

Research Article

A study on stenting in coronary bifurcation lesions

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ABSTRACT

Background: Lesions at coronary bifurcations represent a challenging area in interventional cardiology. Treating bifurcation lesions involves weighing the risk of side-branch closure and the need for additional stent, sometimes requiring complex techniques. There are no specific guidelines established in choosing a one-stent versus a two-stent technique for a bifurcation lesion. The decision is highly dependent on its anatomic configuration and operator preference and expertise.

Methods: Twenty patients of coronary artery bifurcation disease, most of them are double vessel disease with bifurcation coronary lesions planned for bifurcation stenting are included in the study. All the twenty patients' risk factors, angiographic profile, and the technique used for bifurcation stenting are noted. Different stenting techniques are used for bifurcation stenting. Patients clinical follow up at three months, six months and at nine months done. Depending on the clinical symptoms patients are subjected for coronary angiogram.

Results: Patients with complex stenting techniques (T stenting, SKS, & Crush) when compared to simple (provisional stenting) showed increased MACE during nine month follow up.

Conclusions: The general consensus is that for bifurcation lesions without high risk features, the default approach of one stent PCI with provisional angioplasty plus stent is appropriate. For bifurcation lesions with high risk features, two stent techniques may be safer due to protection and treatment of the SB vessel. When coronary bifurcation lesions are treated with a systematic 2-stent technique results in higher rates of major adverse cardiovascular events on follow up at 9 months.

Keywords: Coronary bifurcation, One-stent versus two-stent technique, Coronary angiogram

INTRODUCTION

The European Bifurcation Club defines a bifurcation lesion as a coronary artery narrowing occurring adjacent to and/or involving the origin of a significant side branch, for which acute closure or loss would be substantially detrimental within the global context of a particular patient such as symptoms, location of ischemia, viability, collaterals, left ventricular function.^{1,2} Bifurcation lesions are frequent and occur in ≈10-15% of percutaneous coronary interventions (PCIs).³ Initial results with balloon angioplasty were poor, with a high risk of acute closure

of the main vessel or side branch and a high restenosis rate.⁴ Implantation of coronary stents minimized the problem of acute vessel closure, but bifurcation stenting was still associated with a high rate of restenosis.⁵

The restenosis problems appeared especially pronounced when multiple stents were used.⁶ Lesions at coronary bifurcations represent a challenging area in interventional cardiology. Treating bifurcation coronary lesions involves weighing the risk of side-branch closure and the need for additional stent, sometimes requiring complex techniques.⁷ The approach to bifurcation lesions is based on the angiographic configuration of the lesion(s) in the

main branch and the side branch. Significant disease (>50% stenosis) in the ostium of the side branch increases the likelihood of side-branch closure as well as the restenosis rate after percutaneous coronary intervention (PCI).⁷ Several classification schemes have been developed, most commonly used is Medina classification.⁸

There are no specific guidelines established in choosing a one-stent versus a two-stent technique for a bifurcation lesion. The decision is highly dependent on its anatomic configuration and operator preference and expertise. The general consensus is that for bifurcation lesions without high risk features, the default approach of one stent PCI with provisional angioplasty plus stent is appropriate. For bifurcation lesions with high risk features as described above, two stent techniques may be safer due to protection and treatment of the side branch vessel.⁷

The following are the most frequently used two-stent techniques for bifurcation lesions: 1) T-stenting; 2) simultaneous kissing stenting (SKS). 3) crush stenting and 4) culotte stenting [9].

METHODS

This study was conducted after the institutional ethical clearance and informed consent from all the patients in a tertiary care hospital at Bangalore. This study included male or female patients of >18 years of age with a diagnosis of coronary artery disease with coronary bifurcation lesions planned for bifurcation stenting. Twenty patients of coronary artery bifurcation disease, most of them are double vessel diseases with bifurcation coronary lesions are included in the study.

All the patients' risk factors, angiographic profile, and the technique used for bifurcation stenting are noted. Patients clinical follow up at three months, six months and at nine months done. Patients underwent either telephone or hospital follow-up at 3 and 6 months, followed by a final hospital follow-up visit at 9 months. Adverse events recording continued up to the end of the 9-month follow-up period. Depending on the clinical symptoms patients are subjected for coronary angiogram during follow up. Patients without symptoms ischemia/angina are not subjected for coronary angiogram. P

patients with angiographically visible thrombus within the target lesion left ventricular ejection fraction $\leq 35\%$, serum creatinine >3.0 mg/dL were excluded. The primary end point of the study was a composite of all-cause death, myocardial infarction and target-vessel failure by 9 months. Secondary end points were the individual components of the primary end point, angina status and repeat angiography at 9 months.

Aspirin 32 mg 12 hours before the procedure and a 300-mg loading dose of clopidogrel before the procedure were administered in all the patients. Percutaneous access was

obtained through right femoral artery approach and intravenous heparin was administered to maintain an activated clotting time 250 seconds during the procedure. Glycoprotein IIb/IIIa inhibitors was given for most of the patients (n=15).

Lesion predilatation and final kissing balloon inflation were done in all patients. Depending on operators decision either one stent or two stents are used. Type of bifurcation stenting was operators' choice. Catheters and sheaths are 7F in most of the patients.

Provisional stenting (simple) approach used in ten patients, complex stenting techniques such as, T stenting in five , SKS (Simultaneous Kissing Stenting) technique in four and Crush technique in one patient. In all the patients' drug eluting stents (DES) are used. Post procedure or immediate angiogram good flow -TIMI III flow and no complications noted. All the patients were advised dual antiplatelet therapy.

RESULTS

A total of twenty patients were included. Out of which 16 were male and 4 female patients belongs to the age group of 20 to 60 years. Most of the patients were smokers and hypertensive's (Table 1). Table 2 explains the number of patients diagnosed for different cardiac disorders.

Table 1: Risk factor profile of the recruited subjects.

Condition	Number of patients
Hypertension	11
Diabetes	09
Dyslipidemia	09
Smoking	12
Alcoholism	05
Hypertension + Diabetes	07

Table 2: Type of patients based on the diagnosis.

Condition	Number of patients
Recent ACS	11
Myocardial Infarction	06
Unstable angina pectoris	03
Non ST elevation MI	02
Chronic stable angina pectoris	09

Coronary angiogram showed double vessel disease in seventeen patients, and TVD in three patients. Of the twenty patients with bifurcation coronary lesions taken for bifurcation stenting, different bifurcation stenting techniques are used as mentioned earlier. Ten are provisional stenting (simple stenting strategy), remaining ten patients underwent complex bifurcation stenting strategy with two stents ("T "stenting, SKS and Crush technique). Follow up at three months, out of twenty patients, seventeen patients came for follow up, one patient presented early i.e. at two and half months after

stenting with acute anterior wall myocardial infarction, CAG done which showed stent thrombosis and LCX lesion increased to 90%, hence only POBA done and referred for CABG. Sixteen patients attended 6 month follow up, one patient presented at 5.5 months with re-infarction (AWMI) with cardiogenic shock, CAG showed

ISR of LAD. Since patient was in shock PTCA to LAD done, but patient developed CVA next day and not recovered from shock and expired. Four patients did not come for follow up at six months. All the patients were compliant with dual antiplatelet (Clopidogrel + Aspirin) therapy (Table 3).

Table 3: Comparison of different bifurcation stenting techniques used and the trial end points.

End points	Simple bifurcation stenting (Provisional stenting)	Complex bifurcation stenting (T stenting ,SKS, Crush technique)
Primary end points	n= 10	n=10
Death due to MI,or Target vessel failure 1yr	01(10%)	03(30%)
Secondary end points		
Death	0	01(10%)
due to Periprocedural	0	0
due to Subsequent	0	01
Myocardial Infarction	0	02(20%)
Periprocedural	0	0
Subsequent	0	02
Target vessel failure	01	03
Treated with CABG	0	01
Treated with re PCI	01	02
In hospital MACE	0	0
No of stents used (mean)	1.2	2.2
Procedural success	100%	100%
Stent in main branch	10	10
Stent in side branch	02	10

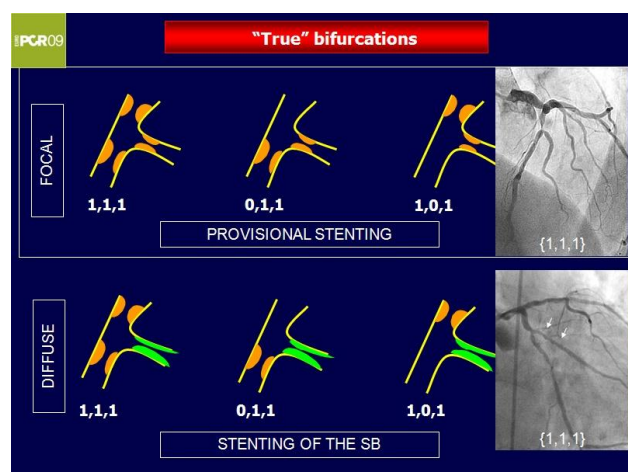


Figure 1: Indicates focal and diffuse bifurcations.

Eighteen patients came for follow up at nine month. Out of these eighteen patients two patients presented with stable angina pectoris, hence these patients are subjected for coronary angiogram, which revealed ISR of 70-90% in these patients. All the patients were compliant with antiplatelet therapy. In all the patients presented with restenosis target vessel re-vascularization done. Out of twenty patients one patient did not come for follow up

from three months up to eight months, in ninth month came for follow up. One patient in provisional stenting presented (stable angina) with restenosis at nine month, angiogram done which showed restenosis and target vessel revascularization done for this patient. Out of five patients of T stenting technique group, two on follow up developed restenosis (one MI at 3 months due to ISR, CABG done, and one death at 5 month due to re-infarction), target vessel revascularization done in both patients. In SKS group one patient was symptomatic (stable angina) at eight month, angiogram showed restenosis/ISR, patients underwent re PCI (Table 3, Figure 1).

DISCUSSION

A number of well-known technical and clinical problems are associated with bifurcation PCI, dependent on the anatomy, the lesions, and on the technique used. Important concerns are plaque shift causing flow problems, wire trapping and subsequent need of wire replacement, stent deformation, stent overlap and large metal burden in the arteries, incomplete lesion coverage, subacute stent thrombosis, and restenosis.¹⁰ Even though the provisional approach of implanting one stent in the main branch (MB) is currently the default strategy for

stenting most bifurcation lesions, the two-stent approach of stenting both the main branch and the side branch is required in approximately 20–35% of cases.¹¹⁻¹⁵ In the present study, twenty bifurcation stenting patients were compared the clinical and angiographic outcome of a simple bifurcation treatment strategy (stenting the main vessel and optional stenting of the side branch; MV) with a complex strategy (stenting of both the main vessel and the side branch; MV+SB).

Most commonly used stenting technique in our study was provisional stenting as is currently the default strategy for stenting most bifurcation lesions is used in ten patients, and one patient in this developed restenosis. T- Stenting was used in five patients, in all these patients two stents are used, two patients in this group developed restenosis. SKS technique used in four patients in that one patient developed restenosis.

In the present study, we found that there is increase in cardiac death, myocardial infarction, stent thrombosis, target-vessel revascularization, or combinations thereof during follow up between a simple and a complex coronary bifurcation stenting strategy. This is comparable with a study by Colombo et al who showed angiographic restenosis at six month was 18% vs 29%.¹⁶ Another study by Pan M et al showed 7% vs 27%.¹⁷ In BBC one study death, MI, target vessel failure at nine months 8% vs 16% in simple versus complex bifurcation strategies.¹⁸

Steigen TK et al undertook a randomized comparison of main-vessel stenting versus stenting of both the main vessel and side branch (the Nordic Bifurcation Study), a low rate of MACE was seen in both groups at 6-month follow-up (2.9% versus 3.4%, respectively).¹⁹ At present, a strategy of optional SB stenting, where the SB is stented only in case of severe stenosis or flow problems after MV stenting, has been found to be safe and efficient in registries and randomized clinical and angiographic trials.²⁰

CONCLUSION

There are no specific guidelines established in choosing a one-stent versus a two-stent technique for a bifurcation lesion. The general consensus is that for bifurcation lesions without high risk features, the default approach of one stent PCI with provisional angioplasty plus stent is appropriate. For bifurcation lesions with high risk features, two stent techniques may be safer due to protection and treatment of the side branch vessel. When coronary bifurcation lesions are treated, a systematic 2-stent technique results in higher rates of major adverse cardiovascular events on follow up at 9 months.

The present study is a clinical follow up and angiographic follow-up done only in symptomatic patients. Since small numbers of patients are studied and follow up done only up to nine months, the follow up for a longer duration and large number of sample size is warranted.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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