hospital with STEMI with primary PCI.

PATIENTS AND METHODS: The population of the study included 100 patients who presented to our hospital with STEMI and underwent primary PCI over a 12-month period. Patients' clinical and angiographic data were retrospectively collected and patients were followed up for 9 months. Technical details of the primary PCI, including stent implantation, and use of drug eluting stents, thrombus aspiration catheter, or platelet glycoprotein IIb/IIIa inhibitors were recorded and correlated to clinical and angiographic patient data.

RESULTS: Of 196 patients who presented o the emergency room with STEMI during the study period, 100 (51%) patients (85 men and 15 women) underwent primary PCI. PCI was successful with TIMI 3 flow of the infarct-related coronary artery in 79 (79%) patients. Six (6%) patients died during hospitalization and another 4 (4.3%) patients died during the 9-month follow up period. Twenty one (22%) patients required rehospitalization for acute coronary syndrome, of whom 17 needed a repeat PCI and 4 patients were submitted to coronary artery bypass grafting. Left ventricular ejection fraction (LVEF) was <50% in 54 (54%) patients. In 52 patients primary PCI was performed in less than 4 hours from onset of symptoms. In his cohort, 19 patients

were thrombolyzed before arriving to the catheterization laboratory. Antithrombotic therapy with platelet glycoprotein IIb/IIIa inhibitors was used in 48 (48%) patients. Univariate analysis showed that the odds of achieving TIMI 3 flow were higher after using IIb/IIIa inhibitors (odds ratio-OR 6.4) or if the LVEF ≥50% (vs LVEF <50%) at the beginning of the PCI (OR 6.4). If the time from the onset of symptoms to PCI was >4 hours, the odds of achieving TIMI 3 flow were reduced by 23.4% compared to time from symptoms to PCI <4 hours. The presence of TIMI 3 flow of the infarct-related artery reduced the odds of death by 10.2% compared to the absence of TIMI 3 flow of the infarct-related coronary artery.

CONCLUSION: Our results are in keeping with those published by other groups performing primary PCI. We demonstrated the importance of time interval from onset of symptoms until PCI is started. We found that the use of GP IIb/IIIa inhibitors was beneficial and emphasized the predictive value of LVEF >50% and the importance of achieving TIMI 3 flow in the IRA at the end of the procedure.

INTRODUCTION

Over the past two decades, cardiologists have witnessed and documented the significance of timely opening the occluded infarct-related coronary artery (IRA) in patients presenting with acute myocardial infarction (MI). Several studies[1-5] have demonstrated that the most efficient way to achieve a good result is through percutaneous coronary intervention (PCI). The adoption of primary PCI as routine treatment in acute MI by most large hospitals represents an important advance in the management of patients with coronary artery disease. Patients presenting with acute MI, who are treated with primary PCI show decreased mortality and suffer less adverse cardiac events compared with patients who receive the classical treatment with pharmacological reperfusion using fibrinolysis.[6,7]

In our hospital an interventional team is on-call on a 24-hour basis and, following the European Society of Cardiology (ESC) guidelines for PCI, an attempt is made to routinely manage patients presenting to the emergency room with acute MI with primary PCI.[7] Thus, the objective of the present study was to review our experience and report the clinical outcome of the first 100 unselected patients who presented to the emergency room of our hospital with acute ST-elevation MI (STEMI) and were treated with primary PCI.

PATIENTS AND METHODS

The population of the study included all patients who presented to our hospital with ST-elevation myocardial infarction (STEMI) and underwent primary PCI over a 12-month period starting in October 2004 and ending in September 2005. One-hundred and ninety-six patients presented to the emergency room with STEMI, and of those, 100 (51%) patients were transferred to the catheterization laboratory for coronary angiography and primary revascularization. Patients' clinical and angiographic data were retrospectively collected and patients were followed up for 9 months. During follow-up, patients were either seen in the out-patient clinic upon completion of 9 months or information was collected via a phone interview if a visit to our hospital was not possible.

Technical details of the primary PCI, including use of balloon, use of a thrombus aspiration catheter, implantation of stents, type of stents implanted, i.e. bare metal (BMS) vs drug-eluting stents (DES), use of platelet glycoprotein IIb/IIIa inhibitors etc., were left at the discretion of the operator and were recorded and correlated with the demographic, clinical and angiographic data. All patients received aspirin and clopidogrel prior to the procedure.

In general, vascular access was obtained via the right femoral artery, and when not feasible, the contralateral femoral artery or the right brachial artery was used. A 6F diagnostic catheter and subsequently a guide catheter of similar size were employed. A total of 5000-10000 units of heparin was used during PCI and the activated clotting time was monitored during and after the procedure. Post-procedure sheath removal was allowed when the activated clotting time (ACT) fell below 200 sec. Use of local hemostatic devices was left at the discretion of the operator.

STATISTICAL ANALYSIS

The analyzed dependent variables of our sample were the binary (Yes/No) variables of PCI success (TIMI 3 flow at the end of the PCI), readmission and death. To enhance our analysis, a new binary combined variable was constructed as a "total success" variable, deducing its data from the original dependent variables. In order to investigate the effect of any independent variable on the odds of the events, we used univariate and multivariate logistic regression models. The building of the multivariate models followed a forward procedure, using the likelihood ratio test. After the modelling procedure, the Hosmer-Lemeshow goodness of fit statistics was used. A p-value<0.05 was considered significant. The Stata™ 8.0 statistical software was used.

RESULTS

Table 1 shows the demographic and clinical characteristics of our study population. Overall 196 patients presented to the emergency room with STEMI over the study period. Of these 196 patients, 100 (51%) underwent primary PCI. These were 85 male and 15 female patients, of whom 72 were younger than 69 years of age, 24 were between 70 and 79 years of age and 4 were over 80 years old.

The PCI procedure was considered successful if at the end of the procedure a TIMI 3 flow was achieved in the infarct-related coronary artery (IRA).[8] TIMI 3 flow in the IRA was obtained in 79 (79%) of the 100 patients at the end of the procedure. Six (6%) patients died during hospitalization and another 4 (4.3%) patients died during the 9-month follow up period. Twenty one (22%) patients required rehospitalization for a new event of acute coronary syndrome, of whom 17 needed a second PCI and 4 patients were submitted to coronary artery bypass grafting.

The left ventricular ejection fraction (LVEF) was measured routinely by echocardiogram in the emergency room. Of the 100 patients, 46 (46%) were found to have LVEF ≥50%, while the remaining 54 (54%) patients had LVEF<50%. In 52 patients primary PCI was performed in less than 4 hours from the onset of symptoms. Of the 100 patients, 19 were thrombolyzed (either with full or half dose thrombolytic agent) before arriving to the catheterization laboratory. Antithrombotic therapy with platelet glycoprotein IIb/IIIa inhibitors, eptifibatide or tirofiban, were used in 48 (48%) patients.

The standard practice in our Institution during primary PCI was to treat only the infarct related coronary artery. Stent implantation was routinely performed at the culprit lesion; however in this group, 7 patients did not receive any stent due to unsuccessful PCI, 59 patients received one stent and 34 patients had more than one stent implanted. In our hospital drug eluting stents (DES) are implanted according to the indications published by the ESC guidelines,[7] hence in this study-group 28 patients received DES. Balloon predilation was performed in 83 patients. In 29 patients a thrombus aspiration device was used.

Both single-factor and multi-factor logistic regression analysis was applied for the statistical analysis. With regards to TIMI 3 flow, univariate analysis showed that the odds of achieving TIMI 3 flow after using IIb/IIIa inhibitors were 3.48 times higher than if IIb/IIIa inhibitors were not used. If the LVEF was ≥50% at the beginning of the PCI, the odds of achieving TIMI 3 flow at the end of the procedure were 6.4 times higher for the patient than if the LVEF was <50%.

If the time from the onset of symptoms to PCI was >4 hours, the odds of achieving TIMI 3 flow at the end of the procedure were reduced by 23.4% compared to time from symptoms to PCI <4 hours. Using death as a single-factor for

TABLE 1. Clinical and Angiographic Characteristics of 100 Patients With STEMI Undergoing Primary PCI

Patient Characteristic	No. of Patients
Age <69 years	72
Age 70-79 years	24
Age >80 years	4
Women	15
Infarct-related coronary artery	
Left main	3
Left anterior descending (LAD)	58
Circumflex	6
Right coronary artery (RCA)	33
LVEF>50%	46
LVEF<50%	54
TIMI 3 flow at end of PCI	79
Time from onset of symptoms to PCI <4 hours	52
Stents	93
DES	28
BMS	65
Number of stents	
0	7
1	59
>1	34
Balloon predilation	83
Thrombosis aspiration catheter	29
GP IIb/IIIa inhibitors	48
Prior thrombolysis	19
Rehospitalization	21
Repeat PCI	17
CABG	4
Total Deaths	10
In hospital	6

BMS= bare metal stent; CABG= coronary artery bypass grafting; DES= drug eluting stent; LVEF= ejection fraction; GP= glycoprotein; PCI= percutaneous coronary intervention; STEMI = ST-elevation myocardial infarction

our statistical analysis we found that the presence of TIMI 3 flow of the IRA at the end of PCI reduced the odds of death by 10.2% compared to the absence of TIMI 3 flow of the IRA. An increase of the patient's age by 1 year conferred an 11% increase of the odds of death.

DISCUSSION

In the present study we report our results and share our experience from performing primary PCI in a consecutive series of patients who presented with STEMI in our Institution. In the "Evagelismos" hospital there are two independent cardiology departments which follow different treatment strategies each, for patients with acute MI. One Department routinely treats all patients with STEMI with primary PCI, whereas the other Department follows a more conservative strategy by referring to the catheterization laboratory for primary PCI only the hemodynamically unstable patients, patients with extended anterior MIs or those patients who do not respond to thrombolysis. This is why only 100 (51%) of the 196 patients who presented in the Evagelismos hospital with acute MI underwent primary PCI. The comparison of the strategies applied by the two departments is a subject of a different study.

In this study we found that the use of platelet glycoprotein IIb/IIIa inhibitors increases the odds of achieving TIMI 3 flow of the IRA. Although the use of these agents is not formally recommended by the ESC guidelines for PCI in this group of patients, there have been other studies reporting results from the use of IIb/IIIa inhibitors in agreement with our findings.[7,10,11] Probably there is a benefit from the use of IIb/IIIa antagonists in primary PCI for patients with STEMI but this requires further investigation with larger and randomized trials.

There have been several studies emphasizing the importance of baseline LVEF as a predictive variable of mortality after primary PCI as well as a determinant of success for primary PCI.[12,13] In the present study we found that a good baseline LVEF at the beginning of PCI increased the odds of achieving TIMI 3 flow at the end of the procedure.

The importance of time from onset of symptoms to PCI is pointed out in every report of primary PCI and it is clear that the patient should be transferred to the catheterization laboratory as soon as possible. In the current study we found that if the time from onset of symptoms to primary PCI exceeded 4 hours, the odds of achieving TIMI 3 flow were severely reduced compared to patients who were transferred to the catheterization laboratory within the first 4 hours.

The importance of time elapsing from the onset of symptoms to the application of the interventional procedure was recently shown in a most recent meta-analysis of 22 randomized trials comparing primary PCI with fibrinolysis.[9] The authors stress the importance of avoiding any delay in the interventional treatment, because the longer the delay the higher the mortality. Nevertheless, this meta-analysis showed that 'primary PCI proved superior to fibrinolysis, regardless of treatment delay'.

Age is an independent predictor of cardiac death after primary PCI. This finding has been reported in several studies and it was true for our patient cohort as well.[2,14] Another strong independent predictor of mortality after primary PCI is TIMI 3 flow of the IRA at the end of the procedure,[12] which was also true for our study-group.

CONCLUSION

The results from this relatively small observational study are in keeping with the results published by other groups performing primary PCI.[3,6-9,13,15-20] Transferring the patients to the catheterization laboratory as soon as possible is of paramount importance in achieving TIMI 3 flow.[15,17-20] The use of platelet glycoprotein IIb/IIIa inhibitors before the initiation or during the performance of primary PCI increases the odds of achieving TIMI 3 flow.[10,11,15,16] Left ventricular ejection fraction >50% is a factor that predicts success of the procedure and good long-term results. TIMI 3 flow at the end of the procedure in the infarct-related coronary artery is a powerful predictor for good long-term results.

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