JACC: ASIA VOL. 4, NO. 3, 2024

EDITORIAL COMMENT

Prognostic Importance of Fractional Flow Reserve and Left Ventricular Systolic Dysfunction After Percutaneous Coronary Intervention*

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Left ventricular ejection fraction (LVEF) and fractional flow reserve (FFR) are prognostic factors in patients with coronary artery disease and useful to guide therapeutic decisions.[1,2] In current practice FFR <0.80 is regarded as significant, but there is variance in prognostic thresholds across the epicardial coronary arteries following percutaneous coronary intervention (PCI).[3] Prior studies have focused primarily on these parameters in isolation, potentially overlooking their relevance when integrated together.

In a study reported in this issue of *JACC: Asia*, Choi et al[4] analyzed data from 2,965 patients with available LVEF from the POST-PCI FLOW registry. This registry provides a comprehensive database of patients undergoing FFR measurement after PCI. Researchers aimed to understand how post-PCI FFR values interact with LVEF in predicting patient outcomes. They focused on several outcomes, including cardiac death, myocardial infarction (MI) linked to the treated vessel, and the need for subsequent revascularization.

The investigators observed that post-PCI FFR is associated with the risk for target vessel failure, but importantly, this association is influenced by LVEF. In patients with a LVEF <40%, a lower post-PCI FFR was linked to an increased risk for cardiac death or target vessel MI. For individuals with LVEF >40%, the lower FFR values correlated more with need for target vessel revascularization. The POST-PCI FLOW study's findings offer useful insights, albeit factoring in a degree of caution.

LVEF is a pivotal determinant of cardiac outcomes, especially in the context of residual coronary artery disease after PCI.[1] The Hagen-Poiseuille equation represents a physical law that gives the pressure drop in an incompressible and Newtonian fluid in laminar flow through a tube of constant cross-sectional dimension. When considering the Hagen-Poiseuille equation, FFR <0.80 signifies a residual impairment in hyperemic myocardial blood flow across a lesion of at least 50%. In this context, increased microvascular resistance following PCI will further exacerbate reduced myocardial perfusion and is associated with adverse outcomes following MI despite target lesion revascularization.[5] In patients with lower LVEF, the presence of residual myocardial ischemia post-PCI can be particularly detrimental, leading to increased risk for adverse cardiac events.[6]

A post-PCI FFR value of <0.80 may indicate residual ischemia, pointing to inadequate blood flow to the myocardium even after the intervention. This threshold has clinical implications: it correlates strongly with an increased likelihood of target vessel failure and signals the need for further intervention.

The clinical significance of effectively detecting and managing residual ischemia in these patients cannot be overstated. For patients with reduced LVEFs, the persistence of impaired myocardial blood flow after PCI suggests an incomplete therapeutic

*Editorials published in *JACC: Asia* reflect the views of the authors and do not necessarily represent the views of *JACC: Asia* or the American College of Cardiology.

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William F. Fearon, MD, served as the Guest Editor-in-Chief for this paper.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

ISSN 2772-3747 https://doi.org/10.1016/j.jacasi.2023.12.002

response, necessitating a more aggressive or alternative approach to management. This might include closer monitoring, medication adjustments, or staged interventions aimed at optimizing myocardial perfusion. From a prognostic standpoint, impaired myocardial blood flow as indicated by FFR <0.80 raises the stakes for patients, particularly those with compromised ventricular function, as it contributes significantly to the risk for cardiac death and other severe outcomes like MI or repeat hospitalizations for cardiac events.

In TARGET-FFR (Trial of Angiography vs. Pressure-Ratio-Guided Enhancement Techniques–Fractional Flow Reserve), Collison et al[7] investigated an FFR-guided optimization strategy post-PCI, randomizing participants to undergo a physiology-guided incremental optimization strategy or a blinded coronary physiology assessment. Improvements in post-PCI FFR were also associated with improvements in coronary flow reserve. Additional stenting further improved FFR compared with those who received further postdilation alone. Participants in the physiology-guided incremental optimization strategy arm were less likely to have residual post-PCI FFR <0.80. The study was designed but not powered to assess clinical outcomes; therefore, longer term outcomes are awaited with interest.

Considering these findings, alternative post-PCI optimization strategies merit consideration, particularly in patients with varying LVEF status. Intravascular ultrasound-guided PCI, for instance, offers a more direct approach for visualizing stent placement and expansion. Intravascular ultrasound-guided PCI has been demonstrated to improve patient outcomes, primarily through reductions in cardiac death and target vessel MI.[8] The integration of such strategies, especially in patients with lower LVEF, should minimize residual ischemia and enhance overall cardiac outcomes.

The findings of Choi et al[4] suggest a nuanced relationship between post-PCI FFR and cardiac outcomes, which is moderated by LVEF. They indicate that post-PCI FFR is influenced by ventricular function. The interpretation of post-PCI FFR adds a layer of complexity that may be valuable in certain clinical scenarios, particularly in patients with compromised LVEFs. However, the value of revascularization over optimal medical therapy in patients with severely reduced LVEFs remains a hot topic and was demonstrated not to diminish the risk for death or hospitalization for heart failure in the REVIVED trial.[9]

The study thereby enhances our understanding of how LVEF can influence the prognostic value of FFR in post-PCI patients. This could lead to more tailored approaches in managing patients after PCI, especially those with varying levels of ventricular function. However, more broadly, multiple factors contribute to patient outcomes. The limitations of this study, including its observational nature, affect the generalizability of its findings, and further outcome data from randomized settings are required.

This study marks a step forward in understanding cardiac risk post-PCI. It highlights the importance of considering both LVEF and FFR in prognostication. For clinicians and researchers, these findings offer a new lens through which to view post-PCI care, emphasizing the need for personalized treatment plans. Moving forward, this study lays the groundwork for further exploration and refinement in cardiac care, ultimately aiming to improve clinical outcomes after PCI.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

Prof Berry is supported by a British Heart Foundation Center of Research Excellence award (RE/18/6/34217) and funding from the Chief Scientist Office, UK Research and Innovation (COVID-HEART, reference MC/PC/20014), the Engineering and Physical Sciences Research Council (EP/N014642/1 and EP/S030875/1), and the Wellcome Trust. Dr Sykes is supported by funding from a British Heart Foundation Center of Research Excellence award (RE/18/6/34217) and NHS Greater Glasgow and Clyde Endowment Funding (GN21CA394). Prof Berry is employed by the University of Glasgow, which holds research and consultancy agreements with Abbott Vascular, AstraZeneca, Boehringer Ingelheim, Coroventis, GlaxoSmithKline, HeartFlow, Menarini, Merck Sharpe & Dohme, Neovasc, Novartis, Servier, Siemens Healthineers, TherOx, and ValoHealth. These companies were not involved in this work. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS fractional flow reserve, left ventricular ejection fraction, left ventricular systolic dysfunction, percutaneous coronary intervention