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FFR: Cornerstone for Optimal Coronary Revascularization

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Introduction

Fractional Flow Reserve (FFR) stands out as a critical tool for guiding Percutaneous Coronary Intervention (PCI), particularly when evaluating intermediate coronary lesions to prevent unnecessary revascularization. It's still seen as the gold standard for physiological assessment, even with the emergence of non-invasive techniques, proving especially useful in complex cases and multivessel disease. This method helps determine lesion significance beyond just how severe it looks anatomically [1].

The discussion around non-invasive FFR, often called FFRct or FFR-CT, explores its potential to pinpoint hemodynamically significant coronary stenoses without invasive procedures. Research highlights its diagnostic accuracy and prognostic value, paving the way for wider clinical use and making FFR assessment more accessible and less invasive [2].

FFR continues to play a vital part in modern revascularization strategies, especially for intermediate lesions and complex Coronary Artery Disease (CAD). The data FFR provides helps shape clinical decisions, ensuring that interventions target only functionally significant stenoses. This approach moves beyond simple angiography, ultimately leading to better patient outcomes and reinforcing FFR's ongoing relevance [3].

A comprehensive review delves into both FFR and the instantaneous wave-free ratio (iFR), comparing their effectiveness in guiding myocardial revascularization. Both techniques physiologically assess lesion severity, helping clinicians decide on the necessity of intervention. The article clarifies the subtle differences between FFR and iFR, offering a clear understanding of their individual strengths and uses in the catheterization lab [4].

Further research, specifically a meta-analysis, provides key insights into the debate between FFR-guided and angiography-guided revascularization for stable CAD. The findings strongly suggest that FFR-guided strategies improve clinical outcomes, including reducing the risk of major adverse cardiac events. This happens by ensuring interventions only address functionally significant lesions, underscoring the superiority of physiological assessment over purely anatomical views [5].

Another meta-analysis looks at the diagnostic accuracy of CT-derived FFR (FFR-CT) for identifying functionally significant CAD. The results show FFR-CT's promise as a non-invasive tool, correlating well with invasive FFR. This suggests it could help with risk stratification and cut down on unnecessary invasive angiographies, leading to more efficient and less burdensome patient care pathways [6].

A state-of-the-art review from JACC provides an extensive update on coronary physiological assessment, centering on FFR. It emphasizes FFR's role as a cornerstone in guiding revascularization decisions, integrating it with other physiological metrics like iFR. The authors highlight its utility in various clinical scenarios, offering a practical guide for cardiologists in the cath lab and reinforcing the move towards function-guided interventions [7].

A systematic review and meta-analysis investigate the impact of FFR-guided PCI in patients with Acute Coronary Syndrome (ACS). This work reveals that FFR guidance can improve clinical outcomes in this challenging patient group, particularly in deciding whether to revascularize non-culprit lesions. The findings suggest a benefit in customizing treatment strategies based on physiological assessment, even in the acute setting, which enhances precision medicine [8].

An article critically evaluates the readiness of CT-derived FFR (FFR-CT) for widespread clinical use. It discusses advancements and challenges, diagnostic performance, and its potential as a gateway to invasive angiography. The authors conclude that while FFR-CT is very promising and can already be integrated into clinical pathways for specific patient groups, continued research is essential to solidify its role and optimize its application [9].

Finally, an overview summarizes the current evidence regarding FFR in managing CAD, solidifying its place as a fundamental tool for guiding revascularization. It synthesizes findings from major trials and guidelines, confirming FFR's contribution to better patient outcomes by preventing unnecessary PCI and ensuring interventions are functionally driven. The article presents a strong case for its ongoing and expanded use in clinical practice [10].

Description

Fractional Flow Reserve (FFR) plays a pivotal role in guiding Percutaneous Coronary Intervention (PCI), particularly in assessing intermediate coronary lesions to prevent unwarranted revascularization. This physiological assessment method is consistently referred to as the gold standard, maintaining its importance despite the rise of non-invasive techniques. FFR proves especially valuable in intricate cases and for patients with multivessel disease, where it helps determine the true significance of a lesion beyond what anatomical severity might suggest, ultimately improving patient outcomes [1, 3, 7, 10].

The utility of FFR extends to its comparison with other physiological assessment tools, such as the instantaneous wave-free ratio (iFR). Both FFR and iFR are crucial for physiologically assessing lesion severity and informing decisions regarding myocardial revascularization. Furthermore, research highlights the significant advantages of FFR-guided revascularization over traditional angiography-guided approaches in stable Coronary Artery Disease (CAD). Meta-analyses consistently show that FFR-guided strategies lead to superior clinical outcomes, including a

reduced risk of major adverse cardiac events, by ensuring that interventions are precisely targeted at functionally significant lesions [4, 5].

There's a significant evolution in the field with the advent of non-invasive FFR, commonly referred to as FFRct or FFR-CT. This innovative approach offers the potential to identify hemodynamically significant coronary stenoses without requiring invasive procedures, making FFR assessment more accessible to a broader patient population. Studies indicate that FFR-CT demonstrates good diagnostic accuracy and correlation with invasive FFR, promising to enhance risk stratification and potentially reduce the need for unnecessary invasive angiographies. This push towards non-invasive methods aims to create more efficient and less burdensome patient pathways [2, 6, 9].

FFR also demonstrates its value in challenging clinical scenarios, such as in patients presenting with Acute Coronary Syndrome (ACS). Systematic reviews and meta-analyses reveal that FFR guidance can lead to improved clinical outcomes in this group, especially when making decisions about revascularizing non-culprit lesions. This capability allows for more tailored treatment strategies based on physiological assessment, even in acute settings, thereby enhancing precision medicine and optimizing patient care [8].

Considering the ongoing advancements and evidence, FFR's role in guiding revascularization decisions continues to be fundamental. It integrates well with other physiological metrics, offering a practical guide for cardiologists in various clinical scenarios within the catheterization lab. The consistent findings from numerous studies and guidelines underscore FFR's vital contribution to improving patient outcomes by avoiding unnecessary PCI and ensuring that all interventions are driven by functional significance, solidifying its expanding role in clinical practice [3, 7, 10].

Conclusion

Fractional Flow Reserve (FFR) is a cornerstone in guiding Percutaneous Coronary Intervention (PCI), helping clinicians assess intermediate coronary lesions and prevent unnecessary revascularization. It is widely considered the gold standard for physiological assessment, proving invaluable in complex cases and multivessel disease by determining lesion significance beyond anatomical severity. The emergence of non-invasive FFR, including FFRct and FFR-CT, offers a promising avenue for identifying hemodynamically significant stenoses without invasive procedures, enhancing accessibility and diagnostic accuracy.

Research consistently shows FFR-guided strategies lead to better clinical outcomes compared to angiography-guided approaches, reducing adverse cardiac events in stable Coronary Artery Disease (CAD) patients. FFR is also critical in Acute Coronary Syndrome (ACS), informing decisions on non-culprit lesions and tailoring treatment. Comprehensive reviews highlight its utility alongside instantaneous wave-free ratio (iFR) and its integration into modern revascularization strategies. While FFR-CT shows readiness for clinical integration in specific patient groups, ongoing research will further solidify its role. The evidence strongly supports FFR's continued and expanding use, ensuring interventions are functionally driven for optimal patient care.

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Conflict of Interest

None.

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