Identical tricuspid ring sizing in simultaneous functional tricuspid and mitral valve repair: A simple and effective strategy

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Objective: Mitral valve repair for functional mitral regurgitation is common. Concomitant tricuspid valve repair for associated functional tricuspid regurgitation has gained favor. Controversy exists regarding annuloplasty sizing for tricuspid valve repair.

Methods: Patients with heart failure having functional mitral regurgitation at the University of Michigan and undergoing mitral valve repair and tricuspid valve repair using identical sized annuloplasty rings between April 2007 and January 2012 were identified. Demographic and clinical records were retrospectively reviewed. Institutional review board approval was obtained for this study.

Results: Fifty-three patients met inclusion criteria. Mean age was 65 ± 1.7 years. Preoperative New York Heart Association class was III or IV in 81% (43) and mean left ventricular ejection fraction was 33% ± 2.2%. All patients had moderate or greater mitral regurgitation preoperatively and moderate or severe tricuspid regurgitation or a preoperative tricuspid annulus diameter greater than 40 mm. There was no 30-day mortality. Mean immediate postoperative tricuspid valve gradient was 1.75 ± 0.12 mm Hg and was 2.3 ± 0.19 mm Hg at 4 weeks. Four weeks postoperatively 88% (42/48) of patients had tricuspid regurgitation considered to be mild or less. There was no significant decline in right ventricular function by echocardiography over this time period.

Conclusions: Functional tricuspid regurgitation can be repaired using an undersized rigid annuloplasty ring. Our data suggest that an identical sizing strategy can be used for tricuspid valve repair, as was used for mitral valve repair, without development of tricuspid stenosis or negative effect on right ventricular function. This method seems to prevent recurrence of significant tricuspid regurgitation. The technique we describe provides effective and reproducible results. (J Thorac Cardiovasc Surg 2014;147:611-4)

Functional tricuspid regurgitation (TR) is an important clinical condition for which surgical repair is being increasingly applied.[1,2] An estimated 1.6 million patients in the United States have moderate or greater TR.[3] Functional TR is usually a secondary result of left-sided heart failure.[4] Typically associated with myocardial or valvular dysfunction, right ventricular (RV) enlargement and asymmetric tricuspid annular dilation lead to TR. Patients with untreated TR can have significant clinical symptoms including fatigue, decreased exercise tolerance, edema, and ascites.[1]

TR has been shown to increase mortality independent of left ventricular ejection fraction, RV size, and RV function.[5] Of special interest is the development of significant TR years after mitral valve (MV) surgery. A growing body of literature supports the notion that ''benign neglect'' of TR at the time of MV surgery (especially in the presence of tricuspid annular dilation) can no longer be considered acceptable.[2,5]

Additionally, reoperations for recurrent TR are associated with high surgical risk (up to 37% in-hospital mortality).[6,7] Because of this higher risk, more aggressive treatment of TR at the time of initial surgery may be prudent. This is especially important inasmuch as TR does not reliably resolve, and frequently progressively worsens, even after successful MV surgery.[6,8,9]

If present at the time of MV surgery, functional TR can usually be treated with ring annuloplasty.[8] Successful tricuspid valve (TV) repair results in a significant improvement in recurrent TR, RV function, event-free survival, and functional outcome.[2,7] The American College of Cardiology/American Heart Association 2006 Practice Guidelines for the surgical management of patients with TR give a class I indication for TV repair in any patient with severe TR undergoing MV surgery.[10] Current European Society of Cardiology 2007 guidelines recommend (class IIa) tricuspid repair for moderate TR with a dilated (>40 mm) annulus in a patient undergoing left-sided surgery.[11]

Significant advances have been made in disease-specific repair strategies for mitral regurgitation, but less is known

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Abbreviations and Acronyms
CI = confidence interval
MV = mitral valve
RV = right ventricular
TR = tricuspid regurgitation
TS = tricuspid stenosis
TV = tricuspid valve

about similar repair strategies for concomitant TR. Many would agree that rigid ring TV annuloplasty offers a better long-term solution than a nonring approach.[8,12,13] In a study of 790 patients undergoing TV repair via 4 different methods, McCarthy and associates[8] found that recurrent TR became more severe faster and was more prevalent after a De Vega compared with a ring annuloplasty. Others have corroborated the finding of late recurrence of significant TR after De Vega, including a prospective randomized trial by Rivera and associates[12] comparing De Vega with the Carpentier-Edwards ring.

Controversy exists regarding size selection for TV annuloplasty.[8,13-15] Methods of sizing have varied. Some have warned against undersizing the TV annuloplasty to avoid a theoretical risk of tricuspid stenosis (TS) or RV failure from loss of "pop-off," whereas others have suggested complex methods such as using a ratio of 2.43:1 between the anteroposterior and septal segments as a guide.[15]

This study reviewed midterm outcomes of patients who had both mitral regurgitation and TR, who underwent MV repair with a rigid complete annuloplasty ring, and who simultaneously underwent TV repair using a simple strategy of identical sized TV annuloplasty ring.

PATIENTS AND METHODS

Patients

From April 2007 to January 2012, all patients with congestive heart failure at the University of Michigan Medical Center undergoing MV and TV repair using identical sized annuloplasty rings (either 26 or 28 mm) were identified. Patients with endocarditis, rheumatic valve disease, or organic disease of the TV leaflets, including congenital anomalies, were excluded. Patient demographics, clinical characteristics, echocardiograms, operative reports, hospital records, and clinic notes were collected from the prospective University of Michigan Cardiovascular Databank, and a retrospective analysis was performed. Institutional review board approval was obtained for this study.

Methods

Annuloplasty ring type was determined by surgeon preference at the time of operation. In general, complete rigid rings were used in the mitral position. The TV ring size was matched to the MV annuloplasty ring size. Tricuspid rings were all rigid remodeling rings.

When we were collecting data from echocardiogram reports, descriptors such as "mild to moderate" or "moderate to severe" were recorded in our database as the greater of the 2 values (ie, "mild to moderate mitral regurgitation" was recorded as moderate). In cases in which echocardiogram reports documented regurgitation as "none," "1+," "2+," "3+," or "4+," these were reported as "none," "trace," "mild," "moderate," or "severe" in our database, respectively.

Descriptive statistics were used to describe the study population. Tricuspid gradient is reported as mean ± standard error of means. Decline in RV function over time was evaluated for patients who had preoperative and 4-week postoperative echocardiograms available that specifically reported on RV function. A 70% confidence interval (CI) for the proportion of patients with increased RV dysfunction 4 weeks postoperatively was calculated.

RESULTS

Fifty-three patients underwent combined MV and TV repair using identical sized rings between April 2007 and January 2012. Patient characteristics are summarized in Table 1. The mean age was 65 ± 1.7 years and 43% were male. Preoperative New York Heart Association functional class was III or IV in 81% (n = 43) and mean left ventricular ejection fraction was 33% ± 2.2%. All patients had moderate or greater mitral regurgitation before surgery. All patients also had preoperative moderate or severe TR or a preoperative tricuspid annulus diameter greater than 40 mm. Concomitant procedures included coronary artery bypass grafting (n = 5), the maze procedure (n = 24), the Acorn procedure (n = 2), and atrial septal defect/patent foramen ovale closure (n = 7). Sixteen were reoperations. The average cardiopulmonary bypass and crossclamp times were 90 ± 2.2 minutes and 71 ± 2.6 minutes, respectively.

Four-week follow-up data were available for 48 (91%) patients and intermediate-term data were available in 9 (17%). There was no 30-day mortality. There were 3 patients who required prolonged ventilatory support, 1 stroke, and 4 late deaths. Preoperative and postoperative TR, TV gradient, and RV function are reported in Table 2. The mean immediate postoperative TV gradient was 1.75 ± 0.12 mm Hg and at 4 weeks' follow-up it was 2.3 ± 0.18 mm Hg. Four weeks postoperatively, 88% (42/48) of patients had TR considered to be mild or less on a scale of "none," "trace," "mild," "moderate," or "severe." At 4 weeks, 10% (5/48) had moderate TR (compared with 36% preoperatively) and 2% (1/48) had severe TR (compared with 34% preoperatively). RV function was specifically evaluated by echocardiography preoperatively and 4 weeks postoperatively in 30 patients. A 70% CI was calculated around the percentage of patients whose RV function worsened during this time frame. Of the 30 patients, 30% showed worsening of their RV function (CI 70%, 21, 41). In addition, 33% (CI 70%, 24, 44) showed improvement in their RV function at the time of 4-week postoperative echocardiogram. No patient had any clinical evidence of RV failure at 4 weeks of follow-up.

DISCUSSION

Surgery of the TV for significant TR should occur at the time of MV surgery. Most now agree that surgical treatment