

Dacron Band versus de Vega Annuloplasty for Functional Tricuspid Regurgitation**Hamed Helal^{a*}, Mostafa Agha^a, Wael Hassanein^a, Mohamed Hassanein^a**

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Abstract

Background: Typically Functional (secondary) tricuspid insufficiency is the most prevalent tricuspid valve disease on top of mitral diseases. Different repair techniques were introduced to deal with this problem.

Objectives: The target of this study was to evaluate the repair of Tricuspid valves using a commonly used suture annuloplasty technique (DE VEGA) versus a patient-tailored synthetic band made of Dacron short-term results.

Patients and methods: From January 2021 to October 2022, 40 patients with secondary tricuspid insufficiency participated in our prospective cohort single-center study. we equally split the patients into two different groups. A total of 20 patients were randomized to the flexible Dacron band group while the remaining 20 patients were allocated to the De-Vega annuloplasty technique group. Preoperative data, major intraoperative and immediate postoperative adverse events, and postoperative regurgitation were assessed.

Results: studied groups' properties regarding Demographic and Preoperative echo data were statistically comparable. The rate of acute postoperative morbidities and complications had no statistical significance. There was no significant difference in postoperative recurrence of tricuspid insufficiency Around (85%) of patients in the De-Vega group and (90 %) in the Band group did not have TR on discharge and after 6 months of follow-up. There was no statistical significance in the incidence of immediate post-operative complications.

Conclusions: Tricuspid repair using a customized Dacron band is a reliable surgical technique for functional Tricuspid Regurgitation. Additional studies with a larger number of patients and a longer term of follow-up are needed to confirm our findings.

Keywords: Valvular heart disease; Suture annuloplasty; Valve repair; De Vega technique.

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Introduction

Secondary tricuspid regurgitation (TR) is the most common type of tricuspid valve (TV) disease, and tricuspid surgical interventions are nowadays becoming more and more recommended (Rogers et al.,2009). Functional TR is most often caused by annular dilatation secondary to mitral valve diseases mostly stenosis. Pulmonary blood pressure increases, and Right ventricle hypertrophy and dilatation will occur as left atrial pressure rises. This leads to cycles of Tricuspid valve insufficiency development, leading to volume overload, which causes progressive annular dilatation and increases in tricuspid insufficiency (Raja et al.,2009).

More research points to the fact that functional TR does not treat by only correction of the cause for example by doing mitral valve (MV) replacement or excision of large myxoma in left atrium, particularly in cases where dilatation of tricuspid annulus is detected. More aggressive TR therapy during the first cardiomy may be necessary as high-risk procedures for repairing tricuspid valves after previous open heart surgery with mortality up to 8% in some studies (Nath et al.,2004; Bernal et al., 2005). To improve patient outcomes, simultaneous tricuspid repair should be carefully examined when MV surgery is performed in the context of annular dilatation of TV. Physicians must therefore be well-versed in the anatomy of the TV, its pathophysiology, as well as current and future functional TR repair techniques in order to act on TR.

In the current practice, placement of an annuloplasty ring is associated with decreased recurrence of TR more than the DE-VEGA technique (Sohn et al.,2021). Few papers compare the efficacy of cost-effective fashioned Dacron band and conventional DE-VEGA.

Patients and methods

At Alexandria University hospitals, after approval of the local ethics committee and written informed consent were taken, a prospective study was conducted, 40 patients who had moderate or higher secondary TR had tricuspid valve repair and mitral valve replacement or repair between January 2021 and October 2022. The tricuspid valve was repaired in 20 of these instances using DE VEGA repair technique (group A), and in the remaining 20 cases with fashioned bands made of Dacron (group B). The choice of repair technique was decided randomly.

Ethics approval and consent to participate: Our research was approved by ethics committee in Alexandria university faculty of medicine. furthermore, Patients were informed and signed written consents for publishing of clinical data.

Preoperative information gathering: The following information were collected and examined: Preoperative data: age, sex, clinical status assessment by (NYHA) score for dyspnea, transthoracic echo (TTE) findings ,TR degree, tricuspid annulus, systolic pulmonary artery pressure , tricuspid annular plane systolic excursion (TAPSE), It evaluates the tricuspid valve annulus' free edge's longitudinal systolic motion., tricuspid annulus (TA) diameter, left ventricle end-diastolic dimensions (LVEDD), left ventricle end-systolic dimensions (LVESD) and ejection fraction.

Surgical data: Collection and analysis of data on cardiopulmonary bypass time, cross-clamp ischemic time, transesophageal assessment of tricuspid regurge in each group, mitral valve intervention, and any other treatments

ICU data:Time of mechanical ventilation in hours, duration of intensive care unit (ICU) admission in days, post-surgical hospital stay, post-operative morbidities, mortality cases, and follow-up

echo postoperative transthoracic echo before hospital discharge.

Follow-up data: In outpatient clinics follow up after 3 months of surgery and finally after 6 months of surgery for all patients in both groups and compare the post-operative clinical and echo data with the preoperative NYHA score, TR degree, pulmonary pressure, and other echo findings.

Operative technique

TV repair was conducted after other associated cardiac interventions i.e. Mitral Replacement, always with the heart beating after de-airing and cross clamp removal and fastening of SVC and IVC snares around venous cannulae while patient is warm and before weaning from bypass. Right atriotomy was done in standard fashion and saline test performed prior to repair to assess valve competency.

The band will be made of Dacron material designed to extend from the anteroseptal commissure to posteroseptal commissure depending on septal leaflet sizer's two notches that comparable to the two commissures. Accordingly, the Dacron band length was equal to the distance between the proper ring sizer's two notches after sizing of the septal leaflet. 7 to 8 interrupted sutures of 2/0 Ethibond are usually needed to stitch the tricuspid annulus from anteroseptal commissure to posteroseptal commissure. Stitches are taken perpendicular to the plane of the annulus avoiding injury of right coronary artery and conduction system. presized Dacron band and fixed in supra-annular position after the band is lowered down fixing the annulus to a new reduced annulus size (**Fig.1**).

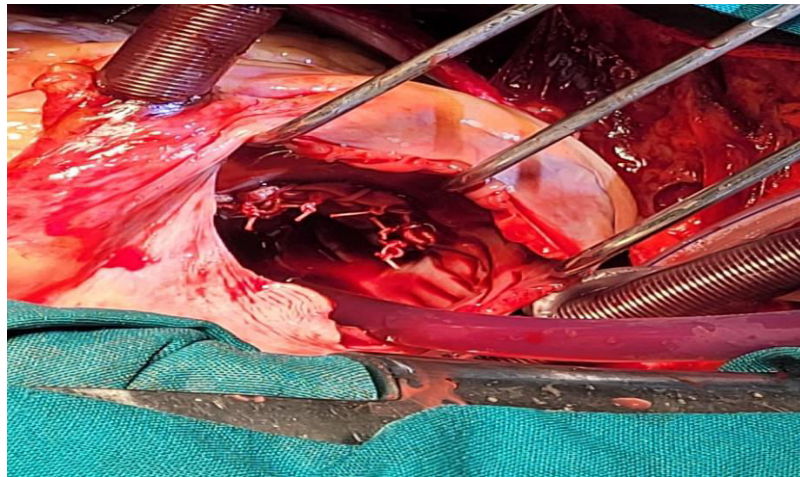


Fig.1. Dacron band Tricuspid annuloplasty

The remaining patients were had DeVega annuloplasty using pledged ethibond sutures taken from the posteroseptal commissure to the anteroseptal commissure, the pledgets sutures were tied. Some surgeon use two finger to avoid tricuspid stenosis. Others may use a large mitral sizer. All methods of repair will be followed by saline test intraoperatively and the repair technique will be considered

successful if equal to or less than mild regurgitation was encountered.

Statistical analysis

The data was fed to the computer and then was analyzed by using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data is described using numbers and percent. Quantitative data is described by using the mean and standard deviation. The results were considered

significant at the 5% level. Chi-square categorical test was used for variables, to compare between different groups, Fisher's Exact or Monte Carlo correction when more than 20% of the cells have expected count less than 5, Student t-test For normally distributed quantitative variables, to compare between two studied groups, Mann Whitney test For abnormally

distributed quantitative variables, to compare between two studied groups

Results

Preoperative patient characteristics are summarized in (Table.1 & Table.2) including clinical, epidemiological, and echocardiological data. There was no significant difference statistically between the two groups, indicating that the two study groups were well-matched.

Table.1. Comparison between the two studied groups according to Gender and Age.

Demographic data	DE VEGA repair (n = 20)		DACRON band (n = 20)		P
	No.	%	No.	%	
Gender					
Female	13	65	15	75	0.564
Age (years)					
Min. – Max.	28-61		37-61		0.723
Mean ± SD.	44.55±9.1		47.38±9.5		

p: p value for comparing between the studied groups; **SD**: Standard deviation,

Table 2. Difference between the two studied groups according to pre-operative echo and clinical data

Variables	DE VEGA repair	DACRON Band	P-Value
TR GRADE			
Moderate	4(20%)	5(25%)	0.7085
Severe	16(80%)	15(75%)	0.7085
TR ANNULUS	36–46	36–48	
	43.03 ± 3.068	43.03 ± 3.449	0.958
TAPSE (mm)	19.16±1.543	18.94±2.38	0.7306
Mitral Stenosis	13(65%)	8(40%)	0.115
Mitral Regurge	2(10%)	4(20%)	0.381
Mixed lesion	5(25%)	8(40%)	0.3717
Other cardiac Diseases	2(10%)	4(20%)	0.3819
NYHA class	3.25±0.6386	2.94±0.74	0.1619
AF	7(35%)	10(50%)	0.688
LVEF %	57.526± 6.266	58.631 ±5.41	0.5541

LVESD	33.842± 6.865	36.473± 6.414	0.2301
LVEDD	57.263± 8.880	57.157 9.124	0.9713
PASP	48.421 ± 12.588	50.789 ±12.651	0.5666

The mitral valve affection was rheumatic in origin in 39(97.5%) cases of the study. There was no statistically significant difference of bypass time and clamp time (*p* value=0.327 and 0.129 respectively) (**Table.3**), regardless of the theoretical concept that placement of band may need more time than the De Vega technique. Other operative and postoperative parameters are shown in (**Table .3**) with no statistically significant differences between both groups.

Comparison of the preoperative and 6 months postoperative values for the degree of TR, and decline in PASP revealed a statistically significant decline in both groups at the end of follow up period, (*p* value = 0.04) for the degree of TR, and (*p* value = 0.04) for the systolic pressure of the pulmonary artery (PASP). However, there was no statistically significant difference between both groups (*p* value = 0.475 for TR and 0.676 for PASP).

Table.3. Operative and ICU data in both study groups

Variables	Group A (DE VEGA) n =20	Group B (DACRON Band) n=20	P value
Bypass time (min)	95.157 ±16.604	96.631 ±10.641	0.327
ischemic time (min)	70.26 ±16.812	63 ±12.489	0.1395
Concomitant mitral valve surgery :			
Repair	2 (10%)	3(15%)	0.636
Replacement	18(90%)	17(85%)	
Other Cardiac Operation			0.381
Aortic replacement, ASD closure	2(10%)	4(20%)	
Mechanical ventilation(hr)	6.473 ± 1.678	6.473± 2.037	0.5130
ICU stay(days)	3.368± 0.597	3.526 ± 0.772	0.4849
Hospital stays (days)	6.421± 0.837	6.578 ±1.387	0.6752

Only One patient (5%) from the Devega group and one patient (5%) from the BAND group explored for bleeding, No

significant difference statistically was detected regarding the post-operative complication (**Table.4**).

Table 4. Post-operativ complications of study groups

Variables	(DE VEGA) n =20	(DACRON Band) n=20	P value
Reoperation for bleeding	1(5%)	1(5%)	1.000
Renal failure	0(0%)	1(5%)	0.317
Pneumonia	2(10)	1(5%)	0.553
In-hospital mortality	0(0%)	0(0%)	1.000
Pacemaker	1(5%)	0(0%)	0.317

After 3 and 6 months of follow-up, TR was insignificantly different between the two groups (**Table.5**). 85 % of patients in the De Vega group and 90 % in the Band group did not have TR after 6 months of follow-up. no patients had severe

regurgitation TR. one patient (5%) in the De Vega group and one patient (5%) in the customized Dacron group had moderate TR (P value of 0.676 and 0.475 for pre and postoperative TR respectively).

Table 5. TR follow-up of both groups

Variables	post-operative	3 months	6months
<u>DE VEGA</u>			
no	19(95%)	18(90%)	17(85%)
mild	1(5%)	1(5%)	2(10%)
moderate	0	1(5%)	1(5%)
severe	0	0	0
<u>Band group</u>			
no	20(100%)	19(95%)	18(90%)
mild	0	1(5%)	1(5%)
moderate	0(0%)	0(0%)	1(5%)
severe	0(0%)	0(0%)	0(0%)
p value	0.896	0.498	0.475

Only one patient (5%) in the suture (De Vega) group needs a temporary pacemaker (p-value = 0.317). Clinical and

echo data of the two groups after 6 months of follow-up found there is no difference between both groups (**Tables.6 ,7**).

Table 6. Echo follow-up of the two groups after 6 month

Variables	(DE VEGA) n =20	(DACRON Band) n=20	P Value
RVEDD (cm)	2.884±0.174	2.784±0.180	0.0820
TAPSE	19.210±1.315	19.473±1.925	0.6168
PSAP	42.263 ± 5.733	43.684± 8.306	0.5327
EF	57.33 ± 8.766	57.27 ± 8.238	0.9823

Table 7. Comparison between the two studied groups according to clinical data(NYHA) after 3 and6 months.

Variables		DE VEGA (n=20)	Band group (n=20)	<i>p</i> <i>value</i>
3 months	I	16(80%)	17(85%)	0.681
	II	3(15%)	3(15%)	1.000
	III	1(5%)	0	0.317
	IV	0	0	1.000
6months	I	17(85%)	18(90%)	.636
	II	3(15%)	2(10%)	.636
	III	0	0	1.000
	IV	0	0	1.000

Discussion

Moderate to severe TR has been linked to poor short- and long-term mortality, regardless of ventricular performance or pulmonary arterial pressure (Nath et al., 2004; McCarthy et al.,2004). We operated on patients with secondary (functional) regurgitation induced by increasing annular dilatation and reduced leaflet coaptation due to rheumatic left-sided valve disease.

Without treating the TV, the mitral valve defect may alleviate mild TR. If moderate or severe TR is not treated, it may remain or worsen following left sided valve(mitral) surgery, leading to heart failure and mortality. Furthermore, reoperation for residual TR entails major risks and may result in a bad prognosis. As a result, some doctors have advocated for a careful decision in cardiac surgery patients with simultaneous TR (Kusajima et al.,2016; Tornos et al.,2015).

The ideal repair model for TV was not recognized yet. the most commonly used technique is suture annuloplasty (DE Vega technique). A number of series have reported its short and long-term success. However, other studies have reported a relatively high recurrence rate for the DE Vega technique, particularly in patients with

high pulmonary blood pressure and/or severe tricuspid annular dilation. It has been recommended that such patients undergo TV repair with an annuloplasty ring (Morishita et al.,2002; Rivera et al.,1985; Yada et al.,1990; Raja and Dreyfus,2009; Duran et al.,1993; Antunes et al.,1983).

As a result, we conducted this research to assess the hospital and short-term outcomes in patients having Tricuspid repair using the De-Vega versus Dacron Band approach.

A retrospective study of 231 consecutive patients with three different repair modalities reveals significantly longer cardiopulmonary duration in the band group than De Vega group. tricuspid regurgitation Severity, pulmonary artery systolic pressure, and right atrial diameters showed significant improvements, compared to De Vega result, in the Band annuloplasty group. in our study the duration of cardiopulmonary bypass for the two groups are comparable (Lafci et al.,2019).

In 2009, TV annuloplasty was linked to a greater need for pacemakers. Contrary to this conclusion, no patients who had Band implants needed a pacemaker in this study, and the sole patient who required pacemaker installation was in the DeVega group (Raja and Dreyfus,2009).

McCarthy found that following pericardial and DE Vega suture repairs, TR recurred after De Vega early and developed to a severe degree ($P = 0.002$ and $P = 0.06$, respectively), in a study of 790 patients who had TV repair (McCarthy et al.,2004). Similar findings have been shown by other investigations. All of these data imply that, as opposed to purely suture-based procedures, an annuloplasty band or ring is advised for patients undergoing TV repair, especially in those with more severe TR (Morishita et al.,2002; Raja and Dreyfus,2009).

No significant difference statistically was detected regarding the post-operative complication between 2 groups in our study. Comparable results were observed in retrospective cohort research (Basel et al.,2010).

Several studies used a pericardial strip for tricuspid annuloplasty with good results regarding long-term survival in comparison to suture annuloplasty (De Vega or Kay). We modified this technique by using Dacron band which has the advantages of strength, and durability avoiding pericardial calcification later on and providing a cost-effective solution in redo cases that lack pericardium (Chang et al.,2008; Jiang et al.,2019).

We took the decision to fix the tricuspid valve using a flexible Dacron band. A flexible band has the following advantages: it Permits for changes in annular structure and size during the cardiac cycle. Despite the fact that a study of 300 patients found that both rigid rings and flexible bands provided satisfactory results for functional tricuspid regurgitation repair, At 12-month follow-up, the flexible band had a benefit in restoring regional ventricle function (TAPSE) And decreases the rate of dehiscence, flexible annuloplasty repair devices minimize suture tension during

systole (Bogachev-Prokophiev at al.,2021; Pfanmuller et al.,2012).

Conclusion

Tricuspid repair using fashioned Dacron band for functional TR is an accepted option especially with lack of rings and high recurrence rate of De Vega. However, further studies with longer term of follow-up of our patients are necessary to confirm durability of our findings.

Conflict of interest: None

List of abbreviations

AF	:	Atrial Fibrillation
ICU	:	Intensive care unit
NYHA:		New York Heart Association
PT	:	Prothrombin Time
PTT	:	Partial thromboplastin time
RCA	:	Right Coronary Artery
TAPSE:		tricuspid annular plane systolic excursion
SD	:	Standard Deviation
TR	:	Tricuspid Regurge
TV	:	Tricuspid Valve

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