

# Anesthesia for Heart Transplantation

Davinder Ramsingh, MD<sup>a,\*</sup>, Reed Harvey, MD<sup>b</sup>, Alec Runyon, MD<sup>a</sup>,  
Michael Benggon, MD<sup>a</sup>

## KEYWORDS

- Heart transplantation
- Criteria for heart transplantation
- Right heart failure
- Circulatory support

## KEY POINTS

- The common primary diagnosis for patients undergoing heart transplantation has shifted over time along with an increase in bridge therapy with mechanical circulatory support.
- Donor age, gender, size, and presence of panel-reactive antibodies remain important factors for successful transplantation.
- Coordination of donor and receipt procedures, along with the appreciation for patients with end-stage heart failure having “fixed” stroke volumes are key for intraoperative management.
- Rapid assessment of cardiac function, in particular right ventricular function, and preparation for treatment strategies is crucial for posttransplantation management.
- Both short-term and long-term survival of heart transplant recipients has gradually improved over time.

## INTRODUCTION AND HISTORY

With advances in the pharmacologic and surgical treatment options for heart failure (HF) coupled with an aging population, the number of people with HF in the United States is expected to rise significantly. However, mortality for these patients remains at nearly 50% within 5 years of diagnosis.<sup>1</sup> Although left ventricular assist devices (LVADs) are able to prolong and improve quality of life for those with American College of Cardiology Foundation/American Heart Association (AHA)

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<sup>a</sup> Department of Anesthesiology, Loma Linda Medical Center, 11234 Anderson Street, MC-2532-D, Loma Linda, CA 92354, USA; <sup>b</sup> Department of Anesthesiology, Ronald Reagan UCLA Medical Center, University of California at Los Angeles, 757 Westwood Plaza, Suite 3325, Los Angeles, CA 90095-7403, USA

\* Corresponding author.

E-mail address: [dramsingh@llu.edu](mailto:dramsingh@llu.edu)

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**Key points**

- The number of patients with heart failure qualifying for cardiac transplantation is growing
- Immunosuppressive agents have dramatically improved success of heart transplantation
- The most common primary diagnosis has shifted over time from ischemic cardiomyopathy (ICM) to non-ICM
- The use of bridge therapy with mechanical circulatory support now exceeds 50%
- Both short-term and long-term survival of heart transplant recipients has gradually improved over time

stage D refractory HF (**Box 1**), heart transplantation (HT) remains the definitive treatment.<sup>2,3</sup>

The first successful human-to-human HT occurred in 1967.<sup>4</sup> In the year following, 102 HTs were attempted worldwide, with consistently poor results due to acute organ rejection and surgical inexperience. Two advancements in the detection and treatment of rejection in the 1970s transformed the landscape of HT. In 1973, Caves and colleagues<sup>5</sup> described the technique for transvenous endomyocardial biopsy for the diagnosis of immune rejection. Although this technique provided the means for identification of rejection, Jean-Francois Borel's<sup>6</sup> 1976 description of the immunosuppressive effects of cyclosporin A finally identified an effective preventive treatment.<sup>7</sup> This success translated to a worldwide exponential increase in the use of HT for the treatment of end-stage HF. Although HT volumes have been stable for years, with recent liberalization of donor criteria, HT volumes are increasing once again.<sup>8</sup>

**Box 1****Definition of advanced heart failure**

1. Severe symptoms of HF with dyspnea and/or fatigue at rest or with minimal exertion (NYHA class III or IV).
2. Episodes of fluid retention and/or reduced cardiac output at rest (peripheral hypoperfusion).
3. Objective evidence of severe cardiac dysfunction shown by at least 1 of the following: (1) LVEF <30%, (2) pseudonormal or restrictive mitral inflow pattern, (3) mean PCWP >16 mm Hg and/or RAP >12 mm Hg by PA catheterization, (4) high BNP or NT-proBNP plasma levels in the absence of noncardiac causes.
4. Severe impairment of functional capacity shown by any 1 of the following: (1) inability to exercise, (2) 6-minute walk distance 300 m, (3) peak  $\text{Vo}_2$  12 to 14 mL/kg per minute.
5. History of at least 1 heart failure hospitalization in the past 6 months.
6. Presence of all the previous features despite "attempts to optimize" therapy, including diuretics and GDMT, unless these are poorly tolerated or contraindicated, and CRT when indicated.

*Abbreviations:* BNP, B-type natriuretic peptide; CRT, cardiac resynchronization therapy; GDMT, guideline-directed medical therapy; HR, heart rate; LVEF, left ventricular ejection fraction; NT-proBNP, N-terminal pro-B-type natriuretic peptide; NYHA, New York Heart Association; PA, pulmonary artery; PCWP, pulmonary capillary wedge pressure; RAP, right atrial pressure;  $\text{Vo}_2$ , peak exercise oxygen consumption.

*Adapted from* Metra M, Ponikowski P, Dickstein K, et al. Advanced chronic heart failure: a position statement from the Study Group on Advanced Heart Failure of the Heart Failure Association of the European Society of Cardiology. *Eur J Heart Fail* 2007;9(6-7):685; with permission.

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