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Review Article

The potential role of fractional flow reserve (FFR) in the diagnosis and treatment of may-thurner syndrome

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Abstract

May–Thurner syndrome (MTS, also known as iliac vein compression syndrome) is a vascular disorder characterized by pelvic venous compression that may lead to chronic venous insufficiency or deep vein thrombosis. Optimal management requires accurate diagnosis and identification of functionally significant venous stenosis. Conventional imaging modalities, such as magnetic resonance venography (MRV) and computed tomography venography (CTV), primarily delineate anatomical obstruction but provide limited information on hemodynamic relevance. Fractional flow reserve (FFR), originally developed for coronary artery disease as a physiological index based on distal-to-proximal pressure gradients, has been proposed in preliminary studies as a potential adjunct for venous assessment. This narrative review examines the potential role of FFR in this context, drawing on evidence from arterial applications and initial venous explorations. Available data suggest that FFR enables quantitative assessment of pressure gradients across stenotic segments, but its applicability in the venous system remains theoretical due to fundamental differences in venous flow physiology. Incorporating FFR into diagnostic pathways could hypothetically improve patient selection for venous stenting, reduce unnecessary interventions, and enhance symptom management. However, concerns regarding technical feasibility, lack of standardized cut-off values, and potential for misdiagnosis must be addressed. Well-designed prospective studies are required to establish whether FFR can be reliably translated into routine venous diagnostics.

Keywords: May–Thurner syndrome, venous insufficiency, fractional flow reserve, intravascular ultrasound, hemodynamics, vascular diagnostics

INTRODUCTION

Conventional imaging techniques such as Doppler ultrasound, MRV, and CTV cannot reliably determine the functional significance of venous stenosis in MTS. Fractional flow reserve (FFR), a hemodynamic index widely validated in coronary interventions, measures the ratio of distal to proximal pressures across a stenotic lesion during hyperemia. Applying this approach to venous disease has been hypothesized to improve diagnostic accuracy and refine patient selection for stenting in MTS.

MTS is most often caused by extrinsic compression of the left common iliac vein by the right common iliac artery, resulting in venous hypertension, thrombosis, and chronic venous insufficiency (1,2). Although anatomical imaging modalities such as CTV and MRV are useful for detecting obstruction, they do not quantify the hemodynamic impact of compression. Current gold-standard invasive tests include intravascular ultrasound (IVUS) and direct venous pressure gradient measurement (manometry). This review explores the potential—but unproven—role of FFR as a complementary functional tool in the diagnostic evaluation of MTS.

Current Diagnostic Challenges in May–Thurner Syndrome

Current diagnostic approaches focus primarily on morphological abnormalities. While Doppler ultrasound, MRV, and CTV effectively identify structural changes, their findings often fail to correlate with symptom severity (3–5). Invasive venography and IVUS are currently considered the reference standards for confirming diagnosis and guiding intervention, as they directly visualize venous anatomy and allow simultaneous treatment (5-9). This discrepancy underscores the need for diagnostic tools

that evaluate venous flow and pressure dynamics in real time.

Role of FFR in Arterial Disease

FFR is a validated index used in cardiac catheterization to assess the hemodynamic significance of coronary lesions. By comparing distal to proximal pressures across a lesion during pharmacologically induced hyperemia, FFR identifies which stenoses warrant intervention (6–8). Its reproducibility and outcome-driven evidence have transformed coronary revascularization strategies.

FFR's Potential Role in Venous Disorders

Although its use in venous disease remains experimental, preliminary reports suggest that pressure-based assessment may help characterize venous stenosis. However, venous hemodynamics differ fundamentally from arterial physiology: venous flow is non-pulsatile, pressure gradients are smaller, and there is no established method of inducing hyperemia. Early attempts adapting the FFR concept to iliac vein obstruction demonstrated that pressure gradients might correlate with symptoms and intervention decisions. Yet, unlike in coronary disease, there are no validated venous FFR thresholds, and catheter-based measurements may be influenced by posture, hydration status, and intra-abdominal pressure.

Technical Considerations and Comparison with Existing Modalities

Practical complexities limit the translation of FFR into venous practice. These include the need for specialized pressure-sensor guidewires, the challenge of obtaining stable measurements in low-pressure venous systems, and the absence of consensus cut-off values for intervention.

When compared with existing modalities, intravascular ultrasound (IVUS) provides direct anatomical detail and is currently the most widely accepted invasive diagnostic tool (9). Venous manometry, based on pressure gradient measurement, offers physiological information without the need for hyperemia but is limited by variability (10). In addition, noninvasive functional imaging approaches, such as flow-sensitive MRI techniques, are under active investigation. In this context, fractional flow reserve (FFR) might eventually serve as a complementary tool; however, current evidence does not demonstrate superiority over IVUS or manometry (9-10).

Clinical Implications and Future Directions

If validated, incorporating FFR into the diagnostic pathway for MTS could theoretically improve treatment precision. Patients with functionally insignificant stenoses could avoid unnecessary stenting, whereas those with clinically relevant pressure gradients may benefit from targeted intervention. Nevertheless, the potential for misdiagnosis due to physiological differences, technical variability, and lack of validated thresholds remains a significant concern. To address these challenges, future studies should be designed as prospective trials directly comparing FFR with established modalities such as IVUS and venous manometry in the context of MTS. In addition, reproducible venous FFR cut-off values need to be established and correlated with clinical outcomes to ensure diagnostic reliability. The safety and feasibility of pressure-wire use in iliac veins must also be systematically evaluated. Finally, the integration of multimodality imaging—combining IVUS, manometry, and experimental FFR—should be explored to provide a more comprehensive and clinically relevant assessment strategy.

CONCLUSION

FFR has theoretical potential to complement anatomical imaging in the evaluation of MTS. By providing pressure-based functional assessment, FFR may one day help identify patients most likely to benefit from invasive treatment. However, current evidence is insufficient, and its direct application from arterial to venous systems is physiologically problematic. Until robust validation is achieved, IVUS and venous manometry remain the preferred standards for clinical decision-making.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

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