The diagnosis and treatment strategies for coronary artery disease are traditionally based on the percentage of coronary angiographic vessel stenosis. We are witnessing a gradual transition from angiographic evaluation of individual coronary artery lesions towards the combination of anatomy and physiology to determining its physiological consequences. With the introduction and rapid evolution of fractional flow reserve (FFR) technology, a new gold standard has been developed to invasively assess the physiological severity of a coronary artery stenosis. Fractional flow reserve provides a real-time measurement of the extent to which a given epicardial stenosis limits maximal myocardial flow and identifies lesions that should be corrected by revascularisation.

The Impact of FFR Technology on Revascularisation Strategies

Various trials helped to support the premise that percutaneous coronary interventions (PCI) should be guided more by physiological considerations and not solely by anatomic factors. A number of studies designed to determine the role of FFR on coronary artery bypass grafting (CABG) have been done with promising results; however, larger prospective randomised trials are needed. Additionally, we still do not know what the long-term effects of not grafting angiographic stenotic lesions will be on the distal myocardium.

The impact of FFR technology on revascularisation strategies

<table>
<thead>
<tr>
<th>Study</th>
<th>Objective</th>
<th>Findings</th>
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<td>DEFER1</td>
<td>To evaluate the applicability of percutaneous coronary interventions (PCI) in single-vessel disease with intermediate stenosis</td>
<td>Worse overall outcome without intervention in patients with coronary stenosis with an FFR measurement of less than 0.75.</td>
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<tr>
<td>FAME5,6</td>
<td>To evaluate the role of FFR in patients with multi-vessel coronary artery disease</td>
<td>Reduced repeat revascularisation, number of stents used, the amount of contrast required and subsequent lower procedure-related costs in FFR-guided patients. Reduced mortality and myocardial infarction at two-year follow-up.</td>
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<tr>
<td>FAME II7,9</td>
<td>To evaluate the combination of PCI plus optimal medical therapy for coronary lesions with an FFR less than 0.80 compared with medical therapy alone</td>
<td>44 % reduction in the relative risk of hard endpoints such as death and myocardial infarction beyond seven days in FFR-guided patients.</td>
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Clinical Examples that Illustrate the Disparity Between Angiographic and FFR Lesion Evaluation

1. The Following Images Describe Significant Angiographic 3-Vessel Disease in a Patient with Stable Angina

Figure 1A: Left Anterior Descending (LAD): An angiographic significant lesion is encircled in white and requires coronary bypass according to conventional criteria. The corresponding FFR measurement is 0.70, which renders this stenosis functionally significant and revascularisation is required.

Figure 1B: Circumflex Artery and Obtuse Marginal Arteries: Significant sequential lesions are encircled in white. The corresponding FFR measurement across the diseased segment is 0.90, which renders this stenosis functionally insignificant and thus not to be revascularised.

Figure 1C: Right Coronary Artery: An angiographic significant proximal lesion is encircled in white. The corresponding FFR measurement of the lesion is 0.84, which renders this stenosis functionally insignificant and yet revascularisation is not warranted.

This example indicates how angiographic significant 3-vessel disease is downgraded to a single vessel LAD lesion. The patient underwent isolated robotic enhanced left internal mammary artery to LAD anastomosis by MIDCAB instead of the originally planned triple bypass surgery.
2. The Following Images Describe the Angiograms of Lesions Judged to be Potentially Insignificant in Two Separate Patients with Stable Angina

Figure 2A: LAD: An angiographically insignificant lesion is encircled in white. The corresponding FFR measurement of the lesion is 0.72, which renders this stenosis functionally significant and revascularisation is warranted.

Figure 2B: LAD: An angiographically insignificant lesion is encircled in white. The corresponding FFR measurement of the lesion is 0.70, which renders this stenosis functionally significant and revascularisation is warranted.

The above examples emphasize the potential upgrading of angiographic insignificant lesions to physiological important lesions with the addition of FFR measurement. These lesions therefore require revascularization for favorable long-term outcome.

Conclusion

FFR technology has proven its value in decision making about percutaneous coronary interventions but before changes are made in determining what vessels should and should not be grafted during CABG, larger prospective randomised trials with longer follow-up are needed to better understand the role of this technology in CABG. FFR-guided CABG is now under intense investigation and may have an important role in determining whether angiographic lesions should be bypassed.

References:

Rx Only

Brief Summary: Prior to using these devices, please review the Instructions for Use for a complete listing of indications, contraindications, warnings, precautions, potential adverse events and directions for use.

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