Left Main Coronary Artery Disease: CABG is superior to PCI

Antonios Roussakis, MD,1 Christina Balaka, MD,2 Panagiotis Dedeilias, MD

ABSTRACT

Left main coronary artery disease (LMCAD) is a special part of coronary pathology and its gold standard treatment is coronary artery bypass surgery (CABG). Over the last two decades, the evolution in technology and materials and the growing experience of interventional cardiologist treating acute coronary syndrome improved the results of percutaneous coronary interventions even in patients with LM disease. Recent prospective randomized studies though (SYNTAX) as well as large registries comparing the two methods showed comparable results concerning safety and inferiority of PCI regarding restenosis and need for reintervention. Up to now CABG remains the treatment of choice for LM disease with PCI being a reliable alternative solution in cases of patients of high surgical risk. The above is strongly recommended by the new guidelines.

INTRODUCTION

Cardiovascular disease is by far the first cause of death in the western world. The prevention and the reduction of cardiac risk factors have beneficial results in the general population, moving the main problem to more elder group of people.

Coronary-artery bypass grafting (CABG) was introduced in 1968 and rapidly became the standard of care for symptomatic patients with coronary artery disease. Advances in coronary surgery (e.g., off-pump CABG, smaller incisions, enhanced myocardial preservation, use of arterial conduits, improved postoperative care as well as widely published surgical outcomes) have reduced morbidity, mortality, and rates of graft occlusion. The rate of mortality at a global level is less than 2% and in most recent studies it is less than 1.3%, including emergency and complex cases.

The incidence of left main (LM) coronary artery disease (LMCAD) among patients undergoing coronary angiography ranges from 4% to 6%. The same percentage for those undergoing surgery is as much as 30%. Although uncommon, LMCAD is a constant topic of discussion between cardiac surgeons and interventional cardiologists. This discussion began in 1975, when Gorlin and Cohen first compared a surgical approach for LM stenosis to any other treatment option and reported that CABG showed significant benefits.

Since then and for over 45 years researchers are trying to find alternative and less
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ful tool in the management of coronary artery disease. For
example, the advantages of PCI in the treatment of acute
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general statement

Before proceeding to the analysis of the recent data about
PCI and CABG, it would be proper to make the following
statements:
1. Patients prefer less interventional therapies
2. The proper and well documented use of PCI can be a use-
ful tool in the management of coronary artery disease. For
example, the advantages of PCI in the treatment of acute
coronary syndrome are undoubtful.

left main coronary artery
disease (LMCAD) – current
perspectives

Left main CAD is part of the pathology in 4-6% of the
patients undergoing PCI and in almost 30% of the patients
undergoing CABG. Although CABG is the gold standard
treatment for LMCAD, according to all major cardiology
societies, 29% of the patients with LMCAD in Europe
and 18% in North America are still being treated with PCI.

The large size of the left main coronary artery renders it
an “attractive” site for the use of endovascular stents when
compared with the other coronary arteries. Nevertheless there
are two anatomical elements because of which PCI cannot

Left Main Coronary Artery Disease (LMCAD) – Current Perspectives

- guarantee long term results: 1) Almost 90% of the lesion of the
  LM involves its bifurcation or its distal segment, which
  present high rates of restenosis; 2) 80% of the patients with
  LMCAD have additional multiple lesions in other coronary
  arteries.

- In these cases the treatment is obviously surgical.

Serruys et al give emphasis to the significance of distal
lesions in the LM coronary artery and their role in the appear-
ation of major adverse cardiovascular or cerebrovascular events (MACCE) shortly after PCI is performed. Their study revealed
a 30% rate of MACCE in patients with distal stenosis, whereas
only 11% of the patients without distal stenosis suffered from
MACCE. It must be pointed out that the procedures in this
study were performed by one of the most experienced teams
of interventional cardiologists.

- The outcome of the use of BMS was not satisfactory in the
treatment of LMCAD. The analysis of the results of 8 studies
performed in the period between 1999 and 2003 concerning
1100 patients showed in-hospital mortality of 6%, need for
repeat revascularization 0-20% and 2-year mortality 17%.
The results were better in young patients with good ventricular
function and lesion in the middle segment of LM coronary
artery. The 3-year mortality in this group was 7.4%. On
the other hand the results of CABG in low risk patients are
excellent. For example in the SOS study the mortality rate
after 1 year follow-up was 0.8%.

- Drug eluting stents (DESs) were expected to be the solu-
tion to the problem of restenosis of BMS and therefore their
use, even in cases with LM disease, started to expand. Studies
with DES showed impressive results reaching 2% in-hospital mortality rate and 2% need for urgent repeat
revascularization. Nevertheless all these studies were badly
designed and included a small sample of patients (50-130)
and also had a small period of follow-up (in most studies less
than one year). Price et al conducted the only study with an-
angiographic examination for restenosis at 3 and 9 months after
PCI and found rates of restenosis 34% and 44% respectively.

The need for a large scale randomized study comparing
PCI and CABG led to the design of the SYNTAX trial. The

- introduction of bare metal stents (BMS), which significantly
  reduced the restenosis rate of plain angioplasty.
- PCI methods, use of adjunctive medical therapy and the
development of new stent design with the drug-eluting stents
(DES), which have significantly curtailed the restenosis rate.
- PCI emerged as a possible alternative in patients with
  complex coronary disease.
- Recent revisions to revascularization guidelines have reflected these improvements in PCI
  outcomes for patients with complex coronary disease.
- In general, during the first year after the index procedure, PCI
  has been found to be as safe as CABG in patients with severe
coronary artery disease; however, the rates of recurrences
  are significantly higher and PCI has again failed to show non-
inferiority compared with BMS due to increased need for
  repeat revascularization.
- New randomized trials with large series of patients, like
  the SYNTAX trial (SYnergy Between PCI with TAXUS and Cardiac Surgery), try to clarify the advantages and dis-
advantages of the two methods. The results of these studies
will possibly answer the question whether modern PCI with
DES can compete with CABG in the treatment of LMCAD
concerning safety and long-term results.
The purpose of this trial was to determine whether or not the PCI method using DES (Taxus Express 2, Boston Scientific) has comparable safety rates and success with CABG in patients with three vessel disease (3VD) or LM disease.

The results of the SYNTAX trial after 1 year of follow-up revealed that the major cardiovascular and cerebrovascular events (MACCE) were more frequent in the PCI group than in the CABG group but with no significant difference (15.8% vs. 13.7% respectively, \( p=0.44 \)). The major difference among the two groups concerning MACCE was detected in the rate of repeat revascularization, where the PCI group had almost double percentage in comparison with the CABG group (6.5% vs. 11.8% respectively, \( p=0.02 \)). Angioplasty was found to be as safe as the surgical treatment and with comparable rates of mortality. On the other hand, the CABG group had significantly greater incidence of stroke comparing to the PCI group (2.7% vs. 0.3% respectively, \( p=0.01 \)) (Figure 1).

The above results were confirmed and further emphasized by the analysis of the data after a 3-year follow-up period and even more recently in the 4-year follow-up report. More specifically in the LM cohort, the rates of MACCE and death/stroke/myocardial infarction (MI) were not significantly different in PCI- and CABG-treated patients. The 3-year rate of repeat revascularization was increased in PCI-treated LM patients (20% vs. 11.7% respectively, \( p=0.004 \)). There was no difference in all-cause or cardiac death rates in CABG- or PCI-treated patients with LM disease (all-cause: CABG 8.4% vs. PCI 7.3%, \( p=0.64 \); cardiac death 4.6 vs. 5.7%, \( p=0.48 \)) (Figure 2).

It must be pointed out that the results described here are only a part of the SYNTAX trial and have to do only with the subgroup of patients suffering from LM disease. The rates

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**FIGURE 1.** Rates of outcomes among the patients (3VD and LM subgroups), according to treatment – 1 year follow-up of “SYNTAX trial”. Kaplan–Meier curves are shown for the percutaneous coronary intervention (PCI) group and the coronary-artery bypass grafting (CABG) group for repeat revascularization (Panel A); and the composite primary end point of major adverse cardiac or cerebrovascular events (Panel B). The rate of repeat revascularization was significantly increased with PCI (relative risk, 2.29; 95\% CI, 1.67 to 3.14), as was the overall rate of major adverse cardiac or cerebrovascular events (relative risk, 1.44; 95\% CI, 1.15 to 1.81). \( P \) values were calculated with the use of the chi-square test. (N Engl J Med, 2009.360, 10: 961-972, Modified).

**FIGURE 2.** Three-year clinical outcomes according to the treatment group in patients with left main disease – 3 year follow-up of “SYNTAX trial”. Death/stroke/myocardial infarction, all-cause death, stroke, myocardial infarction, repeat revascularization (repeat revasc), and major adverse cardiac and cerebrovascular event rates at 3 years in coronary artery bypass grafting (blue bars) or percutaneous coronary intervention-treated (yellow bars). \( P \)-value from log-rank test. (Eur Heart J, 2011. 32: 2125-2134, Modified).
of three-year clinical outcomes in the overall randomized cohort (LM and 3 vessel subgroups together) were even more favorable for those who underwent surgery concerning cardiac death, stroke, MI, revascularization and MACCE (Figure 3).

Furthermore the SYNTAX trial introduced a helpful “tool”, the “SYNTAX score”, which was designed to predict outcomes related to anatomical characteristics and, to a lesser extent, the functional risk of occlusion for any segment of the coronary-artery bed (as reflected by the Leaman score). The Syntax score is calculated with the use of a complicated algorithm which takes into account the vascular dominance, the number, the length and the topography of the lesions, the presence of total occlusion, the existence and the type of bi- or trifurcations, the presence or not of endovascular thrombus, the morphology of the coronary vessels and the severity of the calcifications. When the population of the study was divided into three subgroups according to the SYNTAX score (low – 0-22, intermediate – 23-32 or high – ≥33), the LM patients with the most complex anatomy who were treated with PCI were found to have significantly increased incidence of MACCE (CABG 21.2% vs. PCI 37.3%, p=0.003) and need for repeat revascularization (CABG 9.2% vs. PCI 27.7%, p<0.001) (Figure 4).

Taking all the above data under consideration, the current US and European revascularization guidelines assign CABG a IA indication in most patients with 1, 2, or 3VD with low, intermediate, or high SYNTAX scores. However, due to positive outcomes from other recent studies of LM patients, these guidelines have upgraded the indication for PCI in the LM artery from a Class III to a Class IIb (ACC/AHA) and a Class IIb C to IIa B (ESC-EACTS) indication in patients with isolated LM (ostial or trunk) and with associated 1 vessel disease. Additionally, the ESC-EACTS guidelines have also included the treatment of patients with 3VD and low SYNTAX scores as a Class IIa B indication (Figure 5).

Moreover the use of the SYNTAX score revealed that surgical revascularization remains the standard treatment for patients with more complex coronary anatomy, whereas PCI demonstrates similar outcomes when compared to CABG in patients with less complex disease and lower SYNTAX score for 3VD and lower and intermediate scores for LM disease. Retrospective application of the SYNTAX score to other patient groups has shown value in predicting or correlating high anatomical complexity with increased adverse cardiac events making it an effective risk assessment tool.

**DEBATE BETWEEN CARDIAC SURGEON AND INTERVENTIONAL CARDIOLOGIST**

The modern surgeons, after studying all the results from the latest trials and combining them with their experience, reached the conclusion that CABG is the treatment of choice for patients with LM disease and especially for those with complicated stenosis (high SYNTAX score). In this group of people, PCI failed to present similar results.
FIGURE 4. Major adverse cardiac and cerebrovascular event rates according to the subset, treatment group, and SYNTAX score category – 3 year follow-up of “SYNTAX trial”. Time-to-event curves in the coronary artery bypass grafting (blue line) or percutaneous coronary intervention (yellow line) overall cohorts to 3 years according to the low (0–22), intermediate (23–32), or high (≥33) SYNTAX scores. Major adverse cardiac and cerebrovascular events in patients with left main disease with low, intermediate, or high SYNTAX scores. P-value from log-rank test. (Eur Heart J, 2011. 32: 2125-2134, Modified).

FIGURE 5. ESC-EACTS guidelines. Indications for coronary bypass grafting vs. PCI in patients with lesions suitable for both procedures and low predicted surgical mortality.
concerning MACCE incidence. Additionally, more than 1/3 of the patients with LM disease seeking medical help are characterized unsuitable for PCI treatment from the beginning. This fact on its own indicates that CABG remains the best way to deal with complex coronary and LM disease. It is associated with a relatively low mortality and clearly lesser need for re-intervention. Should this rare necessity occur, reintervention is almost absolutely a safe PCI as opposed to surgical reintervention following PCI which is of a higher risk procedure.

On the other hand, interventional cardiologists still believe that PCI is a reliable solution for managing coronary disease even in some cases of LM disease. This opinion is based on the fact that PCI is not an inferior method compared to CABG when taking under consideration the overall mortality rates and MACCE incidences apart from repeat revascularization. Moreover the convenience of the method for the patient, the fewer days the patient has to stay in the hospital, the faster recovery and the ability to be performed on emergency basis are some arguments in favor of PCI with the use of DES, especially for elderly people (octogenarians) and patients with other co-morbidities and a high surgical risk (high EUROscore).

In addition, it should be emphasized that more complete information about the patient’s clinical and angiographic profile and comorbidities is warranted, while the patient and family should also be fully informed about the available options and the associated procedural risks and benefits; finally, publication of procedure outcomes should be mandated for either team, as it is already done by the surgeons in several US states.

CONCLUSION

After taking all the above under consideration we can reach the conclusion that CABG remains the treatment of choice for patients with complex coronary disease (3VD patients with intermediate/high SYNTAX scores and LM patients with high scores) because they seem to have an increased risk of a MACCE event when treated with the PCI method. Patients with less complex coronary anatomy (low SYNTAX scores in 3VD patients or low/intermediate SYNTAX scores in LM patients) can be alternatively treated with PCI, but CABG remains the preferred treatment option in this last cohort of patients.

In closing we must say that the decision for the appropriate treatment for the patient should be the outcome of the close and impartial cooperation of interventional cardiologist and cardiac surgeon. The goal of this cooperation should be only the best interest of the patient and in cases of disagreement the patient himself should take the decision after being fully informed by the medical team.

REFERENCES


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