REVIEW ARTICLE

LEFT MAIN CORONARY ARTERY STENTING

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ABSTRACT

Coronary artery bypass surgery is considered as the gold standard treatment of unprotected left main coronary artery (ULMCA) disease. Over the last 2 decades, improvement in stent technology and operators experience explained the increased number of reports on the results of percutaneous coronary interventions (PCIs) for the treatment of left main (LM) coronary artery lesion. The recent data which compared efficacy and safety of PCIs using drug-eluting stent and coronary artery bypass surgery showed comparable results and a lesser need for repeat revascularization for coronary artery bypass surgery.

Keywords: Coronary artery bypasses graft, Left main coronary artery, Percutaneous coronary intervention.

INTRODUCTION

Patients who undergo coronary angiography, significant unprotected left main coronary artery (ULMCA) disease found to occur occurs in 5-7% of cases and 3 years mortality of the patients with ULMCA disease who were treated medically was 60%[1]. CABG has been the gold standard therapy for LM disease but with the advent of newer drug-eluting stents (DES), better intravascular imaging modalities and careful patient selection, the use of PCI in this set of patients is expanding.

Management of LMCA Disease

Medical Treatment Versus CABG

Most studies which were conducted 3 decades ago in small numbers of patients for treatment of LMCA disease showed survival benefit of CABG when compared to medical treatment[1].

CABG

Taggart et al[2] reported a review based on a series of studies, all of which showed an inhospital mortality of between 2 and 3% after CABG for Left main artery stenosis and 5-6% mortality at 5 years as per studies which did not report on long-term outcomes.

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PCI with Stent Implantation

Bare-Metal Stents vs DES

Initially ULM stenting with the use of bare-metal stents produced results similar to those of bypass surgery depending on the patient cohort[3]. However, high restenosis rates associated with their use, often resulted in sudden cardiac death which resulted in limitation of ULM stenting advancement during that time period.

With the advent of DES in 2002 and its dramatic reduction in rates of restenosis, registry data from multiple centers worldwide showed major adverse cardiovascular event rates similar to those of CABG[4].

Comparison of PCI vs CABG

According to Ganesh et al[5] PCI with DES is a safe and durable alternative to CABG for the revascularization of UPLM stenosis in select patients at long-term follow-up. Several observational, non-randomized registries have shown similar major adverse cardiovascular events (MACCE) between patients treated with DES and CABG in the subset of patients up to 5 years of clinical follow-up.

Randomized controlled trials (RCTs) which compared PCI With CABG for the Treatment of Unprotected Left Main coronary artery disease (CAD) are shown in table-I.

The SYNTAX 7 (synergy between percutaneous intervention with taxus and cardiac surgery) provides the largest data regarding early and late outcomes of PCI of LMS.

The primary end point of death, stroke, MI and repeat revascularization favored CABG. The secondary end point of death, stroke and MI was not different between those who undergo PCI or CABG. Primary end point favoring CABG was driven by increased rate of repeat revascularization in PCI group (26.7% vs 15.5%), though notably rate of stroke was also significantly lower in PCI group (1.5% VS 4.3%).

Calculating SYNTAX score is a class I indication for left main stem disease or multi vessel disease as per recent AHA/ ACC PCI guidelines.

stratifying patients for late mortality when compared with SS.

The recent *EXCEL* trial[9] (evaluation of Xience Prime or Xience V-eluting stent vs CABG for effectiveness of LM revascularization) evaluated the safety and efficacy of PCI with Xience Prime or Xience V EES vs. CABG in patients with ULMCA disease with a low or intermediate SYNTAX score (<33). This trial concluded that PCI with everolimus eluting stents was non inferior to CABG with respect to the rate of the composite end point of death, stroke, or myocardial infarction at 3 years.

Society Guidelines

Recommendations Pertaining to Unprotected Left Main Intervention in the ***American College of Cardiology Foundation / American Heart Association / Society of Cardiovascular Angiography and Intervention*** 2011 Guidelines for PCI are given in table-II.

Table-I: RCTs comparing PCI vs CABG for unprotected left main CAD.

Trial name	Event rate for primary end points PCI	Event rate for primary end points CABG	*p*-value	Event rate for secondary end points PCI	Event rate for secondary end points CABG	*p*-value
LE MANS[6]	54.9 ± 8.3%	49.8 ± 10.3	0.07	51.1%	64.4%	0.28
SYNTAX	36.9%	31.0%	0.12	31.3% (SS<32) 46.5% (SS>32)	32.1% (SS<32) 29.7% (SS>32)	0.60
EXCEL	15.4%	14.7%	0.02 for Noninferiority 0.98 for superiority	23.1%	19.1%	0.01 for non-inferioriy 0.10 for superiority

Patients with low (0-22) and intermediate score (23-32) can be treated with PCI or CABG with equal results. Those with high score (>32) do better with CABG.

In a subgroup analysis it was found that MACCE rates were significantly higher in the paclitaxel eluting stent (PES) arm compared with the CABG arm in diabetic patients and directionally higher (but non-significant) in non-diabetic patients.

SYNTAX score II[8] (SSII) provides 4-year mortality after coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI) in order to facilitate decision-making between these two methods. SSII has robust prognostic accuracy, both in CABG and in PCI patient groups and was more accurate in

European Society of Cardiology Guidelines 2014

Recommendations for the type of revascularization in left main stem disease are shown in table-III.

Procedural Consideration

Severity of Obstruction

For lesions of indeterminate severity on coronary angiography, intra vascular ultrasound (IVUS) is used. Significant obstruction of LMS, minimal luminal area (MLA) of <6mm^2 has been shown to be highly sensitive and specific to predict fractional flow reserve(FFR)<0.75. Post

PCI, minimal stent area (MSA) <8 mm^2 in the proximal LMS, <7 mm^2 in the LMS bifurcation, <6 mm^2 in ostial LAD and <5 mm^2 in ostial LCx is associated with under expanded stent and ISR[10].

Drug-Eluting Stent Choices

'Intracoronary Stenting and Angiographic Results: Drug-eluting Stents for Unprotected LM Lesions' (ISAR-LM2)[11] evaluated the safety and efficacy of everolimus EES vs zotarolimus eluting stent (ZES) and provided comparable clinical and angiographic outcomes at 1-year follow-up.

Using the results of the French Left Main Taxus and the LEft MAin Xience registries, EES was compared to PES. After 2-year follow-up, there was a reduction by 53% in target lesion failure with EES[12].

NEST[13] registry 154 patients with left main coronary disease were treated with everolimus- (44.2%), zotarolimus- (29.9%) and biolimus A9-eluting (25.9%) stents were followed up for 2 years. The MACE rate was 18.8% and no case of MI or definite stent thrombosis was reported.

In the ERACI IV study, patients treated with second generation DES as compared to the first-generation DES in patients with multiple vessel disease and unprotected left main stenosis had lower incidence of MACCE.

Bio resorbable vascular scaffolds (BVS) in ostial LM lesions has the advantage of avoiding permanent metal struts protruding into the aorta.

Techniques of Left Main PCI

Table-II: Recommendations pertaining to left main intervention.

Classification	Level of Evidence	Recommendations
IIa	B	PCI 1) Low SYNTAX score [≤22], ostial or trunk left main CAD 2) Increased risk of adverse surgical outcomes
IIa	B	PCI 1) UA/NSTEMI with unprotected left main coronary artery is the culprit. 2) Patient is not a candidate for CABG
IIa	C	PCI 1) STEMI with unprotected left main coronary artery is the culprit 2) TIMI flow grade <3 3) PCI can be performed more rapidly and safely than CABG
IIb	B	PCI 1) Low-intermediate SYNTAX score of <33, bifurcation left main CAD 2) Increased risk of adverse surgical outcomes
III (HARM)	B	PCI shouldn't be performed 1) Unfavorable anatomy for PCI 2) Good candidates for CABG

Table-III: Recommendations for the type of revascularization in left main stem disease.

	CABG	PCI
LMS disease with SYNTAX score >22	IB	I B
LMS disease with SYNTAX score 23-32	IB	IIa B
LMS disease with SYNTAX score >32	IB	III B

Ostial And Mid Vessel Lesions

These lesions can be stented with a single-stent strategy. Szabo technique or the passage of a second coronary guide wire into the aortic root to are techniques for proper ostial stent placement.

Distal Left Main Lesions

In more than half of all patients, distal left main stem is involved. In case of LMCA lesions involving bifurcation, PCI is complicated by plaque shift. True distal bifurcation lesions may either be treated by a single or two-stent strategy. Certain lesion characteristics like plaque

distribution, the diameter of the branches, the angle between them, anatomy of the side branches along with operator experience decide the treatment strategy Final KBPD (kissing balloon post dilatation is mandatory while using 2 stent strategy.

A number of 2-stent techniques like T-stenting, crush stenting, culotte stenting, and simultaneous kissing stenting or Y-stenting ca be used with various levels of complexities and indications.

Recently, dedicated bifurcation stents or self-expandable stents (TRYTON, AXXESS, BiOSS, STENTYS) were used for the treatment of distal LMS stenosis. Early results are encouraging, but definite conclusions are still awaited[10].

Role of FFR And OCT

A final minimal stent area >9.6mm sq has been associated with a very low rate of revascularization after LMS PCI. FFR help the operator decide to provisionally stent the pinched LCx artery because the degree of angiographic stenosis of LCx is frequently mismatched with functional severity according to FFR. 3D-OCT (optical coherence tomography) can be used in identifying about carina or plaque shift, side branch compromise and "floating struts" at the side branch ostium.

Dual Anti-Platelet Therapy

According to the current guidelines of AHA 2016, long-term aspirin administration and at least 6 months dual anti-platelet therapy (DAT) should be used in patients receiving a DES (Class: I); however, this is not specific for ULMCA stenting. Although the risk–benefit ratio of long-term DAT is not well defined, many clinicians favor prolonged DAT after ULMCA stenting with DES.

CONCLUSION

Stenting of ULMCA stenosis requires careful patient selection after medical-surgical consultation (Heart Team concept) and ethics of information. Patients with less complex LMS disease can be treated by PCI and more complex LMS lesions by CABG. With the results of ongoing trails, current guidelines can be modified.

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CONFLICT OF INTEREST

The authors report no relationships that could be construed as a conflict of interest.

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