Concomitant mitral repair and continuous-flow left ventricular assist devices: Is it warranted?

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ABSTRACT

Background: Pre-existing mitral pathology is common in patients undergoing continuous-flow left ventricular assist device implantation. We sought to investigate whether concurrent mitral repair confers any advantage.

Methods: From March 2004 to October 2014, 374 patients received a continuous-flow left ventricular assist device. Of these, a total of 115 patients with pre-existing mitral regurgitation (MR) greater than moderate were identified and included in the analysis. Outcomes were compared between patients with concurrent mitral repair (n = 52 [45.2%]; Group A) and without repair (n = 63 [54.8%]; Group B).

Results: The mean age was 56.8 years and 25 (21.5%) were women. Patients in Group A were more likely to have undergone destination therapy (48.1% vs 11.1%; P < .001) and had a greater cardiopulmonary bypass time (125 vs 89 minutes; P < .001) than did patients in Group B. Longitudinal analysis using a generalized mixed-effects model demonstrated the odds of developing moderate or severe MR during device support were 86% lower for Group A patients (P < .001). Among those who were discharged alive, 9 (8.6%)—consisting of 1 (2.2%) in Group A and 8 (13.6%) in Group B (P = .039)—developed late right heart failure requiring a total of 13 readmissions (0.03 vs 0.15 readmissions per patient-year; P = .011). Multivariable competing risks regression revealed mitral repair to be a protective factor (hazard ratio, 0.16; 95% confidence interval, 0.03-0.94; P = .042) for late right heart failure occurrence.

Conclusions: Concurrent mitral repair appears to be efficacious in controlling MR after device implant. The fact that repaired patients developed late right heart failure less frequently than did patients without repair challenges the notion that concurrent repair is unwarranted. (J Thorac Cardiovasc Surg 2017;154:1303-12)

With the evolution of technology and patient management, continuous-flow left ventricular assist device (CF-LVAD) use has grown rapidly. In this context, the management of pre-existing valvular lesions has become a subject of interest. The management of native valve dysfunction in CF-LVAD recipients has been discussed mainly with regard to aortic and tricuspid valves. By contrast, pre-existing mitral pathology and its clinical influence has not been extensively investigated, despite being the most prevalent valvular pathology. The
 mechanism of mitral regurgitation (MR) in most patients receiving device therapy is functional, resulting from tethering of the leaflets secondary to left ventricular (LV) dilatation and a change in geometry from an elliptical to spherical shape. With device decompression, LV dimensions decrease and allow mitral leaflets to coapt, making MR insignificant in most patients. Furthermore, the severity of pre-existing MR does not necessarily provide independent prognostic information. The current consensus statement does not recommend concomitant mitral interventions, regardless of severity, unless there is expectation of ventricular recovery. However, it is of critical importance to note that previous studies were lacking a surgical control group. Therefore, it remains unclear whether patients with pre-existing MR would benefit from repair at device insertion. We have reviewed our experience of CF-LVAD implantation with and without mitral repair to demonstrate the outcomes and ultimately elucidate its clinical implications.

**METHODS**

The Columbia University Institutional Review Board approved all aspects of the study.

**Patients and Study Design**

We retrospectively reviewed 374 consecutive patients who underwent CF-LVAD implantation between March 2004 and October 2014. Of these, 35 patients with previous mitral procedures and 1 with concomitant mitral replacement were excluded. A total of 115 patients with baseline pre-existing MR greater than moderate were identified and included in the analysis. Patients were grouped into Group A (52 [45.2%] with concomitant mitral repair) and Group B (63 [54.8%] without repair). Abstracted data included the following: patient demographic, clinical, and treatment variables, cardiopulmonary bypass (CPB) time, blood product use, dose of vasoactive drugs at device implantation, perioperative and follow-up echocardiographic variables, adverse events, and survival. Follow-up was completed as of July 1, 2015, with a completion rate of 98.3%. The types of CF-LVADs implanted comprise HeartMate II (Thoratec, Pleasanton, Calif) (n = 86; 74.8%), HeartWare HVAD (HeartWare Inc, Framingham, Mass) (n = 21; 18.3%), Ventrisent (Ventracor Ltd, Chatswood, New South Wales, Australia) (n = 3; 2.6%), DuraHeart (TerumoHeart, Ann Arbor, Mich) (n = 2; 1.7%), and DeBakey VAD (MicroMed Technology Inc, Houston, Tex) (n = 3; 2.6%).

**Assessment of MR**

Details of our protocol have been reported elsewhere. In brief, serial transthoracic echocardiography and intraoperative transesophageal echocardiography evaluations, reviewed by the same echocardiographers at our institution, were performed in all patients. The presence of MR was determined at baseline before device implant, and until time of last follow-up or censoring event as clinically indicated. Each valve was evaluated visually in the parasternal short- and long-axis views by transthoracic echocardiography and was graded as none, trace, mild, mild–moderate, moderate, moderate–severe, and severe on an interval scale based on the color flow jet according to the recommendations of the American Society of Echocardiography. Regarding speed optimization, we followed the current recommendations to ensure middle interventricular septum position and intermittent aortic valve opening while attempting to maintain less-than-mild MR.

**Right Heart Failure Definition and Management**

Right heart failure (RHF) during index hospitalization was captured using the Interagency Registry for Mechanically Assisted Circulatory Support definition. Late RHF was defined as RHF requiring rehospitalization after indexed hospital discharge and medical/surgical treatments, including strengthening of diuretics, inotropic support, and right ventricular assist device (RVAD). Patients who were hospitalized due to symptoms of heart failure routinely underwent interrogation of the device and hemolysis workup to rule out device failure and thrombosis, implantable cardioverter-defibrillator/pacemaker interrogation to identify presence of arrhythmia that may have exacerbated RHF, and echocardiography for optimization of pump speed. Initial medical management included intensification of diuretic therapy. Patients with severe RHF, as defined by the presence of end-organ dysfunction, underwent right heart catheterization, with inotropic therapy initiated if needed. In patients with medically refractory RHF, RVAD implantation was then considered.

Detection of late RHF was based on clinical findings, including edema, weight gain, ascites, and jugular venous distention. Heart failure related to device failure, such as device thrombosis, inflow and outflow obstruction, or drive-line fracture, was not considered late RHF.

**Indications and Operative Technique of Mitral Repair**

The indication for mitral repair is pre-existing MR greater than moderate. The decision to perform a repair was based on clinical characteristics in each patient, essentially bridge-to-transplant patients with anticipated prolonged device support (such as blood type O, large body size with body mass index [BMI] > 35) and patients with destination therapy intent at time of device insertion. Tricuspid repair was performed for moderate or greater tricuspid regurgitation. Tricuspid ring annuloplasty was the first choice of procedure. In the case of severe leaflet tethering or destruction, tricuspid replacement was performed with a bioprosthetic valve.

**Annuloplasty.** This is our preferred approach for repair. After establishing CPB with standard aortobivcal cannulation, mitral repair was performed with a beating heart. A standard right-sided left atriotomy was made. A commercially available annuloplasty ring (Table 1) was implanted using interrupted 2-0 polyester sutures placed circumferentially around the annulus in mattress fashion (Figure E1, A). The annulus was usually undersized by 2 sizes. The atriotomy was then closed.

**Edge-to-edge repair.** Edge-to-edge repair (Alfieri stitch) was chosen when other concomitant valve repair/other procedures were performed or ring annuloplasty was not possible due to severe mitral annular calcification. For instance, when concomitant aortic valve repair was performed, CPB was established with the standard aortoatrial cannulation followed by aortic crossclamping and cardioplegia administration. A central
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