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Clinical application of the second- and third-generation continuous-flow (CF) ventricular assist devices (VADs) using a centrifugal or axial pump has improved survival of patients with end-stage heart failure, especially as a bridge to heart transplantation. However, aortic insufficiency (AI), gastrointestinal bleeding, and right heart failure are major complications that have to be overcome for better outcomes.

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CF-VADs often have less pulsatility than pulsatile-flow (PF)-VADs during the assist phase. In this issue of the Journal, Imamura et al report the advantage of pulsatility in left ventricular (LV) reverse remodeling and AI prevention during VAD treatment in propensity score-matched non-ischemic cardiomyopathy patient cohorts. They show that patients with PF-VADs recovered better LV ejection fraction (LVEF) and had more frequent native aortic valve opening and less AI with less remodeling of the aortic root after 6 months of VAD support than those with CF-VADs, although the authors do not clarify the precise mechanisms of these differences. They also report that preservation of native aortic valve opening and prevention of AI are strongly related to better clinical outcomes with better LV systolic function during VAD therapy; therefore, less AI with a PF-VAD might lead to better LV reverse remodeling. However, at this time, we cannot conclude which comes first: preserved aortic valve opening or LV reverse remodeling.

There have been several experiments with mock circulation and animal models analyzing LV unloading by PF-VAD and CF-VAD, which showed that CF-VAD provided greater LV unloading than PF-VAD. However, some studies comparing the two in a clinical setting reported that both types of device provide similar LV unloading or even better LV unloading with PF-VAD. These discrepancies may be related to differences in the assist flow amount and assist pressure, as well as in patient baseline profiles. Therefore, the present article by Imamura et al showing the advantage of pulsatility in matched cohorts indicates the beneficial potential of PF-VAD under equivalent clinical conditions.

Pulsatility may be essential not only for LV reverse remodeling but also for end-organ physiological perfusion. Pulsatility may play an important role in microcirculation and end-organ perfusion through maintenance of vascular endothelial function, even though it is controversial whether pulsatility is significantly diminished at the capillary level. Although CF-VAD therapy preserves the function of end organs such as liver and kidney, pulsatility provides intrinsic shear stress on vascular endothelial cells, increasing endothelial production of nitric oxide, which may maintain physiological perfusion in the microcirculation, including the coronary system. For other problems occasionally observed in CF-VAD patients, such as acquired von Willebrand syndrome and arteriovenous malformation, which may cause critical gastrointestinal bleeding, it is unknown whether less pulsatility is also related to these phenomena.

In Imamura’s report, 5 (25%) of 20 patients were weaned off PF-VAD, whereas only 1 (5%) was weaned off CF-VAD by 6 months in these selected cohorts; however, the morbidity of other major complications and the final survival are not described. It is unclear if the findings obtained with PF-VAD, such as better LVEF, more frequent native aortic valve opening, and less AI with less remodeling of the aortic root, could contribute to improved survival later in this study. For future direction, to improve the morbidity of major complications and the overall survival of VAD treatment, including long-lasting support for destination therapy, some trials incorporating or preserving pulsatility with CF-VADs have to be conducted (eg, by using the intermittent low-speed mode of the Jarvik 2000 Heart® (Jarvik Heart, Inc, New York, NY, USA), the Lavare Cycle cyclic controlled speed change function of the HeartWare LVAD® (HeartWare International, Framingham, MA, USA), and the Artificial Pulse technology of the Thoratec® HeartMate III LVAS (Thoratec Corporation, Pleasanton, CA, USA). The outcomes of these speed-modulating algorithms should be verified clinically, and further studies elucidating optimal algorithms are required.

**References**


