Surgical Treatment of Heart Failure

Robert S.D. Higgins, MD, MSHA[a,*], Ahmet Kilic, MD[b], Daniel G. Tang, MD[c]

KEYWORDS

- Surgical treatment of heart failure • Coronary revascularization
- End-stage myocardial dysfunction

KEY POINTS

- Coronary revascularization is the mainstay of surgical treatment of heart failure in patients with left ventricular ejection fraction less than 35% based on demonstration of viable or hibernating myocardium.
- Patients with end-stage myocardial dysfunction refractory to revascularization may require mechanical circulatory support as a bridge to transplantation or destination therapy.
- Mechanical circulatory support using left ventricular assist devices has developed as an effective means of circulatory support and end-organ perfusion; however, complications of left ventricular assist devices are common, including driveline infection, pump thrombosis, allosensitization, and gastrointestinal bleeding.
- Heart transplantation is the gold standard of biological replacement for end-stage congestive heart failure; however its long-term success and growth is limited by donor availability, perioperative infections, and cellular rejection as complications of chronic immunosuppression, as well as the development of malignancies and transplant allograft vasculopathy.

INTRODUCTION: EVOLVING BURDEN OF DISEASE

Cardiac surgery, as it is applied to patients with advanced heart failure, has evolved significantly in the past 50 years. From the time when anatomic replacement of the heart was conceived and executed by Lower, Shumway, and Barnard as the best definitive way to treat heart failure, advances in surgical technique, myocardial

Disclosure: The authors have nothing to disclose.
[a] Department of Surgery, Johns Hopkins Medicine, 720 Rutland Avenue, Room 759, Baltimore, MD 21205, USA; [b] Heart Transplantation and Mechanical Circulatory Support, Advanced Heart Failure Program, Clinical and Academic Affairs, Division of Cardiac Surgery, The Ohio State University Wexner Medical Center, Columbus, OH, USA; [c] Division of Cardiothoracic Surgery, Virginia Commonwealth University, MCV Campus, West Hospital, 7th Floor, South Wing, 1200 East Broad Street, PO Box 980068, Richmond, VA 23298-0068, USA
* Corresponding author.
E-mail address: Robert.Higgins@jhmi.edu

Surg Clin N Am 97 (2017) 923–946
http://dx.doi.org/10.1016/j.suc.2017.04.003
surgical.theclinics.com

protection during cardiopulmonary bypass, and evolution of mechanical circulatory support (MCS) have revolutionized the field. Along the way, several innovative approaches to ventricular restoration, myocardial revascularization by direct coronary and percutaneous interventions as hybrid procedures, and stem cell therapies have been attempted to mitigate the impact and pathophysiology of ischemic cardiomyopathy as a primary cause of heart failure. Landmark clinical trials, such as the Surgical Treatment for Ischemic Heart Failure (STICH) trial, document the challenges with managing these complex patients and the intense efforts necessary to study the natural history of the heart failure patients before, during, and after interventions designed to treat the growing heart failure patient population.

More than 5 million Americans suffer from heart failure and more than 250,000 die annually. Heart failure has been called the cardiovascular epidemic of the twenty-first century.[1] The diagnosis of heart failure carries an ominous prognosis, with a nearly 40% annual mortality despite optimal treatment with medications. Renin-angiotensin system inhibition with angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers in conjunction with beta blockers and aldosterone antagonists remain the cornerstone of optimal medical management.

ACE inhibitors, beta blockers, and other medical therapies have evolved to reduce the progression of heart failure and subsequent morbidity and mortality. The pharmacologic armamentarium has recently expanded with the introduction of angiotensin receptor and neprilysin inhibitors (valsartan-sacubitril) and sinoatrial node modulators (ivabradine).Other nonsurgical modalities in the treatment of heart failure include cardiac resynchronization therapy or implantable defibrillators and catheter-based interventions for the treatment of valvular heart disease. The rapid expansion and evolution in heart failure therapy underscores the need for integrated multidisciplinary treatment teams.

Current therapeutic interventions are focused on the appropriate assessment of myocardial dysfunction as a means to select the right patient for the appropriate procedure using state of the art myocardial viability testing and metabolic testing to determine if patients with advanced heart failure are candidates for conventional interventions, mechanical devices, or transplant. This is particularly germane in the era of aggressive percutaneous coronary interventions, multivessel percutaneous coronary intervention, left main stenting, and invasive valve procedures. Patients with nonischemic cardiomyopathy secondary to viral or congenital disease serve as a compelling group of patients with limited surgical options who present with advanced heart failure refractory to conventional medical therapies.

Advances in MCS with more efficient and less morbid ventricular assist devises, including potential enhancements in biventricular failure treatment using the total artificial heart (TAH) as a bridge to transplant (BTT), offer the potential to change the trajectory of this growing epidemiologic dilemma. The ultimate goal of creating a biologically compatible replacement for advanced heart failure is still the holy grail of surgical treatment and involves a combination of strategies, which are enumerated in this article.

HISTORICAL PERSPECTIVE

The introduction of the heart-lung machine and the ability to support vital end-organ and neurologic functions has enabled the surgical treatment of patients with heart failure.[2] In 1953, John Gibbon performed the first open heart procedure using the heart-lung machine. Evolution of this seminal work at the University of Minnesota using a bubble oxygenator enhanced safety and visibility for procedures.[3] Coronary