explantation using their protocol. Considering that during continuous-flow LVAD implantation, we start the pump with the outflow graft completely clamped, we believe balloon graft occlusion can be performed with the pump speed turned down to a minimal net flow state. Thus, hemodynamic assessment can be performed with no pump flow but with the pump still spinning and no need to “restart” the pump.

Although the results of this standardized protocol demonstrate that successful LVAD explantation can be performed in a predictable fashion, there may be room for improvement to allow similar protocols to be safely adopted more widely.

See Article page 1922.

Commentary: The debate continues on optimal myocardial recovery assessment

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In their article in the *Journal*, Dr Hrytsyna and colleagues report their experience with a protocolized method of assessing myocardial recovery with the aim of aggressive left ventricular assist device (LVAD) explantation.¹ This single-institution retrospective review has 2 helpful characteristics: a large LVAD population (544 patients) and a long-standing protocol-based assessment for explantation, initiated in 2016. After 4 years of using this protocol, 57 patients (10%) met the authors' screening criteria and underwent speed manipulation under echocardiographic guidance (including pump stoppage). Of these patients, 37 underwent right heart catheterization–guided pump

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CENTRAL MESSAGE

A standardized and continuous approach to left ventricular assist device explantation allows for safe assessment of myocardial recovery, although pump stoppage may provide undue risk and necessitates further review.

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stop with graft occlusion. Finally, 21 patients fulfilled all criteria and were explanted. The rate of 3.9% is higher than the reported myocardial recovery rates in Europe and North America (1%-2%).^{2,3} There is no way to truly determine whether this is the optimal protocol and recovery rate, and with only 1 LVAD reimplantation in a non-compliant patient, this protocol ultimately may be too conservative. However, simply developing and then using any protocol increases awareness, screening, and thus, ultimately, explantation.

The authors note a variety of complications, including 3 patients with severe hypotension and 2 patients with pump stoppage malfunctions, one with eventual restart but the

other unable to be restarted. Luckily, these complications did not occur in the same patient, or the outcome would have been much worse. In December 2020, HeartWare released an urgent medical device communication noting this exact issue at a rate of <0.1%.⁴ For patients with a HeartWare HVAD, this is a critical issue that should be taken into consideration when developing an institutional protocol for assessing myocardial recovery. Finally, we were surprised to read that the authors found no bleeding, thromboembolic, or vascular complications. Ensuring adequate anticoagulation at the time of testing is critical to replicating these results.

Myocardial recovery is an exciting and important topic in mechanical circulatory support, and this article is an important contribution. The detailed stepwise protocol is a great starting point for institutions in developing their own standardized approach. Our program uses the same minimum speeds assessed under echocardiography and catheterization, as well as left ventricle size and function thresholds. However, we do not stop pumps and advocate for programs to carefully consider the need for this maneuver before incorporating it into a protocol. If programs believe pump stoppage to be an important component, they must consider the potential for retrograde flow in centrifugal pumps.⁵ Including this stress test in the second phase of assessment may incorrectly exclude patients. Because of this, a single pump stoppage with outflow graft occlusion would be the most informative assessment.

Although not prominently discussed in the article, percutaneous treatment for mitral regurgitation can be a very helpful adjunct to optimize patients for LVAD explantation. Myocardial recovery can be facilitated by optimizing heart failure medications, treatment of valvular disease, and the simple passage of time. An aggressive approach to LVAD explantation will pair optimization with continuous assessment to identify all potential explantation candidates. Although LVAD outcomes continue to improve, risks persist, and we owe it to our patients to explant the device whenever it can be safely performed.

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