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Percutaneous coronary intervention with stenting of left main coronary artery with drug-eluting stent in the setting of acute ST elevation myocardial infarction ☆

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Abstract

Aim: Primary angioplasty of the left main coronary is not a common procedure. We present 16 cases of angioplasty of left main coronary artery with drug-eluting stent (DES) implantation in the setting of acute ST elevation myocardial infarction.
Method: Between December 2003 and November 2005, sixteen patients presented with acute ST elevation myocardial infarction where the left main coronary artery was shown to be involved with or without the left anterior descending or left circumflex arteries. Primary angioplasties were performed on the unprotected left main coronary artery. Five patients received direct stenting while the rest had pre-dilatation. Only one patient received Taxus® while the rest received Cypher® stents.
Results: Of the sixteen patients, eleven developed cardiogenic shock necessitating intra-venous inotropic and intra-aortic balloon counter-pulsation support. Seven perished in hospital (46%); four within the first day while one had a complicated course and perished on the 42nd day of hospitalization. There was no difference in clinical history (hypertension, diabetes, age, and previous coronary intervention) or hemodynamic features (presenting blood pressure, duration of infarct, stent length, and maximum balloon size or pressure) between the two groups. However, the use of inotropes and intra-aortic balloon counter-pulsation (100% vs. 44% $p=0.034$) was significantly more common in the group which perished. Patient with cardiogenic shock had increased mortality of 63%. Of the nine survivors, one required repeat intervention for subacute stent thrombosis at sixteenth day and one underwent coronary bypass surgery at three months. All remained well up to mean follow up of 420 days.
Conclusion: Left main coronary artery infarct especially in the setting of cardiogenic shock has a very high mortality rate. Percutaneous intervention can be performed on these patients with minimal delay. In our series, we have shown that primary intervention of the unprotected left main coronary artery with a drug-eluting stent carries an acceptable level of major adverse coronary event. In those who survived the initial event, there is a low rate of mortality or morbidity.

Keywords: Left main coronary artery; Primary percutaneous coronary intervention; Drug-eluting stents; Sirolimus eluting stents; Paclitaxel eluting stents; ST elevation myocardial infarction; Left main stenting

1. Introduction

ST-segment elevation myocardial infarction caused by occlusion of left main coronary artery is not a common event. It carries a high mortality and morbidity rate. Patients not infrequently develop cardiogenic shock. The goal of

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Table 1
This shows the sites and extent of lesions in the left main coronary artery

Patient	Age	Sex	Site of left main coronary artery disease	Infarct related artery	Presence of shock	Alive	Stenting technique	Direct stenting	Presence of multi-vessel disease
1	46	Male	LM ostium extending to shaft	LM	Yes	Yes	Single stent in LM ostium to shaft	No	No
2	64	Male	LM ostium extending to shaft	LM	Yes	Yes	Single stent from LM to LAD	No	Yes
3	58	Male	Distal LM extending to proximal LAD	LM	No	Yes	Single stent from LM to LAD	Yes	No
4	55	Male	Distal LM bifurcation	LM	No	Yes	Bifurcation stenting with crush	No	Yes
5	56	Male	Distal LM extending to proximal LAD	Proximal LAD	No	Yes	Single stent from LM to LAD	No	No
6	73	Female	LM ostium extending to proximal LAD	LM	Yes	Yes	Single stent from LM to LAD	No	Yes
7	65	Female	Distal LM extending to LCx	LM	Yes	Yes	Single stent from LM to LCx	No	Yes
8	58	Male	Distal LM extending to proximal LAD	Proximal LAD	No	Yes	Single stent from LM to LAD	No	No
9	86	Male	Distal LM extending to proximal LAD	Proximal LAD	No	Yes	Single stent from LM to LAD	No	No
10	78	Female	LM ostium	LM	Yes	No	Single stent from LM to LAD	No	Yes
11	44	Male	LM ostium	LM	Yes	No	Single stent from LM to LAD	Yes	No
12	51	Male	LM ostium	LM	Yes	No	Single stent from LM to LAD	Yes	No
13	66	Male	LM mid shaft extending to distal LM	LM	Yes	No	Single stent from LM to LAD	No	Yes
14	67	Male	LM ostium	LM	Yes	No	Single stent from LM to LAD	Yes	No
15	57	Male	LM mid shaft only	LM	Yes	No	Single stent from LM to LAD	No	Yes
16	64	Male	Distal LM extending to mid LAD	LM	Yes	No	'T' stenting	No	Yes

LM = left main coronary artery. LAD = left anterior descending artery. LCx = left circumflex coronary artery.

treatment in patient with cardiogenic shock is the relieve of occlusion together with hemodynamic support. This improves the long term prognosis [1].

Although drug-eluting stents (DES) have only recently started to be used in acute ST elevation myocardial infarction [2,3], it's use in left main coronary artery is still uncommon. We present 16 cases of ST elevation infarction involving an unprotected left main coronary where primary angioplasty was attempted with drug-eluting stent implantation.

2. Method

Between December 2003 and November 2005, there were 16 cases of ST elevation myocardial infarction involving the left main coronary artery presented to our institution. All the cases presented with chest pain. The mean age was 61.75(+/−11) years. Three of the patients (19%) were females.

After initial assessment and stabilization at the emergency room, patients were consented for primary coronary intervention. Catheterization laboratory was only activated after consent was obtained. All patients were given Aspirin 300 mg immediately and 100 mg per day henceforth. Clopidogrel was also given 300 mg immediately and 75 mg per day henceforth.

Eleven patients (69%) developed cardiogenic shock requiring intra-venous inotropes and intra-aortic balloon counter-pulsation support. Angioplasty was performed where the modality was at treating physicians' discretion; five cases underwent direct stenting without pre-dilatation. Only one patient received Taxus® while the rest received Cypher® stent implantation. Distal protection device and glycoprotein 2b/3a were not used. Glycoprotein IIb/IIIa inhibitors administration was not reimbursed from health insurance systems in the country during the study period.

3. Statistics

All results are presented as mean ± SD unless otherwise stated. Unpaired Student-*t* tests are used to compare nominal data and chi square or Fisher's exact tests used for ordinal data.

4. Results

Procedural success with TIMI 3 flow was achieved in all cases. The mean stent length was 26 ± 6.7 mm and the mean stent size was 3.4 ± 0.2 mm. Tables 1, 2 and 3 show the

characteristics of the patients as well as the stenting techniques.

Of the 16 cases, 7 (44%) had in-hospital mortality. The other 9 (56%) were discharged well. There was no difference between the surviving group and non-surviving group in the following parameters; age, weight, admission blood pressure or duration of pain. There was also no difference in cardiovascular risk factors namely hypertension, diabetes, previous percutaneous intervention or previous MI. None of the patients underwent previous coronary artery bypass surgery.

The patterns of left main involvement were varied. There was no excess involvement of left main ostium [3(33%) in the alive group vs. 4 (56%) in the deceased group $p=0.6$] or distal left main [7(78%) in the alive group and 4(57%) for the deceased group $p=0.6$] in either groups.

The lengths of stent in the group which survived and which perished were 28±7 mm and 23±6mm ($p=0.06$) respectively. The stent sizes were 3.4±0.2 mm and 3.3±0.3 mm ($p=0.4$) respectively. The most frequently used stenting method was to place a single stent in the left main coronary artery extending into the left anterior descending artery across the left circumflex artery. There was only one case of crush stenting and one case of 'T' stenting.

However, the use of inotropes (100% vs. 44%) and intra-aortic balloon counter-pulsation (100% vs. 44%) was significantly more common in the group which perished compared to the group which survived ($p=0.034$ for both comparison). Although there is no statistical significance, the patients who perished tend to do so within the first 24 h after admission.

Patients with cardiogenic shock were more likely to have the left main coronary artery as the infarct related artery (100%, $p=0.02$). They were also more likely to involve the left main ostium (64%, $p=0.03$) and have a higher mortality rate (63%, $p=0.03$) compared to those without shock.

Table 2
This table shows the clinical characteristics between the group which survived and the group which perished

	Alive	Dead	p
	Mean±SD	Mean±SD	
Numbers	9 (56%)	7 (44%)	–
Age (years)	62±11.6	61±11.3	0.7
Weight (kg)	65±7	69±9	0.3
Height (cm)	164±5.6	165±0.3	0.4
Systolic BP (mmHg)	96±42	82±26	0.08
Diastolic BP (mmHg)	67±27	48±27	0.1
Duration of MI (min)	145±115	150±131	1.0
Length of stay (days)	6.6±4	7.7+/15	0.1
Stent length (mm)	28±7	23±6	0.06
Stent size (mm)	3.4±0.2	3.3±0.3	0.4
Balloon size (mm)	3.6±0.3	3.3±0.3	0.1
Inflation pressure (mmHg)	17.7±4	20±4	0.3
Initial TIMI flow	1.6±0.7	0.7±1	0.1
Final TIMI flow	3	3	1
No. of vessels diseased	1.8±1	1.7±1	0.8

All data are presented as mean±SD.

Table 3
This table shows the ordinal data for the group which survived and the group which perished

	Alive	Dead	p
	Numbers (%)	Numbers (%)	
Hypertension	3 (33%)	2 (29%)	1
Diabetes	1 (11%)	1 (14%)	1
Smoking	2 (22%)	1 (14%)	1
Previous PCI	2 (22%)	0 (0%)	0.5
IABP	4 (44%)	7 (100%)	0.034
Inotropes used	4 (44%)	7 (100%)	0.034
Direct stenting	2 (22%)	3 (43%)	0.5
TIMI flow ≤1	3 (33%)	5 (71%)	0.3
Distal LM involvement	7 (78%)	4 (57%)	0.6
LM ostium involvement	3 (33%)	4 (57%)	0.6

LM = left main coronary artery. IABP = intra-aortic balloon counter-pulsation pump.

One patient was readmitted on the 16th day after discharge with chest pain and new ST elevation indicative of myocardial infarction. This was patient #1 in Table 1. The initial stent was a Cyper 3.5×18 mm stent deployed at 25 atm pressure. The post-procedural angiogram showed TIMI 3 flow. Upon reinfarction, the angiography showed subacute stent thrombosis involving the proximal stent margin. Angioplasty was again successfully performed with implantation of an additional Cypher® stent. One other patient required coronary bypass surgery at 106 days. This is due to presence of extensive disease in the other vessels. This patient remained well thereafter with a follow up of 333 days.

Five patients subsequently consented to angiography at sixth month follow up. These showed that the stents were still patent. All patients subsequently had a mean follow up period of 420 days (range 215–642 days).

5. Discussion

Elective left main intervention with or without drug-eluting stents is well documented [4–6]. Currently one major trial; SYNTAX (SYNergy Between PCI With TAXUS and Cardiac Surgery) comparing percutaneous coronary intervention (PCI) against coronary artery bypass graft (CABG) is underway while a second COMBAT (COMparison of Bypass surgery and AngioplasTy using sirolimus eluting stents in patients with unprotected left main coronary artery disease) is halted awaiting the resolution of safety concerns regarding drug-eluting stent. However, intervention in the setting of acute ST elevation myocardial infarction is much less common. Only sporadic cases are reported [7–10]. One of the largest series [11] did not utilize drug-eluting stent. Furthermore, cardiogenic shock often complicates infarcts in this particular territory. Intervention in this setting carries a high risk. However, the survival benefit for intervention outweighs the risk especially in the long term [12,13] and therefore should be attempted.

Table 4
This table shows patients stratified according to the presence of shock

	Shock	No shock	*p*
Total number of patients	11	5	–
Left main ostial disease (%)	7 (63.6%)	0	0.03
Left main shaft only (%)	1 (9.1%)	0	1.0
Distal left main disease (%)	6 (54.5%)	5 (100%)	0.2
Multi-vessel disease (%)	7 (63.3%)	1 (20%)	0.3
Death (%)	7 (63.6%)	0	0.03
IRA—left main	11 (100%)	2 (40%)	0.02

The percentage given represents column percentage. Therefore the mortality rate for patient with shock is 63.3%. IRA—left main = infarction when the left main coronary artery is the infarct related artery.

In our case series, eleven patients (75%) were complicated by cardiogenic shock requiring intra-venous inotropic agents as well as intra-aortic balloon counter-pulsation for stabilization (Table 4). Despite this, percutaneous revascularization was successfully performed on all patients. This was regardless of the initial TIMI grade flow or method of revascularization. No distal protection devices were utilized. This could have significantly reduced the procedural time and established coronary flow earlier. It is also a general feeling that PCI can be performed with shorter delays than CABG. This was demonstrated in the SHOCK trial where the median time from randomization to PCI was shorter than the median time for CABG [14].

The survival rate in our series was 56%. This is comparable to the other series [11,15,16] treated by percutaneous modality. It is also comparable to the 46% in-hospital mortality treated by emergency CABG for left main coronary infarct [17]. Our series of patients who perished tend to be more unstable and requiring more frequent circulatory support, there were no specific factors which could predict adverse outcome. On the other hand, patients who developed shock had higher mortality rate and more often had the left main artery as the infarct related artery. The site of involvement tended to include the ostium.

In patients who survived, the average length of stay was five days. This is comparable to ST elevation myocardial infarction in other coronary territories. This could be shorter than the average length of stay for CABG. However, in those who perished, the length of stay tended to be either in the first 24 h (four patients) or a very protracted stay (42 days).

For patients who survived the initial event, only 1 patient required a repeat procedure due to subacute stent thrombosis. The long term prognosis for all the patients was excellent with a mean follow up of 420 days. Although 5 of the surviving patients underwent follow up coronary angiography which showed patent stents, this number is too small for meaningful statistical analysis.

Since the introduction of drug-eluting stents, its use has grown exponentially. The use of which in the setting of acute ST elevation myocardial infarction on the other hand, is still not widely recognized. More recently published papers have examined the safety and efficacy of drug-eluting stents in ST myocardial infarction [2,3,18]. However, deployment of drug-eluting stent in the left main coronary artery was not common. This is currently the largest collection of Cypher® stent use in the setting of left main ST-elevation myocardial infarction.

6. Conclusion

Percutaneous coronary intervention with drug-eluting stent in patients presenting with ST elevation myocardial infarction due to the left main coronary artery lesion is feasible. In centers with experience, it carries an acceptable morbidity and mortality rate. Patients who perished tend to be in cardiogenic shock with increased need for inotropic or mechanical support. The mortality for patient presenting with shock even is if PCI is successful is still very high. However, due to the small number of patients in our series, larger randomized trial should be conducted to establish the routine use of drug-eluting stent in ST elevation myocardial infarction due to left main coronary lesions.

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