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Review Article

Early outcome of tricuspid repair for functional tricuspid regurgitation associated with left-sided valve lesions: modified flexible band versus ring annuloplasty

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Abstract

Background
Repairing functional tricuspid regurge during left heart valve surgery in not uncommon. However, the technique of choice to achieve long-term results is still controversial. Although the DeVega technique was widely used, most surgeons have shifted to annuloplasty bands or rings to avoid early high failure rates and increased incidence of recurrent significant regurge.

Objective
To compare short-term results (1 year) of flexible band as a piece of tube graft (polytetraflouroethylene) annuloplasty versus ring annuloplasty for functional tricuspid regurge associated with left-side valve lesions.

Patients and methods
We prospectively studied 100 patients who underwent tricuspid repair during left-sided valve surgery at National Heart Institute. Thirty-one patients had ring annuloplasty whereas 69 patients had modified band annuloplasty. Echocardiography was done at discharge and after 1-year follow-up.

Results
There was no mortality in both groups. Mean age was 31 ± 10 years in group A and 30 ± 7 years in group B. Female sex was 67% in group A and 61% in group B. Five patients had mitral valve repair in group A versus four patients in group B, and the rest of the patient had their valve replaced. The mean cross-clamp time was longer in group B (117 ± 23) compared with group A (105 ± 19), with no significant difference between the two groups. There was no significant difference between the two groups regarding cardiopulmonary bypass time.

Conclusion
Tricuspid valve repair using modified band annuloplasty offers excellent results, which are comparable to ring annuloplasty over 1-year follow-up.

Keywords: Left-sided valve lesions, modified band annuloplasty, ring annuloplasty, tricuspid repair

Introduction

Patients with left-sided valve disease commonly have significant degree of functional tricuspid regurge, especially when associated with pulmonary hypertension [1].

Historically the long-held misperception that Tricuspid regurge (TR) would resolve after left-sided disease was corrected has led surgeons to adopt a conservative approach in treating TR, and moderate TR was not confronted by most surgeons [2].

Neglected moderate tricuspid regurge at the time of surgery for left-sided pathology may progress to severe form over years causing severe symptoms and impairing the right ventricular (RV) function. This is usually managed by maximizing medical treatment, and redo-tricuspid valve

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surgery is considered only after advanced RV dysfunction has been developed. This eventually carries high rates of morbidity and mortality [3].

The DeVega technique offers less durable outcomes when compared with device tricuspid valve annuloplasty [4,5]. In the modern era, there is no consensus of the superiority of one annuloplasty device over the other in terms of long-term control of tricuspid regurgitation [6].

In this study, we examined early postoperative outcome over 1 year after tricuspid annuloplasty for functional TR associated with left-side valve lesions. We compared modified flexible band using sized polytetraflouroethylene (PTFE) tube graft annuloplasty with ring annuloplasty.

Patients and Methods

From May 2015 to February 2017, 100 consecutive patients were studied prospectively at National Heart Institute. All patients had surgery for left-side valve lesions (mitral and/or aortic valve surgery) with concomitant tricuspid repair for associated functional tricuspid regurge. Patients with ischemic heart disease needing coronary artery bypass grafting and redo cases were excluded. Moreover, patients with organic tricuspid valve disease, patients undergoing concomitant aortic aneurysm or root surgery, patients with infective endocarditis, and low ejection fraction cases were excluded.

The studied patients were divided into two groups: group A included 69 patients who had tricuspid valve repair using modified flexible band (PTFE band) technique, whereas group B included 31 patients who had rigid ring annuloplasty.

Preoperative data

Table 1 represents the preoperative data for both groups.

Table 1: Preoperative data

	Group A	Group B	*P*
Number of patients	69	31	
Females (%)	67	61	0.713 (NS)
Average age (mean±SD)	31±10	30±7	0.999 (NS)

Table 2: Operative data

	Group A (69 patients)	Group B (31 patients)	*P*
Mitral repair	5	4	
Mitral valve replacement	55	22	
Aortic valve replacement	5	2	
Double-valve replacement	4	3	
Cross-clamp time/min (mean±SD)	105±19	117±23	0.836 (NS)
CPB time/min (mean±SD)	126±21	131±26	0.241 (NS)

No significant differences were noticed between both groups regarding the cross-clamp time and cardiopulmonary bypass time; however, longer cross-clamp time was noticed in the ring annuloplasty group.

Operative technique

The surgical approach was via conventional median sternotomy; standard aorto-bicaval cannulation with snares was used to initiate cardiopulmonary bypass. Cold intermittent antegrade cardioplegia via the aortic root was used to achieve myocardial protection together with systemic cooling to 28°C and topical ice slush to protect RV. Intraoperative transesophageal echocardiography was used before cardiopulmonary bypass to evaluate mitral valve and the degree of tricuspid regurge. Mitral valve repair was done whenever the valve was repairable; usually, Carpentier-Edwards Physio or Medtronic 638R ring was used. In the rest of the patients, mitral and/or aortic valve replacement was done with tricuspid valve annuloplasty performed under cardiac arrest. Closure of suture lines, deairing, and weaning from bypass were done in ordinary manner. The following table shows the operative data for both groups (Table 2).

A provisional saline infusion test was used intraoperatively to confirm adequate leaflet coaptation and competent valve. This was followed by intraoperative transesophageal echocardiography after discontinuation of cardiopulmonary bypass to exclude significant degree of regurge and to ensure satisfactory results.

Tricuspid valve annuloplasty details

Flexible band

Sixty-nine patients had their functional tricuspid regurge corrected using a piece of flexible PTFE tube graft commonly used for aortic root replacement. The band had a fixed length of 50 mm to reduce the annular circumference to 78.5 mm (circumference of #25 mm sizer) in all patients [7].

The first suture was taken at the level of anteroseptal commissar, and the last suture in the zone of the septal annulus 28.5 mm from the first one. The remaining sutures (2/0 ethibond braided sutures) were placed circumferentially along the hinge of the anterior and posterior leaflets. Annular plication was then obtained by adapting all sutures to 50-mm long band [7].

Rigid ring

Thirty-one patients were corrected with rigid ring using either Medtronic 3D 690R or Edwards MC3 Tricuspid ring. After proper sizing of the ring, 2/0 ethibond braided sutures without Teflon pledgets are passed circumferentially starting from anteroseptal commissar to just before trigon sparing the area of conduction. The sutures corresponding to the three commissars are first passed throw the ring at their marked spots, and the rest of sutures are then distributed along ring between the commissural sutures.

Echocardiographic assessment

Patients had postoperative transthoracic echocardiography at discharge and after 1-year follow-up by an experienced operator to evaluate and monitor degree of tricuspid regurge.

Statistical analysis

The study group was categorized as follows: 69 patients (modified flexible band) in group A and 31 patients (rigid ring) in group B.

All data are represented as mean, SD and numbers. All statistical analysis was done using Minitab 17 (LLC, Pennsylvania).

Qualitative data were represented as numbers and percentage. Association between categorical variables was tested using χ^2-test. When 25% of the cells have expected count less than 5, using two-sample Poisson rate procedure performs a hypothesis test and calculates a confidence interval for the difference between the occurrence rates of two Poisson models.

Meanwhile, hypothesis testing using *P* value was evaluated as follows:

(1) Nonsignificant when the probability of error is more than 5% ($P > 0.05$)
(2) Significant when the probability of error is less than 5% ($P < 0.05$)
(3) Highly significant when the probability of error is less than 0.1% ($P < 0.001$). The smaller the *P* value obtained, the more significant are the results.

Results

There was no mortality among both groups throughout the study. There was no significant difference regarding postoperative need for inotropic support, mechanical ventilation time, and ICU and hospital stay between the two groups. Table 3 shows the postoperative course for both groups.

Echocardiography was done for all patients of both groups at discharge. Table 4 shows the different grades of tricuspid regurge at discharge.

Follow-up was done 1 year postoperatively by echocardiography. Overall, 53 patients from group A completed the follow-up period versus 23 patients from group B. The findings are listed in Table 5.

Table 3: Immediate postoperative course

	Group A	Group B	*P*
Need for inotropic support	30	13	0.279 (NS)
Mechanical ventilation time/h (mean±SD)	9±2	9.5±3	0.335 (NS)
ICU stay/days (mean±SD)	2.5±0.7	2.4±0.7	0.718 (NS)
Hospital stay/days (mean±SD)	8±1.2	8±0.9	0.593 (NS)

Table 4: Echocardiography at discharge

Degree of regurge	Group A (69 patients)	Group B (31 patients)
Trivial	10	6
Mild	47	22
Moderate	12	3
Moderate to severe	–	–
Severe	–	–

Table 5: Echocardiography at 1 year

Degree of regurge	Group A (53 patients)	Group B (23 patients)
Trivial	3	1
Mild	36	18
Moderate	12	4
Moderate to severe	2	–
Severe	–	–

Discussion

Severe tricuspid regurge secondary to RV dysfunction accompanying left-sided valve diseases represents a risk factor for poor outcomes and mortality after surgery [8]. However, the fate of unrepaired TR remains unclear. Proper correction of left-sided valve disease does not guarantee improvement of associated TR; on the contrary, the regurge may persist or even worsen by time [8–11]. However, redo surgeries to correct residual or recurrent significant TR are usually associated with high incidence of mortality and poor long-term results [8,12]. This all would make it highly favorable to properly detect and correct significant TR at the time of initial operation [8–14].

Although the technique of choice to repair a tricuspid valve is controversial, the DeVega procedure offers a simple and fast technique which was widely used by most surgeons [15]. However, several recent studies have reported a high incidence of recurrent significant TR associated with this technique, particularly in patients with huge annular dilatation, and have recommended the use of annuloplasty techniques to ensure durable results [16,17].

In the modern era, annuloplasty repair of tricuspid valve is the preferred surgical treatment for functional TR. The recurrence rate ranges from 2.5 to 5.5% after 1-year follow-up and defined as postoperative moderate or severe TR [18]. To ensure long-term results, a considerable degree of annular reduction is required, and this is best achieved by bands or rings [10,18–21].

However, despite today's popular use of annuloplasty devices to treat functional TR, comparison of bands versus rings annuloplasty has received little attention. Both are likely effective in controlling regurgitation with some privilege of rings over bands in terms of lower rates of recurrence [6,9].

In this study, we compared modified flexible band versus rigid rings annuloplasty for functional TR associated with left valve heart diseases. The modified flexible band (PTEF) was selected as a safe alternative for commercial flexible band which was not consistently available owing to lack of resources.

There was no statistically significant difference between the two groups regarding the early postoperative outcome and at 1-year follow-up. Although longer operative time has been observed in the ring group, this does not rise to a statistically significant level. This may be owing to the complexity of

the technique. However, few numbers of patients and short follow-up period might be limiting factors.

Gatti *et al*. [22] had similar results to our study. They studied 462 patients who underwent their functional TR repaired either by flexible band (345) or rigid ring (117) in association with other cardiac procedures. They concluded that both groups seemed to be equally effective in the long-term treatment of functional TR, despite that ring group showing more complete patterns of right heart reverse remodeling over long-term periods.

In a meta-analysis done by Wang *et al.* [23] comparing the two technique in treating TR, they found that both rigid ring and flexible band have acceptable outcomes, with some advantage for rigid ring, offering more stable rates of TR and long-term freedom from recurrent regurgitation.

The overall results were satisfactory and comparable to recent studies in that both techniques were effective in managing functional TR associated with left-sided valve lesions,

Despite that some patients had moderate TR in both groups, this was insignificant clinically. Most patients were NYHA functional class I, and the clinical condition was well tolerated and controlled by medical treatment. No redo surgeries were needed during that period to correct residual TR.

There was no difference in survival, and major cardiac and cerebrovascular adverse events were the same in the two groups. However, freedom from moderate to severe TR was higher in the ring group than the band group, without any statistically significant difference.

Conclusion

Tricuspid valve repair for functional TR associated with left-sided valve lesions should be treated during the initial operation. This is can be achieved by either modified band or ring annuloplasty, with excellent results in terms of durability and freedom from recurrent regurge.

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Conflicts of interest

There are no conflicts of interest.

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