Ventricular assist device support after biventricular excision: Assistance or alternative?

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Rapidly expanding use of mechanical circulatory support platforms for resuscitative indications has led to remarkable recovery and survival among patients whose conditions would have been invariably deemed fatal in the past. Post-infarction cardiac arrest refractory to resuscitation and revascularization compose a large percentage of these cases.^{1,2} Numerous bridging strategies with various combinations of ventricular assist devices (VADs) and extracorporeal membrane oxygenation (ECMO) have been demonstrated, although high rates of complications require exceptionally careful patient selection, surgical planning, and perioperative management.³⁻⁶ Technical challenges still remain in the creation of such increasingly hybrid physiology, most importantly in our abilities to restore adequate flow, to achieve hemostasis, and to preserve the anatomy for future transplant or other, more definitive therapies.

The novel technique reported by Carrozzini and colleagues⁷ in this issue of the *Journal* of paracorporeal biventricular VAD implantation after biventricular excision is precisely at the frontier of this burgeoning realm.⁶ In this report, the patient was precluded from heart transplantation or conventional VAD implantation at the time of hemodynamic compromise because of prohibitively high thromboembolic risk from extensive intraventricular thrombosis. Although the patient was promptly placed on peripheral venoarterial ECMO and confirmed to have intact neurologic status, he had worsening lactic acidosis and renal and pulmonary dysfunction in the absence of adequate left ventricular unloading. His prognosis, if limited to standard surgical approaches, would have been fatal. Given such circumstances, the approach of Carrozzini and colleagues⁷ to convert from ECMO to paracorporeal biventricular VAD with biventricular excision demonstrates ingenuity and versatility. Doing so simultaneously accomplished 2 essential goals that prolonged ECMO therapy in this case could not have done: (1) near-complete elimination of thromboembolic burden and (2) recovery from shock

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Central Message

In cases in which biventricular excision is required, paracorporeal biventricular assist device support may offer a clinically beneficial alternative to ECMO as bridge to more definitive therapy.

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and end-organ failure in preparation for bridging to more durable therapy, such as transplant or a total artificial heart. Whereas traditional ECMO therapy often has a finite window, after which point end-organ compromise is inevitable, temporary biventricular support has been shown to be stable for weeks.^{8,9}

Several notable technical insights should be gleaned from this report and could guide future endeavors. First, direct left atrial cannulation not only is surgically feasible through careful preservation of the fibrous skeleton and the creation of a rigid cuff but also permits excellent flow and reasonable hemostasis. Even outside this specific context, this technique may offer a solution for patients, such as those with hypertrophic cardiomyopathy, for whom fear of suction events prohibits ventricular cannulation, or those with post-infarction ventricular septal defect. Second, although the patient died after the operation of an ischemic stroke, which Carrozzini and colleagues⁷ presume to have come from an upstream, aortic source, the use of oxygenators in the circuit theoretically mitigated the risk of systemic thromboembolism despite high clot burden in the cardiac chambers and pulmonary vasculature. This report demonstrates a clear example of the sort of ingenuity and out-of-the-box thinking that we as surgeons ought to invoke in applying mechanical circulatory support to our critically ill patients.

Many questions regarding the patient's postoperative course remain after reading this report, and the answers will help determine the technique's true feasibility as a bridge platform. In addition to VAD flow, longer observations of end-organ function and rates of device-related complications will need to be analyzed. In our experience, surgical innovation in this setting is only as meaningful as its ability to bridge to durable platforms.

As the capability of mechanical circulatory support devices and our abilities to manage them effectively continue to improve, we will simultaneously experience the unlimited potential and the unforeseen challenges of these increasingly complex, bionic approaches. Carrozzini and colleagues⁷ are to be commended for their innovative work, which demonstrates a technical foundation to help patients who are otherwise without options or hope.

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