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Commentary: An arteriovenous bridge over novel, troubled water

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CENTRAL MESSAGE

An arteriovenous fistula presents a viable permanent dialysis access in a patient with a total artificial heart.

It is estimated that more than 6 million Americans are living with heart failure (HF) and projected that this number will increase 46% from 2012 to 2030, resulting in >8 million people with HF in the United States.[1] Approximately 25,000 patients between 2006 and 2018[2] have been supported by implanted mechanical circulatory devices, and one half of all heart transplant recipients are being bridged using mechanical circulatory support.[3] Notably, a significant number of these patients are hemodialysis dependent.[4] The high incidence of renal dysfunction in patients with end-stage HF is unsurprising, given that many of them have significant environmental and genetic cardiovascular risk factors and multiple comorbidities.[5] In addition, they experience chronically inadequate renal perfusion secondary to long-standing HF, as well as being at risk for acute-on-chronic kidney injury during episodes of decompensated HF, or during periods of hemodynamic instability related to MCS device implantation or other cardiac procedures.

Strategies for addressing vascular access in patients with continuous-flow left ventricular assist devices have been well described.[6,7] Because of theoretical concerns regarding arteriovenous (AV) fistula venous maturation in the absence of pulsatile flow,[6,7] we and many other experts opt to use AV grafts in patients with continuous-flow left ventricular assist devices.[8] The authors pursued the creation of a staged brachiobasilic arteriovenous fistula in a patient supported with a total artificial heart (TAH).[9] This approach appears plausible for a number of reasons. The Syncardia TAH (SynCardia Systems, Inc, Tucson, Ariz), the only TAH approved by the Food and Drug Administration in the United States,[10] is a pneumatically driven pulsatile flow device, which mitigated the concern for lack of AVF maturation. Use of a native vein may reduce another concern in patients with an implanted MCS device, which is infection and hematogenous seeding of the implant. This risk is augmented by repeated vascular access necessary for hemodialysis, and particularly exacerbated by the presence of an indwelling tunneled dialysis catheter. The use of a dialysis catheter with TAH requires extra caution due to the presence of a mechanical tricuspid valve as well. Furthermore, an AV graft might increase the risk of local infection after a heart (and kidney) transplant.

The authors acknowledge uncertainty regarding the potential for TAH-driven super-physiologic pulsatile flow affecting fistula arterialization and wall integrity but report that the AVF did adequately mature, with sufficient size, arterialization, wall thickening, and high flow rates, despite requiring 3 interventions for atypical aneurysmal degeneration of the arterial limb of the fistula during the 15 months of use, before the patient received a heart–kidney transplant. With more experience, the procedure may be performed in a single setting, saving the patient a second operation.

Like in most cases of advances borne out of necessity, Hair and colleagues used their judgment and experience and applied sound surgical principles to a novel clinical scenario while dealing with uncertainty. Despite complications, their team managed to successfully bridge a patient to a double-organ transplant and demonstrate that, especially as medical devices

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and technology become ever more complex and ubiquitous, surgeons will continue to innovate.

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