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Commentary: Less-invasive approaches to big complex problems in patients with end-stage heart disease

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CENTRAL MESSAGE

Minimally invasive left ventricular assist device implantation with alternative outflow sites is feasible when safe access to the ascending aorta is prohibited.

In this issue of the *Journal*, Tucker and colleagues[1] describe the use of an axillo-axillary bypass to augment left ventricular assist device (LVAD) outflow via a minimally invasive approach in the setting of a hostile mediastinum and porcelain aorta. The LVAD outflow graft was initially anastomosed to the left axillary artery; however, this was complicated by left upper-extremity hyperemia and poor systemic perfusion. An axillo-axillary artery bypass was created with improved flow distribution and resolution of cardiogenic shock. The authors are to be congratulated on their novel and creative approach to augment LVAD outflow.

This report highlights 2 major areas of current development: (1) alternative surgical approaches to LVAD implantation, and (2) device configuration. Although originally developed as a bridge-to-transplantation, significant improvements in medical optimization and newer-generation devices have led to a dramatic increase in LVAD implantation as destination therapy.[2] However, the destination therapy cohort is often older and sicker, with many having undergone previous cardiac surgery. To avoid a hazardous sternal re-entry and for preservation of a virgin chest in patients with bridge-to-transplantation, less-invasive approaches have been described with several advantages, including shorter operative duration, fewer transfusion requirements, earlier extubation, and possibly improved right ventricular function owing to an intact pericardium.[3,4] Access to the apex is achieved via left anterolateral thoracotomy, and the ascending aorta is exposed through an upper hemisternotomy or right anterior thoracotomy.[5] This allows for standard implantation with or without cardiopulmonary bypass and facilitates alternative outflow locations when the ascending aorta is inaccessible.[6]

Alternative outflow sites include the innominate, subclavian, and axillary arteries, and descending thoracic and supraceliac abdominal aorta. The choice of alternative outflow graft location should be tailored to individual anatomy. In this case, the left axillary artery outflow was complicated by left upper-extremity hyperemia, which raises the question of how outflow graft positioning and location impacts native and LVAD flow dynamics. Multiple studies have used computational fluid dynamics analyses to investigate flow differences when the ascending and descending aorta are used as outflows[7-9]; however, there is a paucity of data on how using branch vessels as outflow influences fluid dynamics and in particular, perfusion of the ascending aorta and root when native cardiac output is low. As pointed out by Tucker and colleagues, lack of proximal aortic "washout" with their configuration may result in a region of stagnation prone to thrombus formation.

The landscape of mechanical circulatory support continues to evolve with extended roles in advanced heart failure. As the number of patients requiring short-term and destination LVAD support increases (many with previous cardiac surgery), it is imperative to explore ways to minimize morbidity and mortality. Sternal-sparing implantation

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techniques facilitate easier reoperation at the time of transplantation and reduces the risk of inadvertent injury in a hostile chest. While ascending aortic outflow remains the conventional approach, axillary artery outflow is a valid alternative when safe access to the ascending aorta is prohibited, although its hemodynamic significance and long-term outcomes remain unknown. Further experience with alternative outflow sites is required.

References

1. Tucker LD, Perry J, Bock A, Douglas A, Albert C, Kirksey L, et al. Left ventricular assist device implantation with axillary–axillary outflow graft. *J Thorac Cardiovasc Surg Tech*. 2020;4:197-9.
2. Patel CB, Cowger JA, Zuckermann A. A contemporary review of mechanical circulatory support. *J Heart Lung Transplant*. 2014;33:667-74.
3. Reineke DC, Carrel TP. Less invasive left ventricular assist device implantation—a match changer! *J Thorac Dis*. 2015;7:783-6.
4. Carmona A, Hoang Minh T, Perrier S, Schneider C, Marguerite S, Ajob G, et al. Minimally invasive surgery for left ventricular assist device implantation is safe and associated with a decreased risk of right ventricular failure. *J Thorac Dis*. 2020;12:1496-506.
5. Makdisi G, Wang IW. Minimally invasive is the future of left ventricular assist device implantation. *J Thorac Dis*. 2015;7:E283-8.
6. El-Sayed Ahmed MM, Aftab M, Singh SK, Mallidi HR, Frazier OH. Left ventricular assist device outflow graft: alternative sites. *Ann Cardiothorac Surg*. 2014;3:541-5.
7. Callington A, Long Q, Mohite P, Simon A, Mittal TK. Computational fluid dynamic study of hemodynamic effects on aortic root blood flow of systematically varied left ventricular assist device graft anastomosis design. *J Thorac Cardiovasc Surg*. 2015;150:696-704.
8. Karmonik C, Partovi S, Loebe M, Schmack B, Weymann A, Lumsden AB, et al. Computational fluid dynamics in patients with continuous-flow left ventricular assist device support show hemodynamic alterations in the ascending aorta. *J Thorac Cardiovasc Surg*. 2014;147:1326-33.e1.
9. Kar B, Delgado RM III, Frazier OH, Gregoric ID, Harting MT, Wadia Y, et al. The effect of LVAD aortic outflow-graft placement on hemodynamics and flow: implantation technique and computer flow modeling. *Tex Heart Inst J*. 2005;32:294-8.