Original Article

Outcome of Primary Percutaneous Coronary Intervention (PCI) of Ostial versus Nonostial Occlusion of Left Anterior Descending Artery

(Study conducted at National Institute of Cardiovascular Diseases, Karachi)

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ABSTRACT

OBJECT: The object of this study was to compare the outcome of Primary PCI of ostial versus non ostial occlusion of LAD artery.

MATERIALS AND METHODS: This observational study was conducted at National Institute of Cardiovascular Diseases Karachi, Pakistan from January 1st, 2008 to December 31st, 2008. A total of 70 patients presented to the catheterization laboratory for Primary PCI of LAD artery in whom baseline coronary angiogram showed acute occlusion of left anterior descending artery were enrolled for the study. All Patients received Aspirin, Clopidogrel and Platelet Glycoprotein IIB IIIA inhibitor. Patients were followed at one month, 3 months and 6 months.

RESULTS: Out of 70 cases 50 had nonostial and 20 had ostial occlusion. Baseline characteristics were similar between both groups. Stenting was done in 95% of all patients and was similar in patients with ostial or nonostial narrowing. Procedural success was the same for ostial and nonostial Primary PCI (100% vs. 96%). Six months event free survival was also similar in both groups (75% vs. 76%). Total event rate and mortality was also same in both groups (25% vs. 24% and 10% vs. 10%).

CONCLUSION: Primary PCI of ostial LAD occlusion with suitable anatomy is as safe and similar as non ostial LAD occlusion and optimal results can be achieved in this high risk group of patients in a developing country at a tertiary care public sector hospital. To validate our results further studies with larger cohort are needed.

KEY WORDS: ST-segment elevation, Myocardial Infarction, Primary Percutaneous Coronary Intervention, Ostial Left anterior descending artery, stenting.

INTRODUCTION

In patients with acute ST elevation myocardial infarction (STEMI), it is now an established fact that revascularization with primary Percutaneous Coronary Intervention (PCI) provides better outcome as compared to pharmacological treatment.[1,2] But whether this mode of treatment is equally beneficial in patients with acute ostial occlusion of left anterior descending (LAD) artery, is not known. In the era of balloon angioplasty, ostial PCI was considered as having increased risk with decreased success.[3] Although, stenting has decreased the risk of elastic recoil and dissection, even then precise stent placement can be challenging. Proximal misplacement may jeopardize the adjacent coronary ostium by causing a stent "jail" with or without plaque shift. At the other end, distal misplacement may cause an incomplete coverage of the ostium and hence may lead to restenosis. Moreover, patients with acute occlusion of ostial LAD artery are more likely to have in heart failure and shock. PCI in these unstable patients is more risky and likely to have worse outcomes. Therefore in this study, we compared difficult PCI of ostial LAD with non ostial PCI in patients with acute LAD occlusion.

Primary PCI is being done at our centre since 1999, but initially it was offered to those in whom Thrombolytic treatment is contraindicated. However, for the last two years it is being offered to all patients with acute STEMI. Although this primary PCI program has been running successfully since 2007, the key question is whether we can truly offer this facility in high risk group of patients in a public sector tertiary care centre?

Although outcomes of primary PCI are well known and well evident, the outcomes of primary PCI of acute ostial left anterior descending (LAD) artery occlusion are not known. The primary object of our study was to determine outcomes in patients undergoing primary PCI for STEMI due to occlusion of ostial LAD. Our secondary object was to compare the outcomes of ostial LAD occlusion with primary PCI of non ostial

LAD occlusion.

MATERIALS AND METHODS

Patient population: This was an observational study conducted at National Institute of Cardiovascular diseases (NICVD) Karachi from January 1st 2008 to December 31st 2008. All adult patients (≥18 years old) with chest pain lasting >30 minutes, ST elevation of ≥1 mm in ≥2 precordial leads, and coronary angiogram showing occlusion of LAD artery were included in this study. Informed consent was taken and detailed questionnaire was filled of those patients who agreed for primary PCI.

Only those ostial lesions were treated with primary PCI in whom the ostial plaque did not seem to be involve the distal left main and/or ostium of LCx (Left Circumflex) artery. Moreover, angle of LAD ostium with LCx artery was more than 70º. All other ostial lesions were excluded from the study. Patients who underwent rescue PCI or primary PCI of LCx or right coronary artery were excluded from the study. Patients who received Thrombolytic therapy within 24 hours of hospital admission, those who were diagnosed as Non ST elevation Myocardial Infarction (NSTEMI) and those presenting beyond 24 hours with resolved symptoms were also excluded from the analysis.

Procedure

Primary PCI of the LAD artery was performed in standard method using a variety of guiding catheters, coronary wires, balloons and stents. The majority of interventions were performed through the femoral route. However, the choice of access was on discretion of operators and considerable number of interventions was performed through radial route. All patients received 5000-10,000 units of intravenous unfractionated heparin, Aspirin 300-mg, clopidogrel 600-mg (loading dose), and Platelet glycoprotein IIb IIIa inhibitor. Thrombus extraction catheter (export catheter), intracoronary nitroprusside and adenosine use were at the discretion of operators. All patients were prescribed Aspirin 300-mg, Clopidogrel 75-mg and Atorvastatin 20-40 mg./Rosuvastatin 10-20 mg daily at the time of discharge from the hospital. Patients were followed at one month, 3rd month and 6th month of procedure.

Data collection

The prospective information on variables including age, gender, history of diabetes, hypertension, hyperlipidemia, smoking, prior PCI or coronary artery bypass grafting (CABG), presence of cardiogenic shock, need of intubation and/or intra-aortic balloon pump (IABP), angiographic and procedural details (ostial involvement, segment of vessel, side branch involvement, use of stents, GP IIb IIIa inhibitors, Thrombolysis in Myocardial Infarction (TIMI) flow, and Tissue Myocardial perfusion (TMP) grade and Electrocardiogram (ECG) findings were recorded.

TIMI flow, TMP grades and ST resolution (on 12- lead ECG strips) were visually determined and documented by two independent observers before and after PCI and in case of controversy third expert opinion was taken as final.

Definitions

Ostial lesion was defined as being located within 3-mm of the ostium of the left anterior descending artery. Non ostial lesion was defined as being located ≥3 -mm away from the ostium.

Cardiogenic shock defined as systolic blood pressure (SBP) of <90-mmHg for at least 30 minutes, or requirement of inotropic support to maintain a SBP >90-mmHg. PCI success was defined as achievement of vessel patency to a residual ≤30%. Major bleeding was defined as a hematoma ≥10-cm in diameter or bleeding requiring transfusion, vascular surgery or resulting in major morbidity. TIMI flow grades were defined as: Zero – total occlusion resulting in no antegrade flow, 1 – minimal penetration of contrast across the obstruction but fails to opacify the vessel, 2 – contrast opacifies the vessel beyond the occlusion but with delay, 3 – normal complete perfusion of entire vessel without any delay. TMP grades were defined as: Zero – minimal or no myocardial blush, 1 – dye stains the myocardium and this stain persists on the next injection, 2 – dye enters the myocardium but washes out slowly and strongly persists at the end of injection, 3 – normal entrance and exit of dye in the myocardium. Complete ST resolution was defined as ≥70% ST resolution compared to baseline ECG.

Timing variables were documented as follows: (1) Symptom onset to Emergency Room (ER) time was defined as the time duration between the onset of symptoms to the time of presentation to the ER. (2) Door-to-Lab time was defined as the time taken for the shifting of patient to the Catheterization Laboratory from the point of entry to the ER. (3) Door-to-balloon time was defined as the time taken for the first ballooning from the point of arrival to the ER.

Patients were followed in out patient department (OPD) after one month, 3rd month and at 6th month. Those patients who could not come in OPD, they were contacted through telephone and follow up documented.

Data were managed and analyzed on Statistical Package for Social Sciences (SPSS) Version 10.

RESULTS

A total of 137 patients opted primary PCI out of them 70 underwent PCI to LAD and remaining 67 were ex-

cluded from the study due to reasons mentioned above in the study protocol. Patients who underwent ostial PCI (n = 20) were compared with patients who underwent non ostial (proximal, mid or distal LAD segments) PCI.

Table I shows the baseline demographic and clinical characteristics of both groups. These features did not differ significantly between the two groups. The mean age was just under 51 years in both groups. The frequency of hypertension was nearly same in both groups but diabetes was more common in ostial group although not significantly. The trend of presentation with bundle branch block and cardiogenic shock was seen more commonly with ostial group. Similarly trend of requirement of inotropic support and IABP was towards ostial group. Door to balloon time was nearly same in both groups. In hospital mortality did not differ significantly among the two groups.

Table II shows the angiographic and procedural details of the patients undergoing primary PCI of ostial

TABLE I: CHARACTERISTICS OF PATIENTS UNDERGOING PRIMARY PCI OF (OSTIAL VS NON OSTIAL) LEFT ANTERIOR DESCENDING ARTERY AT NICVD

Baseline Demographic and clinical characteristics	Ostial n=20(%)	Non ostial n=50(%)	P Value
Age (mean {SD}) in years	49 {11.4}	50.9 {12.1}	0.74
Male gender (%)	18 (90)	42 (84)	0.71
Past Medical history			
Hypertension	09 (45)	27 (54)	0.67
Diabetes	06 (30)	09 (18)	0.43
Current Smoker	08 (40)	15 (30)	0.60
Admission Characteristics			
AWMI+BBB	02 (10)	03 (06)	NS
Cardiogenic Shock	02 (10)	04 (08)	NS
Inotrops required	02 (10)	04 (08)	NS
Intubation required	01 (05)	03 (06)	NS
IABP required	02 (10)	03 (06)	0.60
Timing Variables (Mean (minutes) {SD})			
Chest pain to ER	120.4 (84.9)	117.4(108.4)	0.91
Door to Laboratory	72.2 (82.1)	72.3 (52.8)	0.99
Door to Balloon	105.6 (83.4)	104.2(53.8)	0.93
Death (In-hospital)	02 (10)	04 (08)	NS
Death (cardiogenic shock)	02 (10)	02 (04)	NS
Death (no cardiogenic shock)	00	02 (04)	NS

PCI = percutaneous coronary intervention; SD = standard deviation; AWMI = Anterior wall Myocardial infarction; BBB = Bundle Branch Block; IABP = intra-aortic balloon counterpulsation; ER = emergency room; NS = non significant

TABLE II: ANGIOGRAPHIC AND PROCEDURAL CHARACTERISTICS OF PATIENTS UNDERGOING PRIMARY PCI OF OSTIAL VS NON OSTIAL LAD AT NICVD, KARACHI

Angiographic and procedural characteristics	ostial n = 20(%)	Non ostial n = 50(%)	P-value
Single Vessel CAD	14 (70)	33 (66)	NS
Two Vessel CAD	01 (05)	04 (08)	NS
Multivessel CAD	05 (25)	13 (26)	NS
Type A	04 (20)	04 (08)	0.40
Type B	05 (25)	16 (32)	NS
Type C	11 (55)	30 (60)	NS
Artery size in mm (mean [SD])	3.2 [0.34]	3.0 [0.30]	NS
PCI Technique			
Predilation of the lesion	12 (60)	19 (38)	0.12
Direct stenting	06 (30)	19 (38)	NS
Direct stenting followed by Post dilation	01 (05)	08 (16)	NS
Stenting not done	01 (05)	04 (08)	NS
More than one lesions stented	04 (20)	04 (08)	NS
Stent size - 3.0-3.5 mm	17 (85)	39 (78)	NS
BMS used	19 (95)	47 (94)	NS
Side branch involvement	14 (70)	33 (66)	NS
TIMI flow (pre procedure)			
0	10 (50)	30 (60)	NS
I	06 (30)	18 (36)	NS
II & III	04 (20)	02 (04)	NS
TIMI flow (post procedure)			
I	00	01 (02)	0.40
II	01 (05)	02 (04)	NS
III	19 (95)	47 (94)	0.41
Glycoprotein IIb/IIIa inhibitor use	20 (100)	50 (100)	NS
Thrombus visualized	19 (95)	48 (96)	NS
Use of Export Cathter	16 (80)	43 (86)	NS
Clot retrieval	07 (35)	21 (42)	NS
Use of Adenosine	05 (25)	12 (24)	NS
Post PCI Tissue Myocardial Perfusion			
0 & I	14 (70)	35 (70)	NS
II & III	06 (30)	15 (30)	NS
Procedural success	20 (100)	48 (96)	NS
Table Death	00	01 (02)	NS

PCI = percutaneous coronary intervention; LAD = left anterior descending; CAD = coronary artery disease; mm = millimeter; BMS = bare metal stent; TIMI = thrombolysis in myocardial infarction; NS = non-significant

vs. non ostial LAD occlusions. Most of these features did not differ between the two groups. Nearly 95% of lesions were stented in both groups and high procedural success (ostial = 100%; non ostial = 96%) was achieved. One patient was died on table in non ostial group.

Table III shows comparison of outcomes at six month of follow up between the groups of patients undergoing primary PCI of ostial vs. non ostial LAD occlusion. Death rate was similar in two groups although hospital death was slightly higher in ostial group. Total event rate did not differ significantly between the groups (25% vs. 24%) and event free survival at 6 month follow up was nearly same in both groups (75% vs. 76%).

TABLE III: OUTCOME OF PATIENTS UNDERGOING PRIMARY PCI OF LEFT ANTERIOR DESCENDING (LAD) ARTERY - 6 MONTHS OF FOLLOW UP

Major Adverse Cardiac Event (MACE)	Ostial n = 20 (%)	Non-ostial n = 50 (%)
Death : in-hospital	02 (10)	04 (08)
Death : follow up	00	01 (02)
Death : all patients	02 (10)	05 (10)
CABG : in-hospital	00	00
CABG : follow up	01 (05)	04 (08)
Heart Failure	00	01 (02)
Recurrent MI	01 (05)	02 (04)
Stent Thrombosis	01 (05)	00
Total event rate	05 (25)	12 (24)
Event free survival at 6 month	15 (75)	38 (76)

PCI = Percutaneous Coronary Intervention; CABG= Coronary artery bypass grafting; MI=Myocardial Infarction

DISCUSSION

Ostial lesions have peculiar pathological and morphological features. These lesions are technically more demanding and challenging and have inferior outcomes when compared to non ostial lesions. These lesions contain higher calcium and fibrous tissue and they tend to have increased elastic recoil activity.[4,5] Apart from that, increased intimal hyperplasia has been noted after stenting. Due to these factors most of the operators prefer to deploy drug eluting stent (DES), just like in other complex lesion subsets. Although the available data are limited, the DES appears to successfully manage the problem of restenosis. However, even with DES, ostial lesions appear to be correlated with poorer outcomes. The location of these lesions poses inherent challenges to the operators due to limited angiographic views, highly variable ostial anatomy, unstable guide support, accentuated cardiac motion and usually significant myocardium in jeopardy. In addition to these technical challenges, presence of thrombus, sicker clinical condition and presence of heart failure in patients with acute occlusion of ostial LAD makes the PCI more risky and likely to have worse outcomes. However, data is not available in this regard particularly in our part of the world.

This is the first report about the comparison of outcomes of primary PCI of ostial versus non ostial occlusions of LAD artery. Baseline demographic, clinical and angiographic features were nearly similar in patients who underwent ostial and non ostial primary PCI. However, there was a disparity between the numbers of patients in two groups. Ostial group had significantly less number of patients (n = 20) as compare to non ostial group (n = 50). As we enrolled the consecutive patients who underwent primary PCI during the period of one year, this disparity was inevitable and unavoidable. This may also be due to the selection bias of the operators towards more suitable anatomy while dealing with ostial lesions particularly if we keep considering the reasonable number of patients who excluded from the study.

An interesting and encouraging trend emerged from our study was a high procedural success rate (100% vs. 96%) and an excellent overall in-hospital survival rate (90% vs. 92%) in ostial as well as non ostial primary PCI of LAD artery. The high rates of initial success and TIMI 3 flow were almost equivalent in both groups. This may be surprising but considering the fact that characteristic changes in chronic ostial lesions like increased fibrosis content, calcification and increased elastic recoil develop over a longer period of time and that may not be present in acute ostial lesions and during the early stages of disease. Besides that majority of ostial lesions were predilated in our study group that may also explain high procedural success rate although aggressive debulking was not required, probably due to the same reasons mentioned above. An excellent overall in-hospital survival also needs discussion. The fact that is well evident from literature that eversince various balloons, stents and other devices are introduced the success rate of ostial PCI is over 95% and risk of serious complications has reduced considerably.[6] Mavromatis et al in his study has also reported similar in-hospital survival rate but increased TLR at 1 year in ostial PCI group.[7] We reported six months follow up that did not show any significant difference, however, further follow up is needed to know the long term difference.

In our study bare metal stents (BMS) have been used in ~ 95 % of patients in both groups. Although safety of drug eluting stents (DES) in primary PCI has been

observed recently in various trials, [8-10] however, neither it is generally recommended in all patients of Primary PCI nor it become a routine to use DES in the setting of STEMI at our centre. Secondly, financial constraints do not let the operators free to use DES that is more expensive as compare to BMS. Further more primary PCI itself is an expensive mode of treatment and adding the cost of DES makes it much more expensive and difficult to bear for most of our patients in a public sector hospital. In our study despite of this limitation in-hospital and six month follow up did not show any significant difference between the two groups. Although various studies have shown similar result in-hospital and short term outcome of ostial LAD PCI either with BMS and DES but at 9 months follow up there was significantly higher Target Lesion Revascularization (TLR) and Major Adverse Cardiac Events (MACE) in ostial LAD lesions when treated with BMS. [11,12] However, the data on primary PCI of ostial LAD with DES is scarcely available therefore it can not be concluded that outcome of primary PCI of ostial LAD would be better with DES.

There are certain other findings in our study that need further discussion. ~ 85 % patients of our study groups were male. This was probably due to gender bias that is present in our male dominant society where female gender, in general, is a less privilege part of the society. This is consistent with other studies on acute MI and reflects the gender discrimination commonly seen in the Indo-Pakistan subcontinent.[13,14]

The mean age in our study groups was less than 51 years that is lower than the reported studies from the western world. However, this lower age at presentation is again consistent with other studies in Pakistan on acute MI and probably reflects premature atherosclerosis that is commonly seen in southeast Asia.[15]

The rate of predilation was higher in ostial lesions as compare to non ostial although it was not statistically significant (60% vs 36%). This was not unusual as ostial PCI needs more debulking than nonostial PCI due to its unique pathological and morphological features as mentioned above. This is also to prevent plaque shift and to achieve a larger lumen diameter without reliance on stenting. [7]

The mean door-to-balloon (DBT) time was ~ 105 minutes in both groups. This was definitely higher than the standard of 90 minutes. [16] Where as door-to-Laboratory time was more than 72 minutes. This means that the reason for delay was not related to the handling of risky and technically difficult patients but actually delay was related to shifting the patient from ER to Catheterization laboratory. This is understandable if we consider the cost difference between the pharmacological and percutaneous treatment for STEMI. As we are lacking state funding for these types of expensive procedures, patients have to bear most of the cost. This complicates the decision making and hence resulting in delays to definitive treatment.

What would be the implications of our study? It has been shown in our study that Primary PCI is a viable therapeutic option and can be performed in public sector tertiary care hospitals with excellent immediate, short and long term outcomes not only in low risk patients but also in high risk and technically difficult patients. These results can be achieved despite relatively long symptom onset to ER and door-to-balloon times. As incidence of ischaemic heart disease has been increasing in our part of the world, acute STEMI will continue to suffer our young adult workforce. Left anterior descending artery is the culprit in majority (>53%) of STEMI. [17] This predicts the danger to our young population. Although pharmacological treatment (Streptokinase) is widely available at most of urban Pakistan, the efficacy of this treatment in achieving TIMI 3 flow is approximately 50%.[18] Therefore strong commitment is needed and effective measures should be taken to make this expensive Primary PCI treatment widely available to save our young productive workforce.

Study Limitations

The sample size of our study was very small although we collected the data for complete one year. Secondly, there was a disparity and the numbers of patients were grossly unequal between the two groups. Due to these reasons data analysis was difficult and turned insignificant when compared. Therefore, we need to enroll more patients to validate our results in larger cohort.

CONCLUSION

Primary PCI of ostial LAD occlusion with suitable anatomy is as safe and similar as non ostial LAD occlusion and optimal results can be achieved in this high risk group of patients in a developing country at a tertiary care public sector hospital. To validate our results further studies with larger cohort are needed.

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