Post-left ventricular assist device support right ventricular failure: Can it be predicted preoperatively, and should it be a contraindication to implantation?

Ann C. Gaffey, MD, and Pavan Atluri, MD

From the Division of Cardiovascular Surgery, Department of Surgery, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pa.

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Address for reprints: Pavan Atluri, MD, Director, Mechanical Circulatory Support and Heart Transplantation, Director, Minimally Invasive and Robotic Cardiac Surgery, Division of Cardiovascular Surgery, Department of Surgery, University of Pennsylvania, Silverstein 6, 3400 Spruce St, Philadelphia, PA 19104 (E-mail: Pavan.atluri@uphs.upenn.edu).

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Continuous-flow left ventricular assist devices (LVADs) have demonstrated marked success both in bridging patients to cardiac transplant and in providing destination therapy for patients with severe univentricular left-sided heart failure. Right ventricular failure (RVF) occurring after LVAD implantation is one of the most serious complications with unknown predictors and remains a major cause of concern after durable ventricular assist device implantation.¹⁻⁸ Depending on the diagnostic criteria used, the incidence of RVF ranges from 9% to 44%.^{8,9} Preventing, anticipating, and managing postoperative RVF is a key component in the decision to proceed with isolated LVAD therapy at most institutions. It currently appears that 10% to 15% of patients have RVF after LVAD implantation, necessitating the implantation of separate right ventricular assist device (RVAD).^{2-4,6,7,9,10} Questions remain regarding the validity of preoperative risk factors in predicting who may require RVAD implantation as well as regarding postoperative outcomes after temporary RVAD insertion. The literature clearly demonstrates that the presence of RVF after LVAD implantation should prompt early RVAD insertion to optimize hemodynamics, improve end-organ perfusion, reduce associated morbidities, and improve mortality.^{11,12} Even so, the prediction of this patient subset and their outcomes after RVAD insertion are poorly understood.

Although an RVAD is a possibility with the bridge-to-transplant population, this intervention is not a long-term reality with the quickly expanding destination therapy ventricular assist device population. As a result, it is vital that we be able to select patients properly for isolated LVAD therapy. More importantly, in the destination therapy ventricular assist device population, because of the lack of outcomes and data on long-term right ventricular support, the question remains whether right ventricular function is

Ann C. Gaffey, MD, and Pavan Atluri, MD

Central Message

Right ventricular failure remains a serious yet misunderstood post-LVAD complication, with risk factors and outcomes poorly defined.

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recruitable and stabilizes long term after LVAD implantation. The answer to this question will determine whether a given patient with marginal right ventricular function can be treated with a durable LVAD and if needed a temporary RVAD, with eventual transition to isolated LVAD support, or whether durable LVAD therapy is altogether futile.

Along the same lines, many risk scores have been developed to assess whether a patient will tolerate an isolated LVAD or require biventricular support.^{4,12-15} The risk stratification tools are not adequate, however, and many of the variables or combinations thereof are not consistent across the literature with respect to type of device implanted, timing of risk factor assessment, and patient characteristics. Several studies have identified multiple preoperative predictors after LVAD implantation, including female sex, mechanical ventilation, decreased mean arterial pressure, decreased right ventricular stroke work index, elevated central venous pressure, abnormal hepatic transaminases, elevated bilirubin, and elevated creatinine, to predict those who will benefit from RVAD implantation. Nevertheless, a consensus on the appropriate variables and the respective impacts of each individual variable on predicting post-LVAD RVF has not been reached. As we have demonstrated, the predictive power of any current “RVF risk score” remains limited by the individual institutional data set used, arguing for a larger multi-institutional analysis.¹⁵ Overall, RVF remains difficult to predict, probably because of its multifactorial etiology and the lack of multi-institutional data.

In this issue of the *Journal*, Patil and colleagues¹⁶ have presented an excellent single-center retrospective study on RVAD use after continuous-flow LVAD implantation, attempting to address both risk factors for RVF and the long-term outcomes of patients bridged with a temporary RVAD. Patil and colleagues¹⁶ have concluded that the risk factors of decreased tricuspid annular plane systolic excursion and small left atrial diameter are independent predictors of need for a contemporaneous RVAD. Differences in tricuspid regurgitation, central venous pressure, ratio of central venous pressure to pulmonary capillary wedge pressure, and right ventricular stroke work index exhibited a trend toward predicting the need for RVAD placement. Most importantly, Patil and colleagues¹⁶ showed that the patients who required RVAD support after durable LVAD implantation had a similar long-term survival to that of patients who did not require mechanical right ventricular support. Patil and colleagues¹⁶ should be commended for their contribution to our assessment of right ventricular function and suitability for isolated LVAD therapy. Their study demonstrates that right ventricular function can be recruited with a temporary RVAD with outcomes comparable to those of patients with normal right ventricular function, thereby supporting an aggressive approach to LVAD therapy in patients with marginal right ventricular function. This was a patient population that otherwise would be relegated to hospice care. This question remained, until now, largely unanswered in the literature. Further, multi-institutional analysis should be performed on the heels of this excellent single-institutional experience to address this vital concern further in the mechanical circulatory support community.

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