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STATE-OF-THE-ART PAPER

Clinical and Angiographic Risk Assessment in Patients With Left Main Stem Lesions

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Percutaneous coronary intervention of unprotected left main stem lesions has been shown to be a suitable alternative to cardiac surgery in selected patients, emphasizing the need for appropriate risk stratification prior to selection of revascularization modality. Several risk models based on clinical and angiographic variables have been developed to guide patient selection, each of which has significant limitations. This paper reviews contemporary and newly proposed risk models for patients undergoing left main stem revascularization.
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The left main stem is rarely longer than 15 mm, but in view of its extensive myocardial distribution, it is a vitally important part of the coronary arterial tree. Unprotected left main stem (ULM) lesions carry the worst prognosis of any coronary lesion, mainly because of the extensive amount myocardium placed at jeopardy by such lesions. The mortality for nonrevascularized ULM disease has been reported to be as high as 37% at 3 years (1). The optimal therapy for patients with ULM disease remains the subject of continuing debate (2,3).

Coronary artery bypass grafting (CABG) was established as the gold standard for treatment of patients with ULM disease on the basis of trials that randomly assigned patients to CABG versus medical therapy (4). Historically, patients with ULM disease have been excluded from randomized trials comparing percutaneous coronary intervention (PCI) to CABG (5,6). Nevertheless, surveys of real-world practice have indicated that approximately one-third of patients with ULM lesions are treated by PCI (7). Percutaneous coronary intervention for ULM disease is usually "accepted" when: 1) patients require bailout ULM PCI following complications during PCI; 2) ULM disease occurs in the setting of acute myocardial infarction (MI); 3) the left main is protected by a functional coronary bypass graft; 4) patients are turned down for CABG; or 5) patients refuse surgery. Less settled are the indications for left main PCI in patients who are good candidates for CABG.

Recently, important studies have been published specifically relating to selection of revascularization modalities of the ULM (8). These data suggest that in certain groups of patients with ULM disease, such as those with ostial or shaft lesions, revascularization with PCI remains a valid alternative therapy to CABG (8–10). Consequently, in the recent focused update from the American College of Cardiology/American Heart Association (ACC/AHA), PCI for ULM lesions has been upgraded from a Class III to a Class IIb indication in those patients with "anatomical conditions which are associated with a low risk from PCI procedural complications and clinical conditions which predict adverse surgical outcomes" (11).

In view of this recommendation, there is now a clear need to appropriately identify which patients with ULM should undergo revascularization with PCI or CABG. This highly relevant topic was briefly touched upon in a recent white paper on

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PCI for ULM (8); however, its importance to everyday clinical practice necessitates a more detailed review. The aim of this paper is to review the currently available methods for risk stratifying those patients with ULM lesions requiring revascularization.

Does the ULM Need Revascularization?

Prior to embarking on the assessment of risk and formulation of a revascularization strategy for patients with an angiographically identified ULM lesion, it is important to determine whether the lesion is in actual need of revascularization (i.e., is hemodynamically significant). The anatomic location of the ULM, together with vessel foreshortening and overlap makes angiographic visualization and accurate lesion assessment notoriously difficult. Specifically, ostial left main lesions may appear more significant than they truly are due to catheter-induced artifacts, and the severity of distal bifurcation lesions may be notoriously difficult to accurately delineate. In part due to these reasons, lesions in the left main stem are subject to the greatest degree of angiographic intraobserver and interobserver variability compared with lesions located elsewhere in the coronary tree (12,13). Importantly, studies have shown a favorable prognosis in patients with ULM lesions that are not functionally significant (14). Conversely, bypass grafts placed to nonhemodynamically significant lesions have a high rate of early failure (15). Therefore, in practice, a suspicious or borderline ULM lesion warrants further evaluation with intravascular ultrasound, coronary computed tomography, and/or functional assessment with fractional flow reserve (12,14,16), before either suggesting the need for revascularization or dismissing the need altogether.

Abbreviations and Acronyms

ACC = American College of Cardiology
ACEF = Age, Creatinine, Ejection Fraction
AHA = American Heart Association
CABG = coronary artery bypass grafting
CSS = clinical SYNTAX score
EuroSCORE = European System for Cardiac Operative Risk Evaluation
GRC = Global Risk Classification
MACCE = major adverse cardiovascular and cerebrovascular events
MACE = major adverse cardiac events
MCRS = Mayo Clinic risk score
MI = myocardial infarction
PCI = percutaneous coronary intervention
STS = Society of Thoracic Surgery
SXscore = SYNTAX score
ULM = unprotected left main stem

Is There a Need for Risk Stratification in ULM Revascularization?

An assessment of procedural risk is imperative once the decision has been made that revascularization of the ULM is required. Technological advances, such as the availability of left ventricular assist devices during high-risk cases (17), have increased the number of patients in whom PCI is now feasible; however, the appropriateness of ULM intervention cannot be considered without a proper assessment of the risk and benefits of both PCI and CABG.

Procedural risk stratification (for both PCI and CABG) serves several purposes. In the short term, it provides clinicians with supplementary information that can help guide treatment strategy, particularly in view of the latest guidelines "allowing," with a Class IIb recommendation, ULM PCI only in cases in which procedural success is high and procedural risk is low. In addition, and perhaps most importantly, procedural risk stratification enables patients to be more adequately informed about the risks/benefits of the alternative revascularization strategies available, allowing them to make an informed decision. Ultimately, it is the duty of a clinician to convey full and understandable information to their patients (18). Contrary to popular belief, after being offered CABG, very few patients actually refuse. In the SYNTAX (Synergy Between Percutaneous Coronary Intervention With TAXUS and Cardiac Surgery) trial, the rate of refusal was 0.4% (9). Surgeons raise the valid concern that patients who refuse CABG may not have had the opportunity to discuss matters with a surgeon and may have been swayed in their decision by a relatively 1-sided discussion (1). Good clinical practice should ensure that patients with significant ULM disease have the opportunity to speak to both a cardiac surgeon and interventional cardiologist together (the "Heart Team," often with a noninvasive cardiologist) to enable an interactive discussion wherein all issues are discussed and addressed (1). With the current state of evidence, ad hoc ULM PCI should not be performed in the stable patient.

Risk stratification models, and collections of decisions resulting from patient-physician discussions, provide a vital measure of patient care and may identify future directions to further improve outcomes. In terms of clinical governance and the public reporting of results, risk stratification is imperative to enable a suitable comparison of performance between clinicians and government standards. Their significance is further enhanced as it becomes increasingly essential for clinicians to be able to justify clinical decisions to patients, peers, and regulatory bodies.

What Methods of Risk Stratification Are Available for Patients With ULM Lesions?

A variety of different methods of stratifying risk in patients undergoing ULM revascularization is available; however, each has been applied to different study populations, limiting the comparisons that can be made among different risk models. In essence, risk models can be divided into those using clinical-based variables, those using angiographic data, and those using a combination of both. Table 1