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See Article page 1556.

Commentary: Transcending acceptable, moving toward optimal: Standardizing surgical configurations of ventricular assist device therapy

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The number of patients with end-stage heart failure potentially eligible for ventricular assist device (VAD) therapy continues to increase.¹ Meanwhile, VAD outcomes with current centrifugal devices have improved significantly and in the first few years after implantation are approaching those of transplantation, yet at the same time they remain encumbered by adverse events such as stroke and hemodynamic complications like aortic regurgitation (AR).² Our understanding of the mechanisms of VAD complications has expanded from basic engineering of the devices themselves to the patient–pump interface (comorbidities, thrombogenicity), medical management (blood pressure control, aortic valve opening), and surgical configuration.^{3,4} Computational fluid dynamic modeling (CFD) has emerged as a powerful method to investigate hemodynamics and thrombogenicity of various VAD surgical configurations.⁵⁻⁸

In this issue of the *Journal*, Kasinpila and colleagues⁹ examined how outflow graft position might contribute to de-

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An emerging body of evidence supports that VAD surgical configuration may contribute to complications. Standardization of optimal VAD surgical configuration is imperative to improve outcomes.

novo AR using a CFD model. Via 3-dimensional reconstructions of computed tomography–derived aortic geometry of 10 AR and 20 non-AR VAD patients, the authors found that the distance from aortic root to outflow graft was significantly smaller in patients who developed AR, whereas outflow graft angles relative to the aorta did not appear to have a significant impact. CFD modeling also revealed larger recirculation zones and greater wall shear stress in the aortic root of patients with AR. Taken together, the current data establish a plausible theory that the surgical outflow graft configuration may, via hemodynamic alterations in the aortic root, contribute to development of AR during VAD support.

The authors' application of CFD evaluating the association of surgical configuration on the development of AR on support is highly pertinent, as AR is a common complication of continuous flow.¹⁰ Although the study benefits from a robust sample size and thoughtful analysis, its results need to be interpreted in the context of limitations inherent

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to CFD modeling. In this study, the model did not take into account aortic valve anatomy, valve opening, aortic wall compliance, VAD speed, blood pressure control, or model the development of AR over time. More work is needed to further validate CFD modeling of the pathophysiology of VAD surgical configuration and hemodynamics.

Nevertheless, a growing body of evidence makes an extremely strong case for standardizing surgical implantation technique and thus optimizing the configuration of VAD therapy.⁵⁻⁹ It is imperative we start using more deliberate preoperative imaging to guide surgical planning and minimize practice pattern variation of implantation, similar to what is already the standard of care in transcatheter aortic valve replacement.¹¹ Powerful tools like CFD can be leveraged to inform configuration options suitable for future clinical trials. Combined with enhanced VAD engineering, thoughtful patient selection, and optimization of medical management, a more precise standardization of surgical configuration represents the next logical step toward further improving biocompatibility, reducing thrombogenicity, avoiding complications, and improving long-term VAD outcomes. With more standardization, we will be one major step closer to the aspirational goal of achieving VAD outcomes that exceed those of cardiac transplantation. As a field, it is time we finally aspire to transcend acceptable and strive toward optimal.

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