

CARDIOLOGY UPDATE 2006

Primary Percutaneous Coronary Intervention in Acute ST-elevation Myocardial Infarction: The Experience of “Evangelismos” General Hospital of Athens

Prodromos Anthopoulos, MD, Ioannis Antonellis, MD, Georgios Yfantis, MD, Anastasios Salahas, MD, Isidoros Gavaliatsis, MD, Spyros Koulouris, MD, George Andrikopoulos, MD, Ioannis Alexanian, MD, Efrosini Kambitsi, MD, Konstantinos Mihos, MD, Stylianos Tzeis, MD, Kostas Triantafyllou, MD, Antonis Sideris, MD, Ilias Siorras, MD, Fotios Kardaras, MD, Antonios Tavernarakis, MD, Antonis S. Manolis, MD

ABSTRACT

We report our experience from treating a large number of patients who presented to the Emergency Department of our Hospital with ST-elevation acute myocardial infarction (AMI) with primary percutaneous coronary intervention (PCI). Of the 196 patients who presented with ST elevation AMI over a period of 12 months, 100 (51%) patients underwent primary PCI. Clinical and angiographic data were collected and patients were followed up for 9 months. Technical details of the primary PCI, including use of balloon, use of thrombus aspiration catheter, stent implantation, use of drug eluting stents, and use of GP IIb/IIIa inhibitors were recorded and correlated to clinical and angiographic patient data. 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 left ventricular ejection fraction >50% and the importance of achieving TIMI 3 flow in the AMI related artery at the end of the procedure.

First and Second Departments of Cardiology and Catheterization Laboratory Department, “Evangelismos” General Hospital of Athens, Athens, Greece

KEY WORDS: *primary PCI; acute myocardial infarction; acute coronary syndromes; coronary angioplasty; coronary stenting; thrombolysis*

Corresponding author:
Prodromos L. Anthopoulos, MD
Ypsilantou 45-47
Athens 106 76, Greece
Tel.: +30-6932-364344
E-mail: prodromos_a@yahoo.com

INTRODUCTION

Over the past two decades, cardiologists have witnessed and proved the significance of timely opening of the occluded infarct-related coronary artery in patients presenting with acute myocardial infarction (AMI). Several recent 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 AMI by most large hospitals represents an important advance in the management of patients with coronary artery disease. Patients presenting with AMI, 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 “being a high volume center with experienced operators with short response times”, as suggested in the European Society of Cardiology guidelines for PCI, an attempt is made to routinely manage patients presenting to the emergency room with AMI with primary PCI [7]. Thus, the objective of the present study was to report our experience and clinical outcome of unselected patients who present to the emergency room of our hospital with ST-elevation AMI and are treated with primary PCI.

PATIENTS AND METHODS

The population of the study included all patients who presented to our hospital with ST-elevation AMI 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 Department with ST-elevation AMI, 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 (bare metal-BMS vs drug-eluting stents-DES), use of GP 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 from the right femoral artery, and when not feasible, the contralateral femoral artery or the right brachial artery was used. A 6F diagnostic and subsequently a similar sized guide catheter 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 ACT fell <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 improve 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

TABLE 1. Clinical and Angiographic Characteristics of 100 Study Patients

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

BMS= bare metal stent; CABG= coronary artery bypass grafting; DES= drug eluting stent; EF= ejection fraction; GP= glycoprotein; PCI= percutaneous coronary intervention

Emergency Department with ST-elevation AMI 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 less 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 [8]. TIMI 3 flow in the infarct artery 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 acute coronary syndrome (ACS), of whom 17 needed a second PCI and 4 patients were submitted to coronary artery bypass grafting.

The left ventricular ejection fraction (EF) was measured routinely by echocardiogram at the Emergency Department. Of the 100 patients, 46 (46%) patients were found to have EF $\geq 50\%$, while the remaining 54 (54%) had EF $< 50\%$. In 52 patients primary PCI was performed in less than 4 hours from onset of symptoms. Of the 100 patients, 19 were thrombolized (either with full or half dose thrombolytic) before arriving to the catheterization laboratory. Antithrombotic therapy with IIb/IIIa inhibitors, eptifibatid and tirofiban being the only GP IIb/IIIa inhibitors available in our hospital, were used in 48 (48%) patients.

The standard practice in our Institution during primary PCI was to treat only the infarct related 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 European Society of Cardiology guidelines [7], hence in this study-group 28 patients received DES. Balloon predilatation 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. Concerning the TIMI 3 flow, univariate analysis showed that the odds of achieving TIMI 3 flow after using GP IIb/IIIa inhibitors were 3.48 times higher than if GP IIb/IIIa inhibitors were not used. If the left ventricular ejection fraction was $\geq 50\%$ 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 EF was $< 50\%$.

If the time from the onset of symptoms to PCI was > 4 h, 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 h. Using death as a single-factor for our statistical analysis we found that the presence of TIMI 3 flow of the infarct-related artery at the end of PCI reduced the odds of death by 10.2% compared to the absence of TIMI 3 flow of the

infarct-related coronary artery. An increase of the patient's age by 1 year conferred an 11% increase of the odds of death.

DISCUSSION

In this study we report our results and share our experience from performing primary PCI in a consecutive series of patients who presented with ST-elevation AMI to our Institution. In the "Evangelismos" hospital there are two independent cardiology departments which follow different treatment strategies each, for patients with AMI. One Department routinely treats all ST-elevation AMI 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 Evangelismos hospital with AMI 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 GP IIb/IIIa inhibitors increases the odds of achieving TIMI 3 flow of the infarct-related coronary artery. 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 GP IIb/IIIa inhibitors in agreement with our findings [7,10,11]. Probably there is a benefit from the use of GP IIb/IIIa antagonists in primary PCI for patients with ST-elevation AMI 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 percutaneous coronary interventions (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 infarct-related artery at the end of the procedure [12], which was also true for our study-group.

CONCLUSIONS

The results from this relatively small observational study are in keeping with the results published by other groups performing primary PCI. Transferring the patients to the catheterization laboratory as soon as possible is of paramount importance in achieving TIMI 3 flow. The use of GP IIb/IIIa inhibitors before the initiation or during the performance of primary PCI increases the odds of achieving TIMI 3 flow. Left ventricular EF >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.

ACKNOWLEDGMENT/APPENDIX

The work and contribution of all physicians, nurses and technicians of the cardiology departments involved in patients' care is acknowledged and greatly appreciated: Nikos Exadaktylos, MD, Haris Kalogeropoulos, MD, Kostas Kappos, MD, Vasilis Kollopoulos, MD, Athanasios Kranidis, MD, Ioannis Pyrros, MD, Nikos Sakellaris, MD, Nikos Hatzis, MD, Michael Efremidis, MD, Dimitra Kardara, MD, Leonidas Flessas, MD, Vicky Tsagou, MD, Chrysanthi Dasopoulou, MD, Michael Pinnas, MD, Ioannis Michaelides, MD, Dimitris Amorgianos, MD, Michael Gabriel, MD, Ilias Konstantinidis, MD, Eleni Heretaki, MD, Demos Avramidis, MD, Dimitris Sakellariou, MD, Nikos Parzakonis, MD, Sotiris Kounas, MD, Christos Kollas, MD, Maria Spyropoulou, MD, Eirini Mavrikidou, MD, Kostas Letsas, MD, Sotiris Kouloktis, MD, Virginia Markou, MD, Athanasios Zotos, MD, Athanasios Gourziotis, MD, Loukas Pappas, MD, Panayiotis Vlismas, MD, Gerasimos Gavrielatos, MD, Urania Fouska, RN, Stavroula Greka, RN, Georgia Psarra, RN, Dimitra Agelidou, RN, Panayiota Sereti, RN, Theoni Avrami, RN, Vassiliki Nikolopoulou, RN, Despoina Vasiliou, RN, Konstantina Thanopoulou, MD, Yannoula Lyta, RN, Athanasia Papouktsi, RN, Vaia Mballiou, RN, Sofia Dimopoulou, RN, Ioanna Kariofylla, RN, Olga Paraschi, RN, Kyriaki Anagnostou, RN, Aikaterini Kollia-Metaxiotou, RN, Ageliki Psilolichnou, RN, Eleni Ermidou, RN, Zoi Mazaraki, RN, Paraskevi Liapi, RN, Thomas Gourzis, RN, Georgia Pantelopoulou, RN, Grigorios Kyriakidis, RN, Athanasios Tsios, RN, Sofia Griva, RN, Aikaterini

Mihalopoulou, RN, Nikolaos Karapanos, RN, Michael Vitos, RN, Martha Kanioura, RN, Stavroula Kontaktsi, RN, Aikaterini Lazaridou, RN, Aspasia Sotiriou, RN, Areti Kleisiari, RN, Eleni Fountoulaki, RN, Vasileios Kontoyiannis, Georgia Xystra, Christos Athanasopoulos, Konstantinos Lazos. The work of nurse's aids and all other ancillary staff of all three departments and of all personnel of the Emergency Department is also acknowledged and deeply appreciated.

REFERENCES

1. van der Werf F, Baim D. Reperfusion for ST-segment elevation myocardial infarction: an overview of current treatment options. *Circulation* 2002; 105:2813-6.
2. Montalescot G, Andersen HR, Antoniucci D, Betriu A, et al. Recommendations on percutaneous coronary intervention for the reperfusion of acute ST-elevation myocardial infarction. *Heart* 2004; 90:e37.
3. Nunn CM, O'Neil WW, Rothbaum D, Stone G, et al. Long-term out-come after primary angioplasty: report from the primary angioplasty in myocardial infarction (PAMI-I) trial. *J Am Coll Cardiol* 1999; 33:640-6.
4. Brodie BR, Grines CL, Ivanhoe R, Knopf W, et al. Six-month clinical and angiographic follow-up after direct angioplasty for AMI: final results from the primary angioplasty registry. *Circulation* 1994; 90:156-62.
5. Andersen HR, Nielsen TT, Rasmussen K, Thuesen L, et al. DANAMI-2 Investigators. A comparison of coronary angioplasty with fibrinolytic therapy in acute myocardial infarction. *N Engl J Med* 2003; 349:733-42.
6. Keeley EC, Boura JA, Grines CL. Primary angioplasty versus intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomized trials. *Lancet* 2003; 361:13-20.
7. Silber S, Albertsson P, Aviles FF, Gamici GP, et al. Guidelines for percutaneous coronary intervention. The Task Force for Percutaneous Coronary Interventions of the European Society of Cardiology. *Eur Heart J* 2005; 26: 804-47.
8. TIMI Study Group. The Thrombolysis In Myocardial Infarction (TIMI) trial. Phase I findings. *N Engl J Med* 1985; 312: 932-936.
9. Boersma E, and The Primary Coronary Angioplasty vs. Thrombolysis (PCAT)-2 Trialists' Collaborative Group. Does time matter? A pooled analysis of randomized clinical trials comparing primary percutaneous coronary intervention and in-hospital fibrinolysis in acute myocardial infarction patients. *Eur Heart J* 2006; 27:779-88.
10. Montalescot G, Borentain M, Payot L, Collet JP, et al. Early vs. late administration of glycoprotein IIb/IIIa inhibitors in primary percutaneous coronary intervention of acute ST-segment elevation myocardial infarction: a meta-analysis. *JAMA* 2004; 292:362-366.
11. Lee DP, Herity NA, Hiatt BL, Fearon WF, et al. Adjunctive platelet glycoprotein IIb/IIIa receptor inhibition with tirofiban before primary angioplasty improves angiographic out-comes:

PRIMARY PCI FOR ST-ELEVATION AMI

- results of the Tirofiban Given in the Emergency Room before Primary Angioplasty (TIGER-PA) pilot trial. *Circulation* 2003; 107:1497-1501.
12. Brodie BR, Grines CL, Ivanhoe R, Knopf W, et al. Six-month clinical and angiographic follow-up after direct angioplasty for AMI: final results from the primary angioplasty registry. *Circulation* 1994; 90:156-62.
 13. Keeley EC, Boura JA, Grines CL. Primary angioplasty versus intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review of 23 randomized trials. *Lancet* 2003; 361:13-20.
 14. Beohar N, Davidson CJ, Weigold G, Goodreau L, et al. Predictors of long-term out-comes following direct percutaneous coronary intervention for acute myocardial infarction. *Am J Cardiol* 2001; 88:1103-7.