REVIEW ARTICLE

Invasive assessment modalities of unprotected left main stenosis

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Among all coronary lesions, the decision-making process for the treatment of unprotected left main (ULM) stem lesions is still challenging. Indeed, the optimal therapeutic strategy for patients with ULM disease remains controversial: coronary artery bypass grafting was established as the gold standard, but it is without doubt that percutaneous coronary intervention (PCI) performed by experienced operators achieves good results at long term follow up, especially in cases where the ostium and/or shaft of ULM are treated. Thanks to the widespread use of invasive assessment of atherothrombotic ULM stenosis, improved selection of PCI cases and techniques of stenting, better outcomes are now possible. This review seeks to define the place of PCI in ULM disease by describing the different modalities of ULM stenosis assessment.

Keywords: Unprotected left main disease, Percutaneous coronary intervention, Coronary artery bypass graft, Intravascular ultrasound, Fractional flow reserve

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Introduction

Isolated unprotected left main (ULM) involvement is observed in 7% of coronary artery diseases (CAD), and in 13%, 17% and 27% of cases it is associated with single, double and triple vessel disease respectively [1,2]. The optimal therapeutic strategy for patients with ULM disease remains controversial. Although coronary artery bypass grafting (CABG) was established as the gold standard for treatment of patients with ULM disease [3], in the last decade, percutaneous coronary intervention (PCI) for this lesion subset is increasing, especially where the atherothrombotic disease is located at ostium and/or shaft of left main stem [4–11]. Indeed, for this type of lesion, PCI is associated with good long-term outcomes and may represent a valid alternative therapy to CABG [12,13]. Current European guidelines assign a Class IIb, Level of Evidence: B indication for PCI in patients with distal left main bifurcation, either isolated or with concomitant single vessel disease [14].

The rationale for use of intracoronary physiology assessment and imaging arises from the limitations of coronary angiography in determining the severity of coronary stenoses. The visual assessment of percent diameter reduction has significant inter-observer variability even among experienced interventional cardiologists [15].

In addition, the widespread use of invasive imaging modalities has determined a better understanding of the process, which can be related to restenosis and stent thrombosis, underlining the importance of an invasive assessment of ULM atherosclerotic plaque in order to choose the best strategy to adopt. This review tries to define the place of PCI in ULM disease and describes the different modalities of ULM stenosis assessment.

Abbreviations

CABG	= coronary artery bypass graft
CAD	= coronary artery disease
DES	= drug eluting stent
FD-OCT	= frequency-domain optical coherence tomography
FFR	= fractional flow reserve
IVUS	= intravascular ultrasound
MACCE	= major adverse cardiac
MLA	= minimal lumen area
MLD	= minimal lumen diameter
OCT	= optical coherence tomography
PCI	= percutaneous coronary intervention
QCA	= quantitative coronary analysis
ULM	= unprotected left main

CABG or PCI: a delicate choice

In an older study, Cohen and Gorlin [16] revealed that CABG improves 10-year survival when compared with medical therapy in patients with significant ULM stenoses. This finding was subsequently confirmed by several randomized trials [3]. Therefore, in clinical practice today, the gold standard of treatment for ULM stenosis is represented by CABG. Since the beginning of the angioplasty era, ULM PCI has represented an attractive target for interventionalists in relation to its relatively large diameter and proximal location (which do not determine technical problems related to deliverability of device). However, three anatomical features have a capital impact and need to be considered. First, isolated ULM stenoses are only observed in 7% of patients, whereas over 70–80% of patients also have multivessel CAD [2,3,16]. In such cases, CABG could be preferred in order to achieve a complete revascularization. Second, most ULM stenoses (40–94%) concern the distal segment of ULM [2,3,16]. Such bifurcated or trifurcated lesions have high procedural risks and present high rates of restenosis [3], and a possible acute occlusion (stent thrombosis) may have catastrophic consequences. Finally, the presence of calcification is common [17], leading to difficulties in stent expansion.

On the other hand, CABG may be associated with high risk of mortality in patients with co-morbidities in comparison with PCI [18]. Thus, for the correct choice of a revascularization strategy in case of ULM disease, the stratification of procedural risk is as imperative as a careful evaluation of the long-term benefits of both PCI and CABG. Several methods of stratifying risk in patients undergoing ULM revascularization are available. Risk scores can be divided into those using clinical-based parameters, those using angiographic variables, and those using a combination of both.

The European System for Cardiac Operative Risk Evaluation (EuroSCORE) [19] is an additive clinical score including 17 objective clinical variables. The utility of using the EuroSCORE in patients undergoing PCI has been evaluated in the SYNTAX study [20], and several additional non-randomized studies [21–23]. Additive EuroSCORE was shown to be an independent predictor of MACCE not only in patients with ULM disease undergoing PCI [22–24], but also in those undergoing CABG [22–23]. Rodés-Cabau et al. [24] found that in octogenarians EuroSCORE $\geqslant 9$ identified as the best predictor of major adverse cardiac and cerebral events (MACCE) after PCI and CABG