Intravascular Imaging Guidance of Left Main PCI

Nice to Have or Must Have?*

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Advances in percutaneous coronary intervention (PCI) have made left main (LM) PCI a viable alternative to coronary artery bypass grafting, especially in patients with low and intermediate Synergy Between PCI With Taxus and Cardiac Surgery (SYNTAX) scores (1,2) and in those otherwise not eligible for surgery. Of note, the improved results in recent studies have been associated with refinements in patient selection, the use of second-generation drug-eluting stents, and frequent use of intravascular ultrasound (IVUS) to optimize stent implantation (~75% to 80%) (1,2). Nonetheless, LM PCI remains a technically challenging procedure, and safely achieving optimal procedural outcomes is paramount. Indeed, the implications of a suboptimal PCI result in LM disease are more likely to affect survival than in almost any other anatomic subset.

Intravascular imaging has been strongly associated with improved PCI outcomes in both randomized trials and registries (3), and its use to optimize PCI results of LM disease is currently advocated as a Class IIa recommendation (4). However, despite dozens of studies demonstrating that intravascular imaging guidance during PCI reduces the risk for cardiovascular death and major adverse cardiovascular events (3) in a wide range of anatomic settings, its use is still not widespread, with considerable variability across different countries and operators (5). Some of this variability may be attributed to the belief that an experienced operator may develop an "IVUS-like eye," gaining the ability to achieve IVUS-like results. There is little evidence to support this contention. Of course, some of the variability in use is driven by economics. For example, intravascular imaging is fully reimbursed in Japan and is used in >85% of all PCI procedures in that nation.

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In this issue of *JACC: Cardiovascular Interventions*, Kinnaird et al. (6) report a study in which they used the British Cardiovascular Intervention Society database to explore temporal changes in and implications of the use of intravascular imaging for unprotected LM PCI in 11,264 patients. Imaging guidance significantly increased from 30.2% of procedures in 2007 to 50.2% in 2014. After propensity scoring was performed to adjust for baseline imbalances between groups, imaging guidance was strongly associated with a lower rate of coronary complications, fewer in-hospital major adverse cardiovascular events, and 46% and 34% reductions in 30-day and 12-month mortality, respectively. Importantly, these improved outcomes were present and consistent in each year of the study, suggesting that other year-over-year improvements in technique and adjunct pharmacotherapy were less likely contributors.

The present study represents the largest real-word outcomes analysis of the clinical practice of unprotected LM PCI reported to date. Several important lessons from this work are noteworthy. First, this study confirms the increasing trend in the volume of LM PCI performed in recent years and highlights the current excellent rate (>97%) of LM PCI success. Second, even in the most recent year (2014), imaging guidance was used in only one-half of LM PCI cases,

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an unsatisfactory statistic given the risk for patient harm if LM PCI fails (which should warrant doing everything possible to optimize patient outcomes). Third, 30-day and 12-month mortality rates (~4% and ~10%, respectively) were not surprisingly higher compared with those reported in contemporary clinical trials (1,2), even more strongly emphasizing the imperative to optimize PCI technique. Fourth and more surprisingly, the ad hoc LM PCI rate was about 36% despite guidelines (4), emphasizing the need for heart team consideration of the optimal revascularization approach for LM disease. Unfortunately, neither the SYNTAX score not surgical eligibility criteria are available in the British Cardiovascular Intervention Society database, and thus assessments of the appropriateness of PCI is not possible.

The most important finding of this carefully performed study is the strong relationship between intravascular imaging use and the reduction of procedural complications and early and intermediate-term mortality, a relationship that persisted throughout the study period. Nonetheless, despite multivariate and propensity score adjustments, residual confounding due to treatment selection bias cannot be excluded. In this regard, imaging was used less frequently in unstable patients and in those with increasing complexity of baseline disease and low ejection fraction, arguably subgroups that might have benefited the most from imaging-guided stent optimization. On this matter, the greater mortality benefit with imaging was observed with procedures that involved both the LM and left anterior descending coronary arteries, confirming the positive clinical impact of imaging guidance when lesions affect the LM bifurcation and with more complex disease (7). Notably, in terms of survival benefit, the results of the present study are consistent with those of previous registries and small randomized trials in which IVUS guidance was associated with similar rates of reduced mortality (7–13) and greater event-free survival in LM PCI (7–14).

Unfortunately, neither the British Cardiovascular Intervention Society database nor other administrative databases (9) capture how imaging was used to guide LM-PCI; as such, the observed reduction in mortality with imaging use is without clear mechanistic explanation. The investigators do report that imaging was associated with the use of larger and longer stents, suggesting attainment of larger stent dimensions and perhaps less geometric miss, both of which have been related to lower stent thrombosis and restenosis after imaging-guided stenting (15). Imaging use was also associated with fewer acute procedural complications. Considering that intravascular imaging may be helpful in identifying and guiding management of side branch compromise, dissections, and other conditions, the improved short-term outcomes with early divergence of the curves with imaging guidance is plausible although speculative. Finally, the present study provides further support to the concept that LM stenting should be performed by experienced operators but also shows a benefit of imaging guidance regardless of operator volume and experience.

Thus, although we fully support the performance of a large, adequately powered randomized trial of intravascular guidance for LM PCI, the present evidence base strongly supports its use in nearly all cases. Intravascular imaging provides insight at each step of LM PCI for: 1) deciding whether revascularization is really necessary; 2) guiding the appropriate procedural techniques and stent dimensions (diameter and length); and 3) optimizing results (maximizing expansion, circumventing severe malapposition, and avoiding geographic miss).

Additional studies are required to determine the comparative utility of IVUS versus optical coherence tomography in LM PCI. Given its enhanced resolution and dimensional accuracy, optical coherence tomography may be easier to interpret, although its limitations in assessing aorto-ostial disease and requirement for additional contrast use must be recognized. The clinical outcomes resulting from the use of IVUS versus optical coherence tomography, however, are likely to be much less than the differences from using versus not using some type of intravascular imaging guidance. All interventionalists should therefore become familiar with either or both of these modalities on the basis of individual preference and availability. Appropriate education and standardization of operative protocols and goals for PCI optimization represent future challenges for the intravascular imaging clinical implementation. Finally, adoption of intravascular imaging does not obviate the appropriate use of physiological lesion guidance, other aspects of meticulous technique (e.g., the use of radial intervention and optimal distal LM bifurcation management), optimal pharmacotherapy, and so on, all of which are necessary to optimize LM PCI outcomes.

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