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Midterm Results of Pericardial Strip Annuloplasty For Repair of Functional Tricuspid Regurgitation

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Backgrounds: Functional tricuspid regurgitation due to left sided valvular lesions should be properly managed. It could affect functional state and survival. Many surgical techniques were developed with varying results.

Objectives: We investigated our midterm results of repair of functional tricuspid regurgitation using autologous pericardial strip.

Patients and methods: From January 2008 to December 2013, 50 patients (male: female 34:16, with a mean age 34 ± 14 years) with moderate or severe tricuspid regurgitation were enrolled in our study. All had associated left sided valvular lesions (mitral in 33 patients, aortic in 2 and double valves in 15) that were managed by mechanical valve replacement. Tricuspid regurgitation was corrected by pericardial strip annuloplasty. The mean follow up period was 3 years.

Results: The overall survival rate was 98%. Manifestation of right heart failure improved in 14 of 16 patients (87.5%). Forty seven patients (94%) stayed in NYHA class I postoperatively. Freedom from recurrent moderated TR was 94% and 92% at one year and three years respectively.

Conclusion: Pericardial annuloplasty for repair of functional tricuspid regurgitation is an easy, inexpensive, reproducible and efficient technique.

KEY WORDS: Functional tricuspid regurgitation, Pericardial annuloplasty, repair

Tricuspid regurgitation (TR) is mostly functional due left sided valvular lesions or myocardial disease. The underlying mechanism seems to be progressive annular dilatation and decreased leaflet coaptation.(1) Tricuspid regurgitation is usually managed during operations involving other valvular lesions. If left untreated, TR negatively influences functional state and survival.(2) While repair methods such as De Vega has good early results, still the late recurrence of TR is significant (3).

Here we present our experience in tricuspid valve repair using strip of autologous pericardium for repair of functional tricuspid regurgitation.

Patients and methods

This study was conducted under protocol approved by institution research ethics committee in King Abdul Aziz University Hospital (KAUH).

From January 2008 to December 2013, 50 patients underwent tricuspid annuloplasty for functional TR as part of their cardiac surgical procedure at KAUH. Patients were identified and preoperative, operative, and postoperative variables were retrieved from the prospective KAUH Cardiac Surgery Database.

Operative Techniques

All patients were operated upon via median sternotomy. Cardiopulmonary bypass was conducted using aortic and bicaval cannulation in the usual manner. Myocardial protection was achieved by warm antegrade blood cardioplegia

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The left sided valve lesions were managed first by valve replacement. Then the tricuspid valve was approached through right atriotomy with the aorta clamped or on beating heart. The tricuspid valve was carefully assessed.

We used the technique developed by Chang et al (4). We started by harvesting and preparing an autologous pericardial strip (8 to 10 cm in length, 5 to 8 mm in width). The smooth surface was kept upwards and was sutured to the tricuspid annulus with interrupted mattress sutures of 2-0 Ethibond suture (Ethicon, Inc, Somerville, NJ), starting from the posteroinferior aspect of the septal leaflet to the anterior septal commissure. Two- to three-millimeter-interval sutures in the autologous pericardial strip and 5 to 6 mm-interval sutures in the tricuspid annulus. By this way the tricuspid annulus could be shortened. (Fig. 1) After the procedure, we measured the annulus diameter using a valve sizer. In all patients, intraoperative assessment of the valve was done either by direct injection of normal saline solution 0.9% in the right ventricle (RV) through the valve in arrested heart or suctioning the coronary sinus in beating heart to evaluate any regurgitated flow from right ventricle to right atrium. Intraoperative transesophageal echocardiography was used to confirm adequacy of the repair. Transthoracic echocardiography combined with color Doppler flow study were used to assess TR grade pre and postoperatively. Median time of echocardiographic assessment was 1 year. TR was graded as 0 for no regurgitation, 1 for mild, 2 for moderate, 3 for moderate to severe, and 4 for severe.

Follow up

Follow-up data including age, sex, symptoms, functional status, echocardiographic data were obtained for every patient. Assessment was done at one month, 6 months, and 3 years postoperatively.

Statistical Analysis

The data were entered and analyzed using the statistical package for social sciences (SPSS Inc, Chicago, IL, USA), version 16.00. The quantitative data were presented in the form of mean, standard deviation and range, and were compared using independent t-test. Chi-square test was used to compare qualitative data. We considered statistical significance when P value < 0.05 and confidential interval of 95 percent.

Results

We operated 50 patients with moderate or severe functional TR in conjunction with other valve lesions. Table (1) showed the preoperative characteristics

All patients had associated left sided rheumatic valvular lesion. Mitral valve pathology accounted for 96% of patients. No previous cardiac operations were performed. RV failure manifestations (jaundice, neck vein congestion, ascites, enlarged liver and pitting edema) were found in 16 patients (32%).

Age (mean ±SD)	34±14 (16-69)
Female sex	16 (32%)
Duration of illness	5.2 years ±1.04
Preop NYHA class	
VI	12
III	26
II	12
Manifestation of RV dysfunction	16
EF mean±SD	0.543 ± 0.834
≤ 0.4	2
TR	
Moderate	10
Moderate to severe	23
severe	17
TR	
+ mitral disease	33(66%)
+ aortic disease	2(4%)
+ double	15(30%)
PH	
Mean ± SD	75.59±13.12

Table 1. The preoperative characteristics

Operative data

Concomitant mitral valve surgery was performed in 66% of patients, and aortic valve surgery in 5 %. Triple valve surgery was performed in 29 % patients.

Operative data including associated valvular procedures, mean bypass time, number of tricuspid repair on beating or arrested heart and mean cross clamp time are shown in table (2)

Variable	values
Tricuspid + mitral	33
+ aortic	2
+ double	15
Bypass time (min):	
Tricuspid + mitral	92.80±7.75
+ aortic	105±7.78
+ double	124.45±12.65
Clamping time (min):	
Tricuspid + mitral	66.50±5.73
+ aortic	99.50±4.2
+ double	96.18±8.18
Tricuspid repair on beating heart	40 patients(80%)
Tricuspid repair on arrested heart	10 patients (20%)
Mean size of TV annulus (mm)	32.08±0.81
Inotropic support	44 patients (88%)

Table 2. Operative data

Intraoperative assessment of tricuspid valve repair showed competent valve in all cases.

Mortality

There was one (2%) early mortality (within 30 days of surgery or during the same hospitalization). That was a 20 years male patient with sickle cell anemia, renal failure on dialysis and low EF (0.40). He was operated for mitral valve replacement and TV repair and died on postoperative day 11 because of low cardiac output. No late deaths were recorded.

Morbidity

One patient was explored for bleeding and one developed mediastinitis that necessitated debridement and rewiring. Both patients recovered well and were discharged in stable condition. No complications were found related to pericardial strip annuloplasty e.g. dehiscence, thrombosis, calcification.

Follow up

Follow up was complete. Two patients persisted with RV failure manifestations and continued medical treatment. They had recurrent TR more than grade II. The remaining patients showed clinical improvement and stayed in NYHA class I. No cardiac reoperations occurred. All left sided prosthetic valves were well functioning. Transthoracic echocardiographic study of tricuspid valve repair was done pre-discharge, at one year (early) and at 3 years (midterm). Freedom from recurrent moderate TR was 94% and 92% at one year and three years respectively. Data are shown in table (3).

Variable	values	
	No.	%
Early TR		
≤ mild	47	94
Moderate	2	4
severe	1	2
Midterm TR		
≤ mild	46	92
Moderate	3	6
severe	1	2

Table 3. Postoperative echocardiographic assessment of TV

Discussion

Functional TR represents a challenge to cardiac surgeons regarding indications and choice of proper repair method. It is crucial to achieve satisfactory anatomical and physiological correction to ensure favorable long term results (5). Residual TR negatively affects functional status of patients postoperatively

and redo operations for isolated TR have high mortality rate (6). The concept that TR will improve after correcting left sided valvular lesions might be justified only for mild TR with normal TV annulus and valvular structure (7). Recent AHA/ACC guidelines recommended intervention for patients with severe TR who are undergoing surgery for left sided valvular lesions (Class I, level evidence C). Repair should also be considered in cases of mild or moderate TR with either tricuspid annular dilatation (>40 mm diameter or 21 mm/m² diameter indexed to body surface area on preoperative TTE; >70 mm diameter on direct intraoperative measurement) or prior evidence of right heart failure (Class IIa, level evidence B). (8) Many studies emphasized the importance of TV annulus in repair decision irrespective of degree of TR (9). In our study we included 10 patients with preoperative moderate TR for repair. Considering the high mortality rate of tricuspid valve replacement, many repair methods were developed for better outcome (10). De Vega repair is simple, easy, not expensive method with good early results. However, long term results reported by some series showed high recurrence rate particularly in patients with pulmonary hypertension or severe annular dilatation (3,11). There is an increasing evidence to support ring annuloplasty over conventional De Vega stitch with respect to recurrent TR and survival (12). Repair without ring exposes the tricuspid annulus to elevated PAP and RVSP with consequent dilatation and regurge. As an alternative to rigid rings, Chang et al constructed flexible autologous pericardial ring in 1998. In a comparative study including 117 patients repaired by suture annuloplasty (De Vega or Kay) and 217 patients repaired by autologous pericardial strip they found the latter superior in terms of long-term recurrence-free survival (4). Thirty-three (11.1%) of their patients had significant residual TR. We believe that such method of repair might be very appropriate especially with our patients with rheumatic valvular disease and pulmonary hypertension. It has advantages over rigid rings being flexible thus can maintain annular contraction and contribute to RV function. In addition, it is without cost and this economic advantage is appreciated especially in developing countries. We applied the same surgical technique described by Chang et al but we modified it regarding estimating the length of pericardial strip. Chang et al calculated the length as approximately $\frac{2}{3} \times \frac{1}{4} \times 2 \pi R$ (R = radius of tricuspid valve). We applied a simple way that we decided it according to the appropriate tricuspid obturator sizer, by measuring along its rounded margins between the two notches (13). We had 4 patients (8%) with ≥ grade II residual TR which is comparable to other studies (4, 14,15). Two of those patients continued to have manifestations of RV failure and under medical treatment. We may decide for redo operation if they do not improve. Otherwise the remaining patients showed marked clinical improvement of RV function and stayed in NYHA class I. Our study has some limitations. It is a retrospective observational study including few number of cases. We need to carry out a prospective randomized study

to compare it with De Vega stitch and rigid annuloplasty in the future. And lastly we showed early and mid term results which are encouraging, so long term results would be very valuable.

In conclusion, we found repair of functional TR using autologous pericardial strip an easy, reproducible, inexpensive and efficient technique.

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