

Original Research Article

A comparative study on tricuspid valve repair using De Vega's annuloplasty technique and modified De Vega's technique using polytetrafluoroethylene band

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ABSTRACT

Background: The aim of the study was to compare the outcomes of tricuspid valve repair (TVR) with repair techniques for functional tricuspid regurgitation (TR), DeVega's technique and modified DeVega's technique using Polytetrafluoroethylene band.

Methods: A total of 37 patients who underwent TVR at Madurai Medical College from September 2019 to November 2021 formed into Group A, consisting of 16 patients who had DeVega's procedure done and Group B, consisting of 21 patients who had modified DeVega's procedure using Polytetrafluoroethylene band. In addition, in 80% of patients with rheumatic heart disease (RHD), concurrent surgeries included mitral valve replacement (MVR) and double valve replacement (DVR) in 20% of patients. Clinical and echocardiographic follow-up data were also collected for analysis.

Results: All 37 patients were examined and followed up after 3 months and 6 months. Group A De Vegas- 9 out of 16 patients (56%) had mild TR, 4 out of 16 (25%) patients had moderate TR, and 3 out of 16 (19%) patients had severe TR. Group B Modified De Vegas- 16 out of 21 patients (76%) had mild TR, 4 out of 21 (19%) patients had moderate TR, and 2 out of 21 (5%) had severe TR.

Conclusions: Tricuspid valve annuloplasty utilizing a modified De Vega's procedure with a polytetrafluoroethylene band was shown to be beneficial when patients were followed for three and six months, respectively.

Keywords: Tricuspid valve, De Vega tricuspid annuloplasty, Outcome

INTRODUCTION

Functional or secondary Tricuspid regurgitation (TR) is a kind of TR that occurs in the absence of any detectable pathology of the TV leaflets or chordae and is frequently associated with left-sided valve illness. This kind of TR has been referred to as "functional".¹

With an anatomical area of 4-6 cm² and a diameter of 27-29 mm, the TV is the biggest heart valve. It is located inferiorly and anteriorly to the mitral valve (MV), with

the gap between the mitral and tricuspid annuli being less than 8 mm/m² under normal circumstances (displacement index).² Its anatomical structure is intricate, consisting of three leaflets, an annulus, chordae, and papillary muscles.

The medial most septal leaflet (STL) is linked directly to the interventricular septum, whereas the anterior leaflet (ATL) is the biggest. The ATL stretches across the annulus's front section, while the smaller posterior leaflet (PTL) reaches through the annulus's inferior and posterior borders. The most prominent papillary muscle is the

anterior papillary muscle, which gives chordae to the ATL and PTL. The septal papillary muscle, which provides chordae to the STL and PTL, is less pronounced and typically rudimentary. The posterior papillary muscle supplies the chordae to the PTL and STL, often branched or trifurcated.³ These structures are significant because they may hinder normal leaflet coaptation in the event of right ventricle (RV) dilatation, resulting in TR.

The tricuspid annulus has a complicated dynamic structure, unlike the symmetrical saddle-shaped mitral annulus. The posteroseptal section of the tricuspid annulus is the lowest, and the anteroseptal portion is the highest in a typical tricuspid annulus.⁴ The annulus becomes dilated planar and circular in individuals with subsequent TR.⁵ Furthermore, the anteroposterior diameter increases more than the mediolateral diameter, indicating higher dilatation along the RV free wall.

TR is typically easily tolerated, and individuals with mild to severe TR may remain asymptomatic. Patients often complain of asthenia, weariness, and poor exercise tolerance. They also have peripheral oedema, ascites, and congestive hepatomegaly, which indicate high right atrial pressure. The physical examination reveals jugular venous distension with a pronounced 'a' wave, hepatomegaly, and a quiet systolic regurgitant murmur. Atrial fibrillation (AF) is a complication of right atrial hypertrophy.

Aim

The aim of the study was to compare the outcomes of tricuspid valve repair by DeVega's technique and modified DeVega using the polytetrafluoroethylene band technique.

METHODS

In this prospective study, a total of 37 patients who underwent TV repair at Madurai Medical College Hospital from September 2019 to November 2021 formed into group A, consisting of 16 patients who had DeVega's procedure done and group B, consisting of 21 patients who had modified DeVega's procedure done using polytetrafluoroethylene band. Institutional ethical committee approval was obtained. Patients were required in a simple random sampling method during the study period.

Conventional parasternal and apical views were employed to evaluate TR using echocardiography. For TR quantification, the maximum TR jet area visualized using colour Doppler flow mapping was used, with a TR jet to the right atrial area of less than 10% equaling grade 1+, 10% to 20% equaling 2+, 20% to 40% equaling 3+, and greater than 40% equaling 4+. The criteria for 4+ TR was the systolic reversal of hepatic venous flow. The vena contracta was measured to ascertain the severity of TR; a measurement of 7mm or more is deemed serious

TR. Adults have a typical annulus diameter of 28 mm. An annular diastolic diameter greater than 40 mm (or greater than 21 mm/m²) indicates an increased risk of persistent or progressive TR, whereas significant dilatation is defined as a diastolic diameter greater than 40 mm (or greater than 21 mm/m²) and requires a consideration for TVR.

Operative technique

All procedures were conducted using sternotomy, cardiopulmonary bypass (CPB) with aortic and bicaval cannulation, and moderate hypothermia (32° to 34°C). Cross-clamping the aorta and administering cold cardioplegia were performed. After completing the left heart valve operation, the TV was repaired.

The attending surgeon determined the procedure of repair. The band was constructed of polytetrafluoroethylene material and was shaped to stretch from the posteroseptal to anteroseptal commissures in accordance with the septal leaflet sizer's two notches (Edwards M3 tricuspid annuloplasty ring sizer). After sizing the STL, the polytetrafluoroethylene band was wrapped around the ring sizer's two notches to establish its length. 30 mm and 32 mm were the most popular sizes. To stitch the tricuspid annulus from the posteroseptal commissure to the anteroseptal commissure, six to nine interrupted U sutures of 2-0 ethibond were frequently used.

Stitches were placed perpendicular to the annulus' plane. They were then threaded through a presized Polytetrafluoroethylene band and secured in a supra-annular position when the band was lowered, causing the annulus to shrink. Patients who had their TV repaired without using a polytetrafluoroethylene band had a DeVega's treatment (single Ethibond suture from the posteroseptal to the anteroseptal commissure with a pledget at each end of).

A saline test was performed intra-operatively, and Trans Esophageal Echocardiography (TEE) was used to quantify TR. If there was moderate regurgitation or less, the repair process was effective. There was no intraoperative failure for any TVR procedure. In 80% of patients, MVR was performed concurrently, and in 20% of patients, AVR was performed concurrently. TVR was accomplished after completing simultaneous cardiac treatments.

Follow-up

The patients' outcomes were recorded. In addition, the clinical state of the patient, as well as the echocardiographic data, were examined. Finally, three months and six months following their procedure, all patients or family members were called and asked to come in for a postoperative follow-up echocardiogram.

Statistical analysis

The data was gathered, coded, and put into IBM Statistical Package for Social Science (SPSS) version 20. Quantitative data were provided as mean, standard deviations, and ranges, whereas qualitative data were given numbers and percentages. The chi-squared test compared two groups of people who had qualitative data. One-way analysis of variance was used to compare quantitative data with parametric distribution between more than two independent groups (ANOVA).

RESULTS

Demographic variables are listed in Table 1.

Table 1: Age distribution of patients.

Age (years)	Group A (%)	Group B (%)	Total (%)
20-40	3 (18)	4 (19)	7 (18)
40-60	9 (56)	14 (66)	23 (62)
>60	4 (25)	3 (14)	7 (18)
	16	21	37

Table 2: Gender distribution of patients.

Sex	Group A (%)	Group B (%)	Total (%)
Male	7 (43)	5 (23)	12 (32)
Female	9 (56)	16 (76)	25 (67)
	16	21	37

Among the 37 study populations, 18% belonged to the 20-40 years age group, and 62% belonged to the 40-60 age group. The mean age was 34.75 ± 11.26 and 38.90 ± 11.84 years for DeVega's technique (Group A) and modified DeVega's technique with polytetrafluoroethylene (Group B), respectively.

Most of the patients were females in the two studied groups, 56% for the DeVega's technique (Group A) and 76% for the modified DeVega's technique with polytetrafluoroethylene band (Group B).

The research groups had similar preoperative Right ventricle end diastolic dimension (RVEDD), TR grade, pulmonary hypertension (PHTN), and the prevalence of persistent atrial fibrillation (AF). In both groups, most patients exhibited severe (+4 TR) PHTN (85% of DeVega's Group A and 87% of modified DeVega's employing Polytetrafluoroethylene band Group B), with an average of 56mmHg. Table 3 lists the operational information of the research groups. All of the operational CBP and cross-clamp timings were similar.

Table 4 shows the results of the two groups' TVR procedures. There was no difference in hospital mortality rate; in group A, just one patient died. When the two groups were compared together, there was no significant difference in the incidence of neurological complications, AF, postoperative LCOS, heart failure, renal failure, dialysis, respiratory complications, sepsis, and reopening for bleeding.

In both groups, the grade of TR improved significantly after discharge. Around half of the patients had mild TR (grade +1), and 71% of group B, compared to 50% of group A, had no regurgitation (grade 0). Only 6.25% of group A had a moderate degree of TR (grade +1 to +2).

During the three-month follow-up, the vast majority of patients had no regurgitation (grade 0) or mild regurgitation (grade +1), with two patients (12.5 percent) in DeVega's (group A) and one patient (4.7 percent) in Polytetrafluoroethylene band (group B) having moderate regurgitation (grade +2), but none of them requiring reoperation. In addition, there were no instances of tricuspid stenosis recorded.

Table 3: Comparison of pre-operative values.

Variables		Group A (n=16)	%	Group B (n=21)	%
RVEDD (cm)	Mean	3.0±0.32		3.17±0.42	
LVEF %	Range	46-61		44-56	
TR grade	+3	3		5	
	+4	13	85	16	87
AF	No	12		14	
	Yes	4		7	
NYHA	2	2		3	
	3	12			
	4	2	75	3	72
Pulmonary hypertension (mmHg)	Mean	55.14±10.14		56.29±9.66	
Concomitant cardiac surgeries	MVR	14	87	18	85
	DVR	2	12.5	3	14
Operative time (min)	Range	105-195		120-220	
CPB time (min)	Range	40-90		55-95	
Cross clamp time (min)	Range	30-65		35-70	

Table 4: Comparison of post-operative outcomes.

Postoperative outcome and complications	Group A (16 cases)	%	Group B (21 cases)	%
Mortality	1	6.25	0	0
Duration of ventilation (hours- average)	25.17		19.77	
ICU stay in days- average	3.5		3	
Reintubation	2	12.5	1	4.7
Pulmonary edema	3	18.7	2	9.5
Renal failure requiring dialysis	2	12.5	1	4.7
Low cardiac output state (LCOS)	2	12.5	1	4.7
Cerebro vascular accidents (CVA)	1	6.2	0	0
Post-operative cognitive dysfunction	3	18.7	2	9.5
Reopening for bleeding	1	6.2	1	4.7

Table 5: Outcome of discharge.

		Group A	Group B
TR	No	8 (50%)	15 (71%)
	Mild	6	6
	Moderate	1	0
	Severe	0	0
PHTN (mmHg)	Mean	53.62±5.41	51.84±6.72
RVEDD (cm)	Mean	2.94±0.24	2.91±0.42
NYHA	1	12	16
	2	2	3
	3	1	1
AF	No	11	15
	Yes	4	5
RV dysfunction	No	16	21
	Yes	0	0

Table 6: Follow up at 3 months.

		Group A	Group B
TR	No	8	15
	Mild	5	5
	Moderate	2 (12.5%)	1 (4.7%)
	Severe	0	0
PHTN (mmHg)	Mean	49.32±7.38	47.51±4.32
RVEDD (cm)	Mean	2.90±0.12	2.76±0.30
NYHA	1	12	18
	2	2	2
	3	1	1
AF	No	11	18
	Yes	4	3
RV dysfunction	No	13	20
	Yes	2	1

Table 6 compares the performance of the two repair procedures after six months based on five criteria: the frequency of chronic AF, PHTN, improvement in

dyspnea class, end-diastolic dimension of the RV, and degree of TR.

The first three criteria determine the effectiveness of left-sided rheumatic pathology repair and the return of TR. There was a considerable reduction in postoperative PHTN in both groups compared to preoperative levels.

When the two groups were examined combined, the mean decrease in PHTN was negligible (13.15 7.3 mmHg for group B, 9.85 4.06 mmHg for group A, p value of 0.240). While the majority of patients had an NYHA class of 3 before surgery (72% of group B and 75% of group A), they had an NYHA level of 1 thereafter (86 percent of group B, 81 percent of group A). The p-values of the NYHA class before and after surgery were 0.58 and 0.44, respectively.

When the two repair procedures were evaluated combined, the incidence of chronic AF before and after the surgery was not significant; the p-value was 1.00 on discharge and 0.85 after six months of follow up.

As a result, the three variables that potentially influence the recurrence of TR were similar throughout the research groups. In all research groups, the occurrence of TR was minimal.

On discharge, almost half of the patients in each group did not have TR, and after six months of follow-up, the majority of the patients had either no regurgitation or grade +1 TR.

Two patients in group A (10%) and one patient in group B (5%) exhibited moderate (+2) TR (P-value of 0.74 and 0.78 for pre and postoperative TR, respectively).

Finally, the end-diastolic dimension of the right ventricle is reverse remodelled.

With a p value of 0.0001, the mean reduction in RVEDD was largest in group B (0.64 0.47 cm) compared to group A (0.18 0.29 cm), indicating that RV reverse remodelling occurred considerably in group B.

Table 7: Follow-up at 6 months.

		Group A	Group B
TR	No	5	13
	Mild	4	3
	Moderate	4	3
	Severe	2	2
PHTN (mmHg)	Mean	45.29±8.06	43.14±6.84
RVEDD (cm)	Mean	2.82±0.30	2.53±0.26
NYHA	1	13	18
	2	1	1
	3	1	1
AF	No	13	19
	Yes	2	2
RV dysfunction	No	12	20
	Yes	3	1

DISCUSSION

TR is a serious clinical condition that surgeons often overlook.⁶ Independent of ventricular function and pulmonary arterial pressure (PAP), moderate and severe TR is linked to poor short- and long-term mortality.⁷ As with others, we have operated on patients who developed secondary (functional) regurgitation as a result of increasing annular dilatation and reduced leaflet coaptation related to rheumatic left-sided valve disease. Secondary TR is mostly caused by dilatation of the tricuspid annulus, which occurs as a consequence of the RV remodelling owing to prolonged pressure overload.

Thus, treating a left-sided valve lesion alone reduces afterload but does not improve tricuspid dilatation, preload, or RV performance. As a result, full reversal RV remodelling is unlikely, and just normalizing PAP does not remove TR.⁸ Correcting the mitral valve lesion without treating the TV may relieve mild TR in individuals with concurrent mitral valve disease.⁹ However, if moderate or severe TR is left untreated, it will remain or worsen after mitral valve surgery, eventually resulting in progressive heart failure and death.^{10,11} Furthermore, reoperation for persistent TR entails substantial risks and may have a bad prognosis.^{12,13}

Hence, experts have recommended that a more aggressive approach should be taken in cardiac surgery patients with concomitant TR.¹⁴

Intraoperatively, a tricuspid annulus diameter of 40 mm or greater was shown to be comparable to 7 cm.¹⁵

Ring annuloplasty is a method of choice for Tricuspid valve repair. However, due to the cost of the ring and the financial constraints of most people suffering from the disease, Suture annuloplasty techniques are more frequently used for Tricuspid Valve repair.

The most often utilized TVR procedure is DeVega's suture annuloplasty.¹⁶ However, DeVega's procedure has a high recurrence rate, according to reports. Consequently, we conducted this research to evaluate the outcomes and short-term outcomes in individuals who had their TV repaired using two different procedures. To replace the TV, we chose to employ a flexible Polytetrafluoroethylene band; the advantages of a flexible band include the following: better early postoperative results Left Better diastolic blood flow through the mitral valve in individuals with a rigid ring because the annular size and configuration may adjust to variations during the cardiac cycle. Furthermore, during systole, polytetrafluoroethylene band repair puts less tension on the sutures, reducing the risk of dehiscence.^{17,18}

There was a considerable reduction in the dyspnea class of patients, reduced PHTN, and non-progression of TR grade when the two repair approaches were compared. The first two indicators improved when the left-sided rheumatic valve pathology was corrected, while the third component represents TV surgery success. In addition, the Polytetrafluoroethylene band TVR approach improves RV reverse remodelling significantly. Furthermore, AF has been identified as the primary risk factor for functional TR advancement after mitral valve dysfunction. Its incidence was similar in both groups on discharge and six months later, omitting its function in this investigation's progression, recurrence, or genesis of new TR.

All of these data imply that in patients having TVR, a Modified DeVega's approach employing a Polytetrafluoroethylene band or DeVega's technique is advised to minimize recurrence in the future. Furthermore, in the near run, the modified DeVega's method repair employing the Polytetrafluoroethylene band looks to be better than or equivalent to DeVega's technique repair. Although the former approach has been shown to reduce the likelihood of suture dehiscence and recurrent Tricuspid Regurgitation, the long-term outcomes are unknown.¹⁹ Regardless, we anticipate seeing a significant advantage from tricuspid valve surgery using a Polytetrafluoroethylene band, and our findings have led to a shift in surgical practice at our institution.

Limitations

There were few flaws in this research. One disadvantage of this research was that surgeon choice, and lack of randomization might bias the TVR approach. Patients who had a TVR utilizing the modified DeVega's procedure with the polytetrafluoroethylene band, on the other hand, had improved short-term outcomes, confirming our conclusion that the polytetrafluoroethylene band should be utilized more commonly in TVR surgery. Other limitations of this research included a limited number of study groups, a short follow-up time, and the use of just the RVEDD to

demonstrate reverse remodelling. Also, this study's limitation is the cost constraints involved while using the tricuspid annuloplasty ring.

CONCLUSION

Although both procedures may be used to repair the TV, using a Polytetrafluoroethylene band in patients having TV surgery is linked to improving RV remodelling and RV function and a superior repair result. However, a larger number of patients and a longer follow-up time are required to determine the impact of TR independence on survival. In addition, further research from numerous centres will be needed to back up the superior outcomes of TVR using a Polytetrafluoroethylene band.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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