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Original Article

Tricuspid valve repair with Dacron band versus DeVega or segmental annuloplasty. Hospital outcome and short term results

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ABSTRACT

Background: The purpose of this study was to compare the hospital outcome and short term results of tricuspid valve (TV) repair with three repair techniques for functional tricuspid regurgitation (TR), namely, flexible Dacron band, DeVega and segmental annuloplasty.

Methods: A total of 60 patients underwent TV repair at National Heart Institute from January 2013 to November 2014, of which 20 had DeVega procedure (DV), 20 had a segmental annuloplasty (SA) procedure and 20 had a Dacron band (DB) procedure. Concomitant procedures done for rheumatic left sided valve pathology consisted of mitral valve replacement in 70% of patients, and double valve replacement in 30% of patients. Clinical and echocardiographic follow-up data were obtained. Follow-up was 100% complete and was concluded after one year.

Results: All demographic criteria and preoperative characteristics of the three studied groups were comparable except for preoperative right ventricular (RVEDD) size that was significantly bigger in Dacron band group as compared to the other two groups (3.18 ± 0.43 cm compared to 3.00 ± 0.33 cm (DV) and to 2.88 ± 0.35 cm (SA), p value of (0.045)). Similarly, all operative and postoperative criteria were comparable among the study groups. Noticeably, (RVEDD) size remodeled better postoperatively in (DB) group as compared to the other two groups, (2.54 ± 0.26 cm compared to 2.83 ± 0.311 cm (DV) and to 2.72 ± 0.29 cm (SA), mean difference values were group (0.64 ± 0.47 cm) for (DB) compared to (0.18 ± 0.29 cm) for (DV) or to (0.16 ± 0.45 cm) for (SA) with p value of 0.000. The majority of patients in each group did not have tricuspid regurgitation (TR) or mild degree (+1) of (TR) on discharge. After one year of follow-up, most of the patient had either no regurgitation or grade (+1 TR). Two patients (10%) in DV group and one patient (5%) in SA group had (+3 TR). There was no statistical significance in the incidence of hospital mortality, only one patient died in DB and one in DV group (5%) and no death happened after hospital mortality for the three groups after one year.

Conclusions: The three techniques are options to repair the tricuspid valve, however, placement of Dacron band in patients undergoing tricuspid valve repair is associated with better RV remodelling, and hence, a probable better right ventricular performance and better outcome of repair is expected. A higher number of patients are needed with longer follow up period to appreciate the effect on survival and rate of freedom from tricuspid regurgitation and re-intervention.

1. Introduction

Secondary or functional TR refers to TR, usually seen in association with left-sided valve disease and occurring in the absence of any identifiable pathology of the tricuspid valve leaflets or chordae. The term "functional" has been used to describe this form of tricuspid regurgitation for several decades.[1]

Some authors like Braunwald et al. in 1967 recommended conservative treatment of functional tricuspid regurgitation[2] as, by definition, it would be corrected when the left-sided valve is treated surgically. However, the excellent results of repaired tricuspid valve regurgitation during mitral valve surgery by Carpentier in 1974 made it very justifiable procedure.[3] Moreover, Dreyfus et al. reported that patients who had tricuspid valve repair at the time

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of mitral valve surgery had better long-term results than those who had not.[4] An increasing wealth of observational data now supports surgical treatment of functional tricuspid regurgitation.

Consequently, early methods used to repair the tricuspid valve by sutures (suture based techniques) such as "bicuspidization" described by Sharony et al.[5] and "modified DeVega tricuspid annuloplasty" described by Antunes et al.[6] One current method is remodeling annuloplasty using a flexible band. The current study was undertaken to examine the hospital and short-term outcome of TV repair by suture based techniques versus flexible band technique.

2. Patients and methods

From January 2013 to November 2014, a total of 60 patients underwent TV repair at our institution, of which 20 had De Vega procedure (DV), 20 had a segmental annuloplasty (SA) procedure and 20 had a Dacron band (DB) procedure. Concomitant procedures consisted of mitral valve replacement in 70% of patients, and double valve replacement in 30% of patients.

Clinical and echocardiographic follow-up data were obtained. For echocardiographic assessment of tricuspid regurgitation, echocardiographer used standard parasternal and apical views (standard long-axis, 2-chamber, and 4-chamber images). Looking at tricuspid valve morphology first to detect any flail or coaptation defect as seen in some cases of severe degree of TR, Color flow was applied in the apical views to evaluate TR. The maximal TR jet area visualized using color Doppler flow mapping was used for TR quantification, with a TR jet-to-right atrial area ratio of less than 10% = grade 1+, 10% to 20% = 2+, 20% to 40% = 3+, and greater than 40% = 4+. Systolic reversal of hepatic venous flow was also used as a criterion for 4+ TR.

For statistical purposes grade 0 is translated to No regurgitation, +1 is translated to mild, +2 is translated to Moderate, 3+ is translated to moderate to severe and +4 is translated to Sever. The peak systolic TR jet velocity was measured by continuous wave signal. Lastly, vena contracta was measured to determine degree of TR, if the measurement was 7 mm or more it is labeled as severe TR. The Ethics Research Board of the National Heart Institute approved this observational study.

2.1. Operative technique

TV repair was performed with an annuloplasty band (DB) in 20 patients and without a band in 40 patients either SA (20) or DV (20) (no band). The choice of repair technique was at the attending surgeon's choice.

The annuloplasty band was made of Dacron material fashioned to extend from the posteroseptal commissure to anteroseptal commissure according to septal leaflet sizer's two notches (Edwards M3 Tricuspid annuloplasty ring sizer) that correspond to the two commissures. Therefore, the Dacron band was encircled around the ring sizer's two notches to determine its length after sizing of the septal leaflet. The mostly used sizes were 30 mm and 32 mm. Six to nine interrupted U sutures of 2/0 Ethibond® were usually needed to stitch the tricuspid annulus from posteroseptal commissure to anteroseptal commissure. Stitches were taken perpendicular to the plane of the annulus and then were passed through the presized Dacron band and tied in supra annular position after the band is lowered down fixing the annulus to a new smaller size position.

Patients undergoing TV repair without an annuloplasty band underwent a classic DeVega procedure (single Ethibond suture from the posteroseptal to the anteroseptal commissure with a pledget at each end) or a modified DeVega (segmental annuloplasty) (2 pledgeted polypropylene sutures taken from posteroseptal commissure to the middle of anterior leaflet and the second one from the middle of anterior leaflet to the anteroseptal commissure, the pledgets of each suture were tied separately). All methods of repair were followed by saline test intraoperatively and the repair technique is considered successful if equal to or less than mild regurgitation was encountered. No failure was encountered intraoperatively for any method of tricuspid repair.

Concomitant procedures consisted of mitral valve replacement in 70% of patients, and double valve replacement in 30% of patients. TV repair was performed before performing other concomitant cardiac procedures, always with the heart beating after going into cardiopulmonary bypass and fasting of superior and inferior vena cava snares while patient is worm and before cross clamp application.

2.2. Follow-up

Hospital outcome for the patients was documented. Patient clinical status and echocardiographic results were analyzed. All patients and/or patient family members were contacted by telephone and invited for postoperative follow up echocardiography 12 months after their operation. Follow-up was 100% complete.

2.3. Statistical analysis

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 20. Qualitative data were presented as number and percentages while quantitative data were presented as mean, standard deviations and ranges. The comparison between two groups with qualitative data was done by using ***chi-squared test*** and/or ***fisher exact test*** was used instead of chi-squared test when the expected count in any cell was found less than 5. The comparison between more than two independent groups regarding quantitative data with parametric distribution was done by using ***One Way Analysis of Variance (ANOVA).*** The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: $P > 0.05$: Non significant, $P < 0.05$: Significant, and $P < 0.01$: Highly significant.

2.4. Results

Demographic criteria of the three groups are listed in Table 1. The mean age was 38.90 ± 11.84 years, 35.70 ± 10.70 years, and 34.75 ± 11.26 years for dacron band (DB) annuloplasty, devega (DV) and segmental annuloplasty (SA) groups respectively (P value of 0.48). Most of the patients were males in the three studied groups, 55% for each of DB and DV groups and 65% for SA group (P value of 0.76).

All preoperative characteristics were comparable between the study groups apart from preoperative right ventricular (RVEDD) size in cm that was significantly higher in DB group, (p value of 0.009). The grade of tricuspid regurgitation, pulmonary hypertension and incidence of chronic atrial fibrillation (AF) was comparable between the study groups (p value of 0.49, 0.91, 0.81 respectively). The majority of patients were having severe (+4 TR) in the three groups (80% of DB and 65% of each of DV and SA groups. P value of 0.49) and the average pulmonary hypertension was 56 mmgh (P value of 0.91).

The operative details of the studied groups are also listed in Table 1. The concomitant cardiac procedure was double valve replacement in 30% of each DB and DV groups compared to 65% in SA, MVR in 70% of DB and DV groups, and 65% in SA group, (p value of 0.92). The operative, CBP, and cross clamp times were all comparable (P values were 0.11, 0.73 and 0.34 respectively).

Table 1
Preoperative and operative data of studied groups.

		Flexible band No. = 20	Devega No. = 20	Seg. ann. No. = 20	Test value	*P*-value
Age (years)	Mean ± SD Range	38.90 ± 11.84 22–62	35.70 ± 10.70 18–55	34.75 ± 11.26 18–60	0.744◆	0.480
Sex	Female Male	9 (45%) 11 (55%)	9 (45%) 11 (55%)	7 (35%) 13 (65%)	0.549*	0.760
RVEDD (cm)	Mean ± SD Range	3.18 ± 0.43 2.5–4	3.00 ± 0.33 2.6–3.7	2.88 ± 0.35 2.4–3.5	3.286◆	0.045#
LVEF (%)	Mean ± SD Range	54.40 ± 7.93 38–66	52.50 ± 7.02 35–62	53.25 ± 6.56 38–62	0.354◆	0.703
TR grade (0 to +4)	+3 +4	4 (20%) 16 (80%)	7 (35%) 13 (65%)	7 (35%) 13 (65%)	1.429*	0.490
Chronic AF	No Yes	11 (55.0%) 9 (45.0%)	12 (60.0%) 8 (40.0%)	10 (50.0%) 10 (50.0%)	0.404*	0.817
NYHA	2 3 4	5 (25%) 11 (55%) 4 (20%)	3 (15%) 13 (65%) 4 (20%)	2 (10%) 11 (55%) 7 (35%)	2.829*	0.587
Pul HTN (mmHg)	Mean ± SD Range	56.30 ± 9.67 40–75	55.15 ± 10.15 33–75	56.30 ± 10.78 33–77	0.085◆	0.919
Com. Card. Op	DVR MVR	6 (30%) 14 (70%)	6 (30%) 14 (70%)	7 (35%) 13 (65%)	0.154*	0.926
Operative time (m)	Mean ± SD Range	144.80 ± 21.32 110–200	144.70 ± 27.31 111–190	158.10 ± 19.63 133–194	2.248◆	0.115
CPB time (m)	Mean ± SD Range	64.10 ± 13.46 45–95	66.65 ± 13.07 50–90	67.25 ± 13.54 58–95	0.314◆	0.732
Cross clamp time (m)	Mean ± SD Range	42.50 ± 11.74 28–65	45.65 ± 14.43 28–70	50.05 ± 21.23 30–85	1.083◆	0.346

RVEDD: Right ventricular end diastolic dimension, LVEF: Left ventricular ejection fraction; TR grade: Tricuspid regurgitation: AF Atrial fibrillation, NYHA: New York Heart Functional Association Class, Pul HTN: Pulmonary hypertension, Com. Card. Op: Commitant cardiac operation, CPB time: Cardiopulmonary bypass time.
◆ One Way Analysis of Variance (ANOVA) test.
* Chi-squared test.
# Significant *p*-value.

In-hospital outcome of TV repair performed in the three groups is listed in Table 2. On discharge there was a significant improvement of TR grade in the three groups with around half of patients with mild TR (grade +1), and 25% of DB compared to 40% of each of DV and SA groups had no regurgitation (grade 0). Only 10% of each DB and SA groups compared to 15% of DV group had mild to moderate degree of TR (grade +1 to +2) (P value of 0.74).

There was no statistical significance in the incidence of hospital mortality, only one patient died in DB and one in DV group (5%). There was no significant difference in the incidence of neurological complications whether stroke or coma, atrial fibrillation, postoperative low cardiac output syndrome, heart failure, renal failure, need for dialysis, respiratory complications, need for pacemaker, septic complications and reopening for bleeding between the three groups when compared together.

In this study, only one patient in DV group (5%) needed permanent pacemaker implantation as compared to other two groups, and p value is 0.36 by one way ANOVA test with no statistical significance.

Table 2 also demonstrates the short-term (one year) follow up of the study groups. Recurrent TR was insignificant for all followed up patients. The vast majority of patients remained in either no regurgitation (grade 0) or mild regurgitation (grade +1) during the follow-up, and 2 patients (10%) in DV group and one patient (5%) in SA group had moderate regurgitation (grade +2), however, none of them needed reoperation. Moreover, there were no cases reported of tricuspid stenosis.

As far as one year survival is concerned, no death happened after hospital mortality for the three groups.

Finally, Table 3 shows a comparison between the three repair techniques' performance after one year as regards to five criteria, namely the incidence of chronic AF, pulmonary hypertension, improvement in dyspnea class, end diastolic dimension of the right ventricle and degree of tricuspid regurgitation. The first three factors reflect the success of left sided rheumatic pathology correction and are known to affect recurrence of tricuspid regurgitation.

In this study, there was a significant decrease in postoperative pulmonary hypertension in the three groups when compared with preoperative values (*P* value of paired *t* test < 0.001). However, the mean difference of decrease in pulmonary hypertension was insignificant when the three groups compared together (13.15 ± 7.3 mmHg for DB, 9.85 ± 4.06 mmHg for DV and 11.55 ± 6.46 mmHg for SA, *P* value of 0.240).

While majority of patients were having preoperative NYHA class of 3 (55% of each of DB and SA and 65% of DV group), they were having mostly postoperative NYHA class of 1 (70% of DB, 55% of DV, 75% of SA). Pre and postoperative p value of NYHA class were 0.58 and 0.44 respectively.

Similarly, the incidence of chronic AF before and after the operation was not significant when the three repair techniques were compared together; p value was 1.00 on discharge and was 0.85 after one year of follow up. Thus, the three factors that can affect the recurrence of TR remained comparable between the study groups.

The recurrence of tricuspid regurgitation was insignificant for all study groups. Around half of patients in each group did not have TR on discharge and after one year of follow up most of the patients had either no regurgitation or grade +1 TR. Two patients (10%) in DV group and one patient (5%) in SA group had moderate (+2) TR (*P* value of 0.74 and 0.78 for pre and postoperative TR respectively).

At last, reverse remodeling of the right ventricle end diastolic dimension is shown, and the mean difference of decrease in RVEED

Table 2
Hospital outcome and 1 year follow-up of the studied groups.

Hospital outcome		Flexible band		Devega		Seg. ann.		Test value	*P*-value
		No	%	No	%	No	%		
Predischarge tricuspid regurgitation grade (0 to +4)	No-trivial	5	25%	6	40%	5	40%	1.955*	0.744
	Mild (1)	12	65%	10	45%	13	50%		
	Mild to moderate (1–2)	2	10%	3	15%	2	10%		
Predischarge ejection fraction (%)	Mean ± SD	52.63 ± 5.84		52.65 ± 7.69		53.70 ± 6.15		0.169◆	0.845
	Range	40–60		30–62		40–62			
AF on discharge	No	13	68.42%	12	63.16%	12	60%	0.304*	0.858
	Yes	6	31.58%	7	36.84%	8	40%		
LCOP	No	17	85%	16	80%	16	80%	0.223*	0.895
	Yes	3	15%	4	20%	4	20%		
HF	No	17	85%	17	85%	17	85%	0.000*	1.000
	Yes	3	15%	3	15%	3	15%		
Reopening for bleeding	No	18	90%	18	90%	17	85%	0.323*	0.851
	Yes	2	10%	2	10%	3	15%		
Respiratory complications	No	17	85%	16	80%	17	85%	0.240*	0.887
	Yes	3	15%	4	20%	3	15%		
Septic complications	No	19	95%	19	95%	20	100%	1.034*	0.596
	Yes	1	5%	1	5%	0	0%		
RF	No	19	95%	20	100%	20	100%	2.034*	0.362
	Yes	1	5%	0	0%	0	0%		
Multiorgan Failure	No	19	95%	20	100%	20	100%	2.034*	0.362
	Yes	1	5%	0	0%	0	0%		
Pace maker	No	20	100%	19	95%	20	100%	2.034*	0.362
	Yes	0	0%	1	5%	0	0%		
One year follow-up									
AF after 1 Year	No	8	42.11%	9	47.37%	8	40.0%	0.227*	0.892
	Yes	11	57.89%	10	52.63%	12	60.0%		
RVEDD (cm)	Mean ± SD	2.54 ± 0.26		2.83 ± 0.31		2.72 ± 0.29		5.190◆	0.009#
	Range	2.3–3.2		2.2–3.4		2.4–3.3			
NYHA	1	14 (70%)		11 (55%)		15 (75%)		5.775*	0.449
	2	5 (25%)		6 (30%)		5 (25%)			
	3	0 (0%)		2 (10%)		0 (0%)			
	Died	1 (5%)		1 (5%)		0 (0%)			
EF (%)	Mean ± SD	55.35 ± 6.88		54.47 ± 5.06		55.30 ± 4.70		0.147◆	0.864
	Range	40–66		46–62		46–66			
TR grade (0 to +4)	No–trivial	7 (35%)		7 (35%)		8 (40%)		4.758*	0.783
	Mild (1)	10 (50%)		6 (30%)		8 (40%)			
	Mild to moderate (1–2)	2 (10%)		4 (20%)		3 (15%)			
	Moderate (2)	0 (0%)		2 (10%)		1 (5%)			
	Died	1 (5%)		1 (5%)		0 (0%)			
Need for reoperation	No	19 (100%)		19 (100%)		20 (100%)		NA	NA
	Yes	0 (0%)		0 (0%)		0 (0%)			

NA: Not applicable.
LCOP: Low cardiac output syndrome, HF: Heart failure, RF: Renal failure, RVEDD: Right ventricular end diastolic dimension, NYHA: New York Heart Functional Association Class, TR: Tricuspid regurgitation.
◆ One Way Analysis of Variance (ANOVA) test.
* Chi-squared test.
# Significant.

was highest in DB group (0.64 ± 0.47 cm) compared to DV group (0.18 ± 0.29 cm) or to SA group (0.16 ± 0.45 cm) with *p* value of 0.000● denoting that RV reverse remodeling happened significantly in DB compared to other repair techniques.

3. Discussion

TR is a significant clinical problem that may be undertreated by surgeons.[7] Moderate and severe TR have been associated with poor short-term and long-term survival, independent of ventricular function and pulmonary arterial pressure.[8] Similar to other reports, we operated upon patients having secondary (functional) regurgitation, caused by progressive annular dilation and decreased leaflet coaptation secondary to rheumatic left sided valve pathology.

Some authors hypothesized that the cause of secondary TR is mainly due to dilation of tricuspid annulus which results from a remodeling process of the right ventricle (RV) due to chronic pressure overload.[9] Therefore, treatment of left sided valve lesion alone only decreases the afterload, but has nothing to do with tricuspid dilatation or preload or right ventricular function.[4] Consequently, complete reverse RV remodeling may not occur, and normalization of pulmonary artery pressures alone will not eliminate TR in many patients.[10]

In patients with concomitant mitral valve disease, correcting the mitral valve lesion without treating the TV may improve mild TR.[11] However, if moderate or severe TR left untreated, TR may persist or even worsen after mitral valve surgery, leading to progressive heart failure and death.[12,13] In addition, reoperation for residual TR carries significant risks and may impose a poor prognosis.[14–16] It has, therefore, been recommended by some experts that a more aggressive approach should be taken in cardiac surgery patients with concomitant TR.[7,12,13,17]

As an alternative approach to the intraoperative assessment of the tricuspid annulus diameter, echocardiographic measurement of the tricuspid annulus diameter has been used. A tricuspid annulus diameter of 40 mm or more has been demonstrated to be equivalent to 7 cm intraoperatively.[18]

The optimal technique to repair the TV remains uncertain. Despite the fact that bicuspidization results are reasonable especially for rheumatic patients, it is now rarely performed.[19,20]

Table 3
Comparison between performances of the three repair techniques after one year.

		Dacron band No. = 20	Devega No. = 20	Seg ann No. = 20	Test value	*P*-value
Pul. HTN (mmHg)						
Before	Mean ± SD	56.30 ± 9.67	55.15 ± 10.15	56.30 ± 10.78	0.085◆	0.919
	Range	40–75	33–75	33–77		
After	Mean ± SD	43.15 ± 6.85	45.30 ± 8.07	44.75 ± 7.65	0.439◆	0.647
	Range	30–50	30–60	30–60		
Mean difference		13.15 ± 7.3	9.85 ± 4.06	11.55 ± 6.46	1.465◆	0.240
Paired *t*-test	*T*	11.197	10.861	7.986		
	p-value	<0.001	<0.001	<0.001		
RVEDD (cm)						
Before	Mean ± SD	3.18 ± 0.43	3.00 ± 0.33	2.88 ± 0.35	3.286◆	0.045#
	Range	2.5–4	2.6–3.7	2.4–3.5		
After	Mean ± SD	2.54 ± 0.26	2.83 ± 0.31	2.72 ± 0.29	5.190◆	0.009●
	Range	2.3–3.2	2.2–3.4	2.4–3.3		
Mean difference		0.64 ± 0.47	0.18 ± 0.29	0.16 ± 0.45	8.717◆	0.000●
Paired *t*-test	*T*	10.746	3.755	1.320		
	p-value	<0.001	0.002	0.188		
Predischarge TR grade (0 to +4)	No-trivial	5 (25%)	6 (40%)	5(40%)	1.955*	0.744
	Mild (1)	12(65%)	10 (45%)	13 (50%)		
	Mild to moderate (1–2)	2 (10%)	3 (15%)	2 (10%)		
TR grade (0 to +4) after 1 year	No–trivial	7 (35%)	7 (35%)	8 (40%)	4.758*	0.783
	Mild (1)	10 (50%)	6 (30%)	8 (40%)		
	Mild to moderate (1–2)	2 (10%)	4 (20%)	3 (15%)		
	Moderate (2)	0 (0%)	2 (10%)	1 (5%)		
	Died	1 (5%)	1 (5%)	0 (0%)		
AF on discharge	No	11(70%)	13(70%)	13(70%)	0.000*	1.000
	Yes	8(30%)	6(30%)	7(30%)		
AF after 1 Year	No	13 (68.42%)	12 (63.16%)	12 (60%)	0.304*	0.858
	Yes	6 (31.58%)	7 (36.84%)	8 (40%)		
Preoperative NYHA	2	5 (25%)	3 (15%)	2 (10%)	2.829*	0.587
	3	11 (55%)	13 (65%)	11 (55%)		
	4	4 (20%)	4 (20%)	7 (35%)		
Postoperative NYHA	1	14 (70%)	11 (55%)	15 (75%)	5.775*	0.449
	2	5 (25%)	6 (30%)	5 (25%)		
	3	0 (0%)	2 (10%)	0 (0%)		
	Died	1 (5%)	1 (5%)	0 (0%)		

Pul HTN: Pulmonary hypertension, RVEDD: Right ventricular end diastolic dimension, TR: Tricuspid regurgitation, AF: Atrial fibrillation.
◆ One Way Analysis of Variance (ANOVA) test.
* Chi-squared test.
# Significant.
● Highly significant.

As far as the DeVega suture annuloplasty is concerned, it is the most commonly used TV repair technique.[21] A number of series have reported its short and long-term success.[22–24] However, other investigators have reported a relatively high recurrence rate for the DeVega technique,[7,25] particularly in patients with severe tricuspid annular dilation and/or pulmonary hypertension.[19] It has been recommended that such patients undergo TV repair with an annuloplasty ring.[7,25–33] We therefore undertook the current study to compare hospital outcome and short-term results in patients undergoing TV repair with three repair techniques.

We elected to use dacron band as a flexible band to repair the tricuspid valve, the benefits of a flexible band, include the following:

1. Better early postoperative LV systolic function over patients with a rigid ring.[28]
2. Allows annular size and configuration to adapt to changes throughout cardiac cycle.
3. Better diastolic blood flow across the mitral valve, particularly during exercise.[29]
4. Flexible annuloplasty repair devices place less stress on the sutures during systole, minimizing the likelihood of dehiscence.[30]

In comparing the three repair techniques together, there was a significant improvement of the dyspnea class of patients, decrease in pulmonary hypertension, and non progression of tricuspid regurgitation grade. The first two factors improved after correcting the left sided rheumatic valve pathology and the third one is due to success of tricuspid valve repair. However, Dacron band annuloplasty confers significant improvements over segmental annuloplasty in right ventricular reverse remodeling, and a similar finding was found by some authors[18] which for sure means better outcome of the repair.

Moreover, atrial fibrillation has been demonstrated as a main risk factor for progression of functional TR after mitral valve disease.[10] and in this study its incidence was comparable between the three groups both on discharge and after one year excluding its role in the progression, recurrence or development of new tricuspid regurgitation.

Dreyfus et al. in 2005 found that TV annuloplasty has been associated with a higher rate of pacemaker requirement. In contrary to his finding, no patients had DB implantation in this study required a pacemaker, and the only patient needed pacemaker implantation was in DV group.[4]

Several other studies support our finding of the superiority of TV repair with an annuloplasty ring.[7,12,24–26] A prospective randomized study of 159 patients conducted by Rivera et al.[25] comparing the DeVega suture to Carpentier ring annuloplasty demonstrated a higher recurrence of moderate and severe TR in the DeVega group at 45-month follow-up.

Similarly, in a study of 790 patients who underwent TV repair for secondary TR, McCarthy et al. reported that TR recurred early and progressed to moderate and severe degree after pericardial and DeVega suture repairs ($P = 0.002$ and $P = 0.06$, respectively, compared with the Carpentier ring).[7]

A similar study in 45 patients by Matsuyama et al. showed a 45% recurrence of 2+ to 3+ TR in DeVega compared with only 6% in the Carpentier repair group ($P = 0.027$).[22] Freedom from moderate and severe TR at a mean follow-up of 39 ± 23 months was 45% in the DeVega group and 94% in the Carpentier group.

Other studies have demonstrated similar results.[26,27,31,32] All these findings suggest that an annuloplasty band or ring is recommended in patients undergoing TV repair, particularly in those with more severe TR, to avoid future recurrence as compared to merely suture based techniques.

However, whether segmental annuloplasty is better than or equal to dacron band repair on long-term results is unclear because the former technique has been reported to lower the risk of suture dehiscence and recurrent TR.[33] Nevertheless, we expected to find a marked benefit of tricuspid annuloplasty band and our results have prompted a change in surgical practice at our institution.

4. Study limitations

Our study has several limitations. One limitation of our study is that TV repair technique could be biased by surgeon preference and lack of randomization. The fact that patients who received an annuloplasty band exhibited better short-term results further supports our conclusions that annuloplasty band should be used more frequently in TV repair surgery.

Moreover, small number of the three study groups, short period of follow-up and use of right ventricular end diastolic dimension alone to show reverse remodeling process are other limitations in this study. Might be better if we use right ventricle long and short axis measurements as some authors did.[18]

5. Conclusion

The three techniques are options to repair the tricuspid valve, however, placement of Dacron band in patients undergoing tricuspid valve repair is associated with better RV remodeling, and hence, a probable better right ventricular performance and better outcome of repair is expected. A higher number of patients are needed with longer follow up period to appreciate the effect on survival and rate of freedom from tricuspid regurgitation and re-intervention.

Disclosures

None.

Conflicts of interest

None declared.

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