

Biologic Left Ventricular Assist: A New Strategy for Patients with Advanced Heart Failure with Pulmonary Hypertension

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Pulmonary arterial hypertension due to increased vascular resistance is a clinical condition that directly impacts the prognosis of patients with heart failure (HF), and it is considered one of the main contraindications to orthotopic heart transplantation.¹ Although hemodynamic values vary in the literature, there is a consensus that pulmonary artery systolic pressure above 50 mmHg, transpulmonary gradient above 15 mmHg, and pulmonary vascular resistance above 3 Wood units, when unresponsive to vasodilators, contraindicate orthotopic transplantation.² Therapeutic strategies to decrease or reverse this condition are a challenge in clinical practice, which, if resolved, may allow definitive treatment of HF with orthotopic transplantation.

The use of long-term continuous-flow left circulatory assistance devices as a bridge to candidacy is a reality in large transplant centers in developed countries. Several studies have demonstrated that device implantation not only leads to the expected eligibility for orthotopic transplantation in some patients; it also improves the quality of life of patients for whom it ends up remaining as the target therapy. In a study recently carried out by Ruan et al, it was demonstrated that, approximately 6 months after device implantation, there was a reduction and stabilization of pulmonary pressure.³ The reversal of pulmonary hypertension through left assistance devices is possible, given that there is an important decrease in filling pressures by means of the continuous emptying of the left ventricle.⁴

Heterotopic transplantation is a technique that was initially conceived by Christian Barnard in 1974 as an alternative to circulatory support in cases of graft failure due to primary dysfunction or hyperacute rejection and in cases of pulmonary hypertension. In addition to these three classic indications, over time, two other indications were added, namely, when there is a substantial mismatch in weight between the donor and recipient and when the graft is considered marginal (long ischemia times, high doses of vasopressors and/or inotropes, and segmental alterations on echocardiogram).⁵ The use of the heterotopic technique as a form of ventricular support was described by Barnard; however, in the configuration

initially proposed, support is biventricular, and the left and right circulation are connected in parallel. This model of circulation causes the native heart to progressively stop its mechanical activity, which can cause arrhythmias, formation of intracavitary thrombi followed by emboli, in addition to increasing the incidence of endocarditis. These complications were responsible for the discontinuation of the technique.⁶

In 2011, Jake and Hannah Copeland published an alteration of Barnard's heterotopic transplant technique by means of parallel connection of the left ventricle and only decompression of the right ventricle. This modification proved to be effective in cases where right ventricular function is normal, which is similar to the indications for implantation of left mechanical assistance. This model of heterotopic transplantation can be considered biologic left ventricular assist (bio-LVA).⁷

In 2020, Gaiotto et al. proposed a modification of the Copeland technique, in which the superior vena cava drainage is directly connected to the right atrium of the implanted heart, keeping the right ventricle functioning and in series with the cranial segment of circulation. This model was proposed for patients with fixed pulmonary hypertension with contraindication to orthotopic transplantation. Once left assistance is performed with this model, a drop in pulmonary pressure and the feasibility of conventional transplantation are expected. Knowing that the heart in the heterotopic position maintains left and right ventricular function by modification of the previously described technique, in a subsequent moment, the native heart can be explanted and the other heart can be repositioned in an orthotopic position (Figure 1). This proposal with both stages was already carried out in 2021, and the result was surprising. The patient, who had a contraindication to conventional transplantation and was in palliative care, underwent heterotopic implantation as a "bridge to candidacy." In less than 40 days, there was a significant drop in pulmonary pressure, and the second stage was successfully performed. He did not have access to the long-term mechanical device due to the high cost.

There is still a lot to be studied regarding this topic, and we understand that we need to perform other cases for better conclusions. The fact is that, as of now, with only one case performed, the technique conceived by Gaiotto et al. has already shown to be promising, as it may provide a low-cost and effective alternative for patients with fixed pulmonary hypertension.⁸ Could this be the rebirth of heterotopic transplantation, this time with a new configuration? This could give hope to patients in palliative care who will never have access to long-term mechanical devices.

Keywords

Heart Transplantation; Heart Failure; Hypertension, Pulmonary

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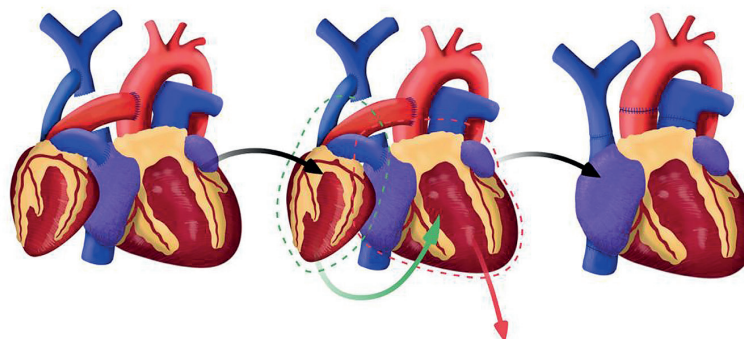


Figure 1 – Images demonstrating the technical modification of heterotopic transplantation and, subsequently, the final aspect of the second stage of the procedure.

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