Accuracy of intravascular ultrasound and optical coherence tomography in identifying functionally significant coronary stenosis according to vessel diameter: A meta-analysis of 2,581 patients and 2,807 lesions

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Introduction Accuracy of intracoronary imaging to discriminate functionally significant coronary stenosis according to vessel diameter remains to be defined.

Methods PubMed, Scopus, and Google Scholar were systematically searched for studies assessing diagnostic accuracy (area under the receiver operating characteristic curve [AUC], the primary end point) and sensitivity and specificity (the secondary end points) of minimal luminal area (MLA) or of minimal luminal diameter (MLD) derived from intravascular ultrasound (IVUS) or optical coherence tomography (OCT) to detect functionally significant stenosis as determined with fractional flow reserve (FFR).

Results Fifteen studies were included, 2 with 110 patients analyzing only left main (LM), 5 with 224 patients and 306 lesions using OCT, and 9 with 1532 patients and 1681 lesions with IVUS. Median MLA for the OCT studies was 1.96 mm^2 (1.85-1.98 mm^2), 2.9 mm^2 (2.7-3.1 mm^2) for MLA of all lesions assessed with IVUS, 2.8 mm^2 (2.7-2.9 mm^2) for lesions with an angiographic diameter >3 mm, 2.4 mm^2 (2.4-2.5 mm^2) for lesions <3 mm, and 5.4 mm^2 (5.1-5.6 mm^2) for LM lesions. For OCT-MLA, AUC was 0.80 (0.74-0.86), with a sensitivity of 0.81 (0.74-0.87) and specificity of 0.77 (0.71-0.83), whereas OCT-MLD had an AUC of 0.85 (0.79-0.91), sensitivity of 0.74 (0.69-0.78), and specificity of 0.70 (0.68-0.73). For IVUS-MLA, AUC was 0.78 (0.75-0.81) for all lesions, 0.78 (0.73-0.84) for vessels with a diameter >3 mm, and 0.79 (0.70-0.89) for those with a diameter <3 mm. Left main AUC was 0.97 (0.93-1).

Conclusion Intravascular ultrasound and OCT had modest diagnostic accuracy for identification hemodynamically significant lesions, also with specific cutoff for different diameters. Invasive imaging for assessment of LM severity demonstrated excellent correlation with FFR.

What is already known about this subject?

Fractional flow reserve represents the criterion standard to evaluate the prognostic value of coronary stenosis, whereas its relationship with IVUS and OCT remains to be assessed.

What does this study add?

Despite improvement, IVUS and OCT do not predict functional stenosis, even with dedicated cutoff, apart from LM disease.

How might this impact on clinical practice?

The recent guidelines of myocardial revascularization have stressed the crucial role of FFR before performing percutaneous coronary intervention on LM, whereas intravascular imaging is often exploited to drive revascularization. The present analysis stresses the point that LM percutaneous coronary intervention may be driven only by intravascular imaging, given the high accuracy for significant ischemic lesions, whereas for other vessels, these 2 techniques mirror 2 different aspects. (Am Heart J 2015;169:663-73.)

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Determination of coronary lesion severity is critical in patients presenting with coronary artery disease because of its practical impact on clinical and interventional management as well as its impact on prognosis.[1-3] Although visual estimation of angiographic lesion diameter stenosis has significant limitations, quantitative coronary angiography shares some of these limitations, from reproducibility to feasibility.[4-6] In an effort to improve our estimation of disease severity, 3 techniques have emerged to assess stenosis severity based on either intracoronary imaging or physiologic assessment of disease severity.

Fractional flow reserve (FFR) has gained favor over the last 2 decades given its ability to assess the functional significance of coronary lesions. Fractional flow reserve was first validated against single-photon emission computed tomography, positron emission tomography, and cardiac magnetic resonance, later showing in 3 randomized controlled trials and in various observational studies an impact on clinical prognosis with a reduction in myocardial infarction and revascularization during follow-up for patients treated with FFR-guided percutaneous coronary intervention (PCI).[7-9]

Intravascular ultrasound (IVUS)[10,11] and optical coherence tomography (OCT)[12,13] represent 2 imaging different imaging modalities that enable not only visualization of coronary lumen but also characterization of the coronary plaque, identification of thrombus, and assessment of stent expansion. The impact of IVUS and OCT on outcomes of PCI remains to be completely assessed, although they clearly have a role in aiding PCI in challenging scenarios such as understanding the mechanism of in-stent restenosis or in PCI of the left main (LM) or bifurcation lesions.

Fractional flow reserve has been adopted as the criterion standard for assessment of coronary lesion significance, but recently, the relationship between functional evaluation and IVUS has been questioned.[1,14-16] Waksman et al[17] recently demonstrated that assessment of vessel diameter performed better than lesion area for IVUS and OCT for correlation with lesion significance defined by FFR, especially for specific lesions like the LM.[18] Thus, we performed a meta-analysis to assess the diagnostic accuracy of IVUS and OCT for the prediction of significant coronary lesions determined by FFR.

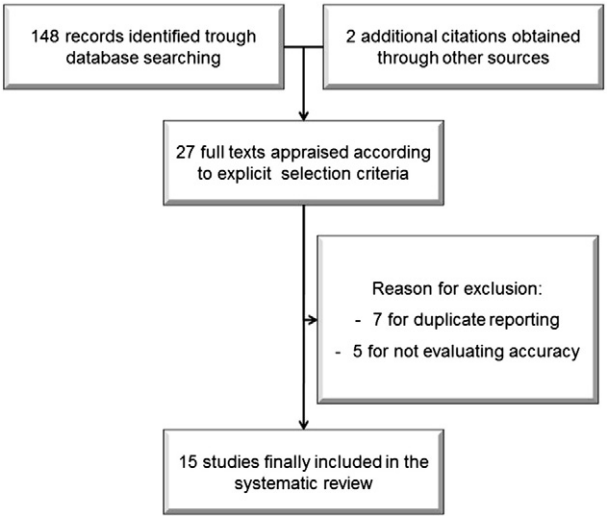
Methods

This article complied with the Preferred Reporting Items for Systematic reviews and Meta-Analyses and amendment to the Quality of Reporting of Meta-analyses statement.[19-21]

Search strategy and study selection

Two reviewers (F.D.A., U.B.) independently searched Biomed Central, CENTRAL, and MEDLINE/PubMed with the following strategy "((fractional AND flow AND reserve) OR (FFR) OR (pressure AND wire))) AND ((optical coherence tomography) OR (OCT))))) AND (coronary) NOT (review[pt] OR editorial[pt] OR letter[pt])).

Figure 1



Flowchart.

Studies were included according to the following criterion: evaluating accuracy of IVUS/OCT for lesion significance based on FFR. Exclusion criteria were as follows: (*a*) duplicate publication and (*b*) absence of relationship between imaging and functional evaluation.

Data extraction and outcome selection

We appraised age, indications for angiography, prevalence of dyslipidemia, hypertension, diabetes, smoking habit, and clinical presentation as clinical variables. As angiographic features, we evaluated stenosis location, diameter and length of lesions at angiography, minimal lumen area (MLA), and minimal lumen diameter (MLD) at IVUS and/or OCT. Accuracy (evaluated with area under the receiver operating characteristic curve [AUC] of IVUS/OCT for FFR-positive lesions) was the primary end point, whereas sensitivity, specificity, and positive and negative likelihood ratios (LRs) were the secondary end points. Sensitivity analysis was performed according to angiographic diameter of lesions (evaluated at each center with visual estimation of vessels), for LM and for studies including only cutoff values of FFR less or equal than 0.80.

Data analysis and synthesis

Continuous variables were reported as mean (SD) or median [range] and categorical variables as n (%). Pooled analyses of AUC, sensitivity, specificity, positive LR, and negative LR were evaluated with random-effect analysis. Meta-regression with random effect was performed to assess the impact of gender, diabetes mellitus, lesion length, diameter stenosis, and MLA cutoff on test performance. Meta Disc (Unit of Clinical Biostatistics