

Management Of Functional Tricuspid Regurge. Is A Flexible Band Superior To Suture Annuloplasty?

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ABSTRACT

Background: We used to compare the midterm outcome of the technique in which a piece of synthetic tube graft of PolyTetraFluoroEthylene (PTFE) is used as an annuloplasty flexible band versus suture segmental annuloplasty for management of functional tricuspid regurge in settings of rheumatic mitral valve pathology.

Objective: In this article, we compared midterm results of segmental suture annuloplasty versus a technique in which a piece of PTFE tube graft is used as a modified flexible band for annuloplasty.

Patients and Methods: This is a retrospective study compared the management of functional tricuspid regurgitation caused by surgery for rheumatic valve disease between patients who got flexible band annuloplasty (n = 84) and suture segmental tricuspid annuloplasty (n = 96) with a mean follow-up of 24 months.

Results: There were no mortalities in both groups at thirty days after the operation, degree of tricuspid regurge was lower for the band group after 24 months follow up by echocardiography, we found no need for reoperation in both groups for tricuspid regurge at 2-year post operatively.

Conclusion: In cases of functional tricuspid regurge linked to rheumatic mitral pathology, the flexible band annuloplasty technique using a piece of PTFE tube graft demonstrated a good outcome and tendency for improved results and better durability of repair than suture annuloplasty for longer follow-up periods to confirm.

Keywords: Tricuspid regurgitation (TR), Band annuloplasty, Suture segmental annuloplasty.

INTRODUCTION

Although functional tricuspid regurgitation (TR) in adults is a widely observed finding concomitant with rheumatic mitral valve disease, its clinical importance has been underestimated. The cause of functional TR is pulmonary hypertension (PHT) associated with dilatation of the tricuspid annulus and the right ventricle (RV) geometry ⁽¹⁾. Some reports suggest that regression of TR occurs spontaneously after surgery to the diseased mitral valve ^(2,3).

On the other hand, some studies suggest that repair of the tricuspid at the time of left-sided surgery had a great implication on the outcome, with a decrease in morbidity and mortality ^(4,5). So there is a debate between surgeons regarding how and when to repair secondary tricuspid valve regurge ⁽⁵⁾.

Many surgical techniques had evolved to repair functional TR based on the concept of reduction of the tricuspid annulus. Suture annuloplasty in the form of bicupidization (kay repair), semicircular repair (De Vega method), or segmental annuloplasty offers good early post-operative results ^(6,7).

The use of flexible bands, semi-rigid rings, and rigid rings for ring annuloplasty has increased over the past few decades, however, there is no conclusive proof of the superiority or longevity of any particular type ⁽⁸⁾. In this article, we compared midterm results of segmental suture annuloplasty versus a technique in which a piece of PTFE tube graft was used as a modified flexible band for annuloplasty.

MATERIALS AND METHODS

Patient population:

We designed a retrospective clinical study on one hundred eighty patients who underwent functional

tricuspid valve annuloplasty in settings of mitral valve surgery from March 2017 to April 2020 in Kasr Al Aini hospitals. An immediate and mid-term follow-up analysis was done.

Echocardiographic Evaluation of the degree of tricuspid regurgitation was scored as 4 degrees, first for mild regurge, second for moderate regurge, third for moderate to severe regurge, and fourth degree was associated with severe tricuspid regurgitation.

The definition of the significance of regurge was any patient with grade 3 or more tricuspid valve regurge.

Exclusion criteria:

- Organic tricuspid valve disease.
- Aortic root surgery.
- Infective endocarditis.
- Low Ejection Fraction (EF).
- Concomitant Coronary Artery Bypass Grafting (CABG).
- Redo cases.
- Complete heart block with a permanent pacemaker.

Endpoints:

We classified study endpoints into primary and secondary, primary objectives were to compare postoperative hospital mortality and to assess the grade of tricuspid regurge at the time of discharge and 2 years follow-up.

Secondary endpoints were the need for reoperation for significant severe tricuspid regurge and cases of hospital readmission associated with manifestations of right-sided heart failure.

Surgical Technique:

Conventional midline sternotomy under standard cardiopulmonary bypass with the usual double venous cannulation. Antegrade intermittent cold blood cardioplegia was used for myocardial protection. After the concomitant left-side procedure was performed, Tricuspid valve annuloplasty was done with complete cardiac arrest. Through oblique right atriotomy, the TV was carefully explored. Competence of the valve and leaflets coaptation was assessed using a saline infusion test. If tricuspid regurge was equivalent to or less than mild for any form of tricuspid repair, the repair approach was considered successful. Transthoracic echocardiography was used to evaluate the tricuspid valve postoperatively one week after discharge and over the subsequent two-year follow-up period.

1-Flexible Band:

Eighty-four patients had repaired their TR using the flexible band of PTFE. Nine to ten Ethibond 2/0 sutures without pledgets were used starting from the middle of the septal leaflet to ending at the posteroseptal commissure circumferentially. Ethibond passes perpendicular to the annulus in U shape fashion. Ring sizer(Edwards M3 Tricuspid annuloplasty ring sizer) was used to determine setal leaflet size then PolyTetraFluoroEthylene (PTFE) band was measured by encircling it around the ring sizer’s two notches to determine its proper length. Sutures were then passed through the band at which sutures tightened to fix the band in the supra-annular position. Another technique by measuring the distance between the midpoint of the septal leaflet and posterseptal commissure by a silk suture then using a band that measures 2/3 to 3/4 that length.

2- Suture Annuloplasty:

Segmental annuloplasty, a modified DeVega treatment, was performed on 96 patients. The anteroseptal commissure and the middle of the anterior leaflet were connected by one polypropylene suture, while the posteroseptal commissure and the middle of the anterior leaflet were connected by the other. Each suture had two pledgets tied separately at its beginning and end.

Ethical consent:

The academic and ethical committee of Cairo University approved the study. Each patient signed a written informed consent form to agree to participate in the study. The Declaration of Helsinki, the World Medical Association's code of ethics for studies involving humans, guided the conduct of this work.

Statistical Methods

SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows was used to run the statistical analyses. Data were presented as means ± standard deviations (±SD), frequencies (number of occurrences), and percentages when appropriate. For independent samples, numerical

variables were compared between research groups using the Student t-test. The Chi-square (X²) test was performed to compare categorical data. An exact test was used in its place when the expected frequency was less than 5. Differences were considered statistically significant at p-values less than 0.05.

RESULTS

Preoperative characteristics:

There was no statistically significant difference between the 2 annuloplasty techniques according to preoperative demographic factors, echocardiography data, and New York Heart Association (NYHA) class.

Table (1): Pre-operative patient's characteristics

	Suture group (n=96)	Band group (n=84)	p-value
Age (yrs)	38±11	40±13	0.9
Gender			
Male	39(40.6%)	35 (41.7%)	0.6
Female	57 (59.4%)	49 (58.3%)	
TR Grade	3.23±0.77	3.44±0.62	0.7
PAP (mmHg)	63 ± 14.21	65 ± 15.32	0.8
Cardio Pulmonary Bypass Time (Min)	92± 21.35	101± 24.12	0.3
Cross-Clamp Time (Min)	63 ± 13.54	74 ± 16.32	0.9
NYHA Functional Class	3.4± 0.8	3.2± 0.6	0.6

Endpoints:

Primary endpoints:

Hospital mortality: No single hospital mortality for both groups and all patients were discharged from the hospital in good condition.

Postoperative TR grade: Preoperative TR score was 3 or more, postoperatively, there is an excellent and significant improvement of TR grade in both groups compared to the preoperative grade of regurge. In the segmental annuloplasty group, the mean TR at discharge was 1.88 ± 0.73 and in compare to 1.79 ± 0.53 in the band annuloplasty group (Tables 2, 3).

Table (2): Postoperative TR grade for suture annuloplasty group

TR grade	Suture group (n=96)	
	At discharge (n=96)	24-month post-op (n=92)
1	22	12
2	60	52
3	10	22
4	4	6
Mean ± SD	1.88 ± 0.45*	2.2±0.52

*p value 0.03 compared to the preoperative value

Table (3): Highlights TR grades at the time of discharge and 2 years for the PTFE band group.

Band group (n=84)		
TR grade	At discharge (n=84)	2 yr post op (n=81)
1	21	8
2	59	65
3	4	8
4	0	0
Mean ± SD	1.79 ± 0.43*	1.86 ± 0.45

* p value 0.01 compared to the preoperative value

In terms of TR grade, there was no statistically significant difference between the two groups (p-value 0.08) At two years, the segmental annuloplasty group's mean TR grade was 2.2±0.08, while the band group's mean TR grade was 1.86±0.79.

Secondary endpoints:

24 months survival:

- There were four mortalities in the suture group. 2 mortalities happened due to cerebral hemorrhage because of warfarin toxicity (one patient died 9 weeks after discharge and the other died 6 months following discharge), and two other patients died due to early onset infective endocarditis complicating prosthetic mitral valve (one patient 8 weeks after discharge and other patients 3 months after discharge).
- Three members of the band died, one of which occurred seven weeks after discharge. The patient was complicated when he was brought into the emergency room with cardiac tamponade and an INR of 9, and after several failed attempts at resuscitation, he quickly decompensated into cardiac arrest. A huge retroperitoneal hematoma with an INR of 10 caused the death of the second patient 8 months after surgery, while a sudden cardiac arrest caused the death of the third patient 10 months after surgery.

Hospital readmission and Re-operation:

Although some patients of both groups had developed grade 3 or 4 TR, all of them were controlled by medical treatment. There are 6 patients readmitted for control of right-side heart failure during the 2-year follow-up. They are all members of the segmental annuloplasty group, but none of them required a second procedure because they were all compensated with anti-failure measures.

DISCUSSION

Progressive annular dilatation and decreased leaflet coaptation are the main causes of functional TR secondary to rheumatic left-sided valve disease, which leads to substantial TR⁽⁹⁾. Regarding the long-term effects of concurrent TV annuloplasty versus conservative therapy for mild to moderate functional

TR, there is an unbridgeable difference. However, patients with grade 3 or 4 TR clearly demonstrate a huge difference ⁽¹⁰⁾.

Despite the annuloplasty techniques have changed over many years, some limited objective data can be used as a decision-making tool. Therefore, the decision to conduct an annuloplasty and the type of annuloplasty techniques depend frequently on the judgment and experience of the surgeon ⁽¹¹⁾.

No matter the kind of annuloplasty, several studies have identified some risk factors for recurrent TR after annuloplasty. Preoperative tricuspid valve leaflet tethering, postoperative left ventricular dysfunction, or increased right ventricular pressure may all contribute to early and midterm recurrence of TR. However, this research did not discuss the benefits or drawbacks of various annuloplasty techniques ⁽¹²⁾. Our study's findings on postoperative tricuspid regurge are comparable to those of other studies in terms of severity.

Significant grade 3 (moderate to severe) or grade 4 (severe) concurrent functional TR in patients were seen in our investigation, which is consistent with the majority of prior studies.

Even with mild TR, **Murashita et al.** ⁽¹³⁾ advise annuloplasty for patients with atrial fibrillation or pulmonary hypertension. Regardless of the TR grade, **Dreyfus et al.** ⁽¹⁴⁾ even recommend annuloplasty for any patient with tricuspid annular dilatation.

Although there are various approaches for TV annuloplasty in patients with functional TR, these patients typically benefit the most from this procedure. However, recurring and residual TR are observed to occur often. After TV annuloplasty, **Tang et al.** ⁽¹⁵⁾ described a TR recurrence in 30% of patients (among 702 patients) after a mean follow-up of 5.9 years. **McCarthy et al.** ⁽¹⁶⁾ observed a residual TR in 15% of the population under study (790 patients) one month after repair.

Recurrent mitral valve surgery and tricuspid repair failure were not related. **Dreyfus et al.** ⁽¹⁴⁾ studies and those of **Matsunaga and Duran** ⁽¹⁷⁾ both found no connection between recurrent TR and recurrent MR following mitral valve surgery. In the vast majority of patients, an annuloplasty is notably superior to no repair. 37% of patients with preoperative TR grade 2 (moderate) have TR grade 3 (moderate to severe) or 4 (severe) throughout the eight years following mitral valve replacement alone, according to **Matsuyama et al.** ⁽¹⁾. According to a recent study by **Matsunaga and Duran** ⁽¹⁷⁾, 53% of patients exhibit grade 2 or higher TR three years after mitral valve surgery alone.

In our study, the outcomes of the band annuloplasty group were better than the segmental annuloplasty group regarding the tricuspid regurge grade which was lower for all grades of regurge severity. The reason may be attributed to good sizing of the band by tricuspid sizers besides the higher tensile strength of the PTFE graft material but without

statistically significant difference.

in both groups, some patients developed late moderate TR but in a good clinical condition .more than 60% of the patients who developed moderate TR were in NYHA functional class I, and only 6 cases (all in the segmental annuloplasty group) had late severe tricuspid regurge with symptoms well controlled on medical treatment. No patient in both groups needed reoperation for residual or recurrent TR at a 2-year follow-up.

There were no differences between the two groups in terms of survival and absence of serious cardiac/cerebrovascular adverse events. Suture annuloplasty was inferior to band annuloplasty due to a higher frequency of moderate to severe TR, but there was no statistically significant difference between the two procedures.

Limitations:

- 1- Single institution experience.
- 2- More echocardiographic data is needed regarding PTFE band flexibility and 3-dimensional annular geometry.
- 3- The difference in the echocardiographic experience of operators.
- 4- Longer follow-up periods are needed.

CONCLUSION

Both band and segmental annuloplasty are safe, simple, and effective methods for the repair of grade 3 and 4 functional TR secondary to left-sided rheumatic valvular disease. Band annuloplasty trends to work in a superior way to segmental annuloplasty with lower incidence of residual and recurrent TR but without statistically significant difference at 2 years follow up.

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