Rheumatic tricuspid valve disease: Repair versus Replacement

Ahmed M. Elwakeel[a*] , Ashraf A.H. El Midany[b], Ismail N. El-Sokkary[c], Mohamed El-Hossiny Mahmoud[c], Bahaa A. Elkhonezy [c], Haytham M. Abdelmoaty [b], Mohammed Wael Badawi [b], Tamer Hikal [c], Mohamed H. Ahmed [b],Ahmed A. Khaled [d], Mohammed E. ElSaid [b], Ibrahim K. Gamil[b], Mahmoud khadrawy[e],Mahmoud Elwakeel[f], Eman Mahmoud [g], Ahmed H. Lamloom[a]

[a]Department of Cardio-Thoracic Surgery, Faculty of Medicine, Cairo University, Giza, Egypt.

[b]Department of Cardiovascular & Thoracic Surgery, Ain-Shams University Hospital, Faculty of Medicine, Cairo, Egypt.

[c]Department of Cardiovascular & Thoracic Surgery, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.

[d]Department of Cardiovascular & Thoracic Surgery, Military Medical Academy, Cairo, Egypt.

[e]Department of Cardiovascular & Thoracic Surgery, Nasser Institute, Cairo, Egypt.

[f]Department of Anesthesia, Surgical ICU, and Pain Management, Faculty of Medicine, Cairo University, Giza, Egypt.

[g]Department of Cardiology, Fayoum University, Fayoum, Egypt.

Abstract

Background: Tricuspid valve disease is most commonly functional, however, organic affection still accounts for one fourth of cases. Rheumatic fever which is endemic in Egypt is a main cause of organic affection. Current practice largely relies on tricuspid valve repair; however, it has been difficult to determine optimal procedure.

Objectives: Herein, we study the outcome of replacement versus repair in such patients.

Patients and methods: A prospective study was conducted on 300 consecutive patients with rheumatic heart disease showing severe tricuspid valve affection underwent tricuspid valve surgery, between 2014 and 2018. The patients were divided into two groups; TVR group (n=150) which included patients who underwent tricuspid valve replacement and TVr group (n=150) which included patients who underwent tricuspid valve repair. Diagnosis and follow up were done by echocardiography. Peri-operative variables, clinical outcome, morbidity, mortality, and follow up data were recorded.

Results: Mean follow-up was 4±1.32 years. In-hospital mortality was 6 patients (4%) in TVR group and 3 patients (2%) in TVr group (P value ≥ 0.05). Postoperative low cardiac output syndrome and stroke were significantly higher in the repair group. Postoperative RV dysfunction, renal impairment, renal failure and chest re-exploration were significantly higher in the replacement group. Severe tricuspid regurgitation was reported in 19 patients (12.6%) of the repair group on follow up.

Conclusion: Tricuspid valve repair is preferable to replacement to avoid the drawbacks of prosthesis. However, tricuspid valve replacement is feasible with comparable survival outcome and the progressive nature of the rheumatic disease may recommend replacement.

Key words: Rheumatic valve disease; Primary tricuspid valve disease; Tricuspid valve repair; Tricuspid valve replacement; Outcome.

DOI: 10.21608/svuijm.2022.155076.1372

*__Correspondence__: aelwakeel@kasralainy.edu.eg

Received: 9 August,2022.

Revised: 23 August,2022.

Accepted: 27 August,2022.

Cite this article as: Ahmed M. Elwakeel, Ashraf A.H. El Midany, Ismail N. El-Sokkary, Mohamed El-Hossiny Mahmoud, Bahaa A. Elkhonezy, Haytham M. Abdelmoaty, Mohammed Wael Badawi, Tamer Hikal, Mohamed H. Ahmed, Ahmed A. Khaled, Mohammed E. ElSaid , Ibrahim K. Gamil, Mahmoud khadrawy, Mahmoud Elwakeel, Eman Mahmoud, Ahmed H. Lamloom (2022). Rheumatic tricuspid valve disease: Repair versus Replacement. *SVU-International Journal of Medical Sciences*. Vol.5, Issue 2, pp: 428-441 .

Introduction

Tricuspid valve disease (TVD) either regurgitation or stenosis may be primary or secondary. Most of the TVD have a functional etiology, however, the primary causes still account for 25% of TVD cases. The major causes for primary TVD include rheumatic fever, infective endocarditis, congenital diseases, and carcinoid syndrome. Despite rheumatic TVD is rare in developed countries, it is common in developing countries, secondary to the endemic rheumatic fever(**Mao et al., 2016).**Tricuspid valve disease is commonly insidious in onset and may be well tolerated for years. Medical therapies such as diuretics are an option in management strategy of TVD; however, surgery is the most definitive treatment for severe TVD to avoid its deleterious effect on right ventricular (RV) function**. (Matebele et al., 2010; Nishimura et al., 2014; Rogers and Bolling, 2009; Vahanian et al., 2012)**

Tricuspid valve surgery has always been a challenging and debatable. Although the current practice largely relies on tricuspid valve repair and several investigators have purported the potential benefit of repair over replacement in the tricuspid position, it has been difficult to develop firm conclusions as to the optimal procedure, especially non-negligible rates of recurrent tricuspid regurgitation can still be observed at midterm follow-up despite recent annuloplasty devices. Tricuspid valve replacement plays a role when etiologic mechanisms besides annular dilation coexist**. (Breyer et al., 1976; Buzzatti et al., 2014; Chidambaram et al., 1987; De Bonis et**

al., 2012; McGrath et al., 1990; Ratnatunga et al., 1998).

The decision as to whether a patient should undergo tricuspid valve repair (TVr) or replacement (TVR) is one of the most difficult challenges especially if the disease has a progressive nature as in rheumatic pathology. Hence, our purpose to appraise the outcome of tricuspid valve replacement versus repair in patients with rheumatic heart disease associated with severe tricuspid valve disease.

Patients and methods

After approval of local ethics committee and written informed consent, a prospective study was conducted, between 2014 and 2018, on patients with rheumatic heart disease associated with severe tricuspid valve disease who underwent tricuspid valve surgery, repair or replacement. Patients who needed combined valve procedures were also included.

Patients with mild and moderate tricuspid valve lesions and patients with congenital tricuspid valve dysfunction or Ebstein anomaly, or endocarditis were excluded.

The patients were divided into two groups; TVR Group (n=150) which included patients who underwent tricuspid valve replacement and TVr Group (n=150) which included patients who underwent tricuspid valve repair.

Routine preoperative clinical assessment and work up were done for all patients. Standard surgical technique via median sternotomy including cardiopulmonary bypass and mild systemic hypothermia (32o c) were done.

Tricuspid valve replacement was performed on beating heart in cases of isolated TVD and on arrested heart if combined with other valve procedures. Valve prosthesis choice was according surgeon preference. The valve was implanted using interrupted transverse pledgetted mattress 2/0 Ethibond sutures (Ethicon, Inc., a Johnson & Johnson company; Somerville, NJ). Repair techniques included ring or suture annuloplasty with or without commissuroplasty.

Replacement was the choice when the valve leaflets had a major degree of structural deformity and in the cases of failed previous repair. Repair was chosen when the annular dilation is the main cause for tricuspid regurgitation (TR) with or without minimal leaflet deformity or leaflet tethering.

Warfarin therapy was started on first postoperative day to maintain the INR within a range of 2.5 to 3.5 in the TVR group and within a range of 1.5 to 2.5 in cases of ring annuloplasty in TVr group.

Follow up was carried out periodically every month in outpatient clinics, in addition to the visits for the warfarin dosage adjustment.

Studied variables were the preoperative patient characteristics, operative data, and postoperative outcome including mortality and morbidity and to identify its possible patient-related risk factors.

Mortality and morbidity was defined according to the guidelines for reporting mortality and morbidity after cardiac valve interventions (**Nishimura et al.,2014**). Recurrence of TR was defined as more than moderate degree of TR on follow-up echocardiography.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. Independent-samples t-test of significance was used when comparing between two means. Paired sample t-test of significance was used when comparing between related samples. Chi-square (x2) test of significance was used in order to compare proportions between qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the Probability (p-value) was considered significant as the following: P-value <0.05 was considered significant. P-value <0.001 was considered as highly significant.P-value >0.05 was considered insignificant.

Results

300 consecutive patients were included in the study. The mean follow-up period was 4±1.32 years. Of the total population, 212 patients (70.6%) had completed the study.

The mean age was 41.68±4.38 years in TVR group and 40.6±4.41 years in TVr group. The estimated EuroscoreII was 4.0±1.0 in TVR group and 3.5±1.1 in TVr group, (P-value ≥ 0.05).

The mortality was 6 patients (4%) in TVR group and 3 patients (2%) in TVr group, (P-value ≥ 0.05). The main causes of death were low cardiac output due to RV failure, acute renal shutdown and multisystem failure.

Most patients in this study (n=138, 46 %) were presenting in NYHA class III in both groups, with 71 patients (47.3%) in TVR group and 67 (44.7%) in TVr group. All preoperative characteristics were similar in both groups. The main valve lesion was pure tricuspid regurgitation in 185 patients (61.6%) of both groups, 87 of them in TVR group and 98 in TVr group, p value >0.05. The majority of cases were having mainly severe tricuspid regurgitation alone or with variable degree of stenosis, and only 2 cases in each group were having pure severe tricuspid stenosis, p value = 0.06, as mentioned in (**Table 1**).

Table 1. Preoperative data of two groups of patients undergoing tricuspid valve repair or replacement for rheumatic tricuspid valve disease

Preoperative data	TVR group (n=150)	TVr group (n=150)	P-value
Gender Female	90 (60.0%)	94 (62.7%)	0.635
Age (years) Mean±SD	41.68±4.38	40.60±4.41	0.134
Euroscore II	4.0 ± 1.0	3.5 ± 1.1	0.08
NYHA Class II Class III Class IV	 51 (33.7%) 71 (47.3%) 28 (18.7%)	 65 (43.3%) 67 (44.7%) 18 (12.0%)	0.07
Diabetes	23 (15.3%)	28 (18.6%)	0.38
Systolic PAP (mmHg)	47.31 ± 8.05	48.52 ± 7.94	0.08
Preoperative rhythm Sinus rhythm Atrial fibrillation	 122 (81.3%) 28 (18.7%)	 115 (76.7%) 35 (23.3%)	0.08
Renal Chronic RF-dialysis Cr>200 umol/l	 5 (3.3%) 1 (0.7%)	 2 (1.7%) 0 (0.0%)	0.14
Liver dysfunction Increase bilirubin (≥2 mg/dl) Ascites	 22 (18.0%) 21 (14.0%)	 18 (12.0%) 15(10.0%)	0.43
Tricuspid Valve Pathology Regurgitation Stenosis combined	 87 (58.0%) 2 (1.3%) 61 (40.7%)	 98 (65.3%) 2 (1.3%) 50 (33.3%)	0.06

NYHA: New York Heart Association; RF: Renal Failure; Cr: Creatinine, PAP: Pulmonary Artery Pressure.

Tricuspid valve repair was a combined procedure with left sided heart valve surgery in all patients of TVr group and in those patients the tricuspid valve showed moderate rheumatic leaflet and chordal affection; however, isolated tricuspid valve replacement was indicated in 49 patients (32.7%) due to failed prior tricuspid repair and 50 patients (33.3) due to severe tricuspid valve deformity and 51 patients (34%) of TVR group had concomitant left side valve surgery, most common was mitral valve replacement (n-42 (27.9%), of them 7 patients (4.6%) were operated for a second time.

All cases with failed previous TVr, had TVR, as rheumatic valve affection is a progressive disease, and a second repair was judged to have a high risk of failure.

Emergency surgery was indicated in 12 patients (8%) of TVR group and 2 patients (1.3%) of TVr group. Isolated mitral valve replacement – whether operated for the first time or redo - was the most frequently performed concomitant operation in the study (n=155, 51.7%). Mean aortic cross clamp and total bypass times were longer in repair group, however this was not significant, as shown in (**Table.2**).

Table 2. Operative data of patients undergoing either tricuspid valve replacement or repair for rheumatic tricuspid valve disease

Operation details	TVR group (n=150)	TVr group (n=150)	p-value
Cross clamp time (min)	52.30±12.32	54.93±13.43	0.265
Total bypass time (min)	71.53±18.83	79.03±20.03	0.063
Isolated TV Procedures			
Failed prior repair	49 (32.7%)	0 (0.0%)	<0.001
Severe TV deformity	50 (33.3%)	3 (2.0%)	
Concomitant valve surgery	**51 (34%)**	**150 (100%)**	
Mitral valve replacement	35 (23.3%)	87 (58.0%)	
Aortic valve replacement	3 (2.0%)	0 (0.0%)	
Double valve replacement	0 (0.0%)	31 (20%)	0.258
Redo Mitral valve Procedure	7 (4.6%)	26 (17.3%)	
Redo Aortic valve replacement	6 (4.0%)	0 (0.0%)	
Redo Double valve replacement	0 (0.0%)	6 (4.0%)	
Operative priority			
Elective	130 (86.7%)	142 (84.7%)	0.072
Emergency	12 (8.0%)	2 (1.3%)	
Urgent	8 (5.3%)	6 (4.0%)	

TV = Tricuspid Valve

Most patients in the replacement group received bioprosthesis (n=121, 80.6%) and 29patients (19.4%) received mechanical valves. In the repair group, 127 patients (84.7%) were repaired by suture annuloplasty, 18 patients (12%) were repaired by commissurotomy and suture annuloplasty, and 5 patients (3.3%) were repaired by ring annuloplasty using Carpentier Tricuspid annuloplasty ring(Edwards Lifesciences LLC; Irvine, Calif)

The postoperative low cardiac output syndrome and stroke were significantly higher in the repair group with more than half of patients in the TVr group having low cardiac output vs 40.7% of the . On the other hand, postoperative renal impairment, renal failure and chest re-exploration were

significantly higher in the replacement group. However, there were no differences between both groups for postoperative arrhythmia including transient or permanent pacing for heart block, ventilation duration, mean intensive care unit and hospital stay as shown in (**Table.3**).

Table 3. Postoperative data of two groups of patients undergoing either tricuspid valve replacement or repair for rheumatic tricuspid valve disease.

Post-Operative data	TVR group (n=150)	TVr group (n=150)	p-value
NYHA **Class** I **Class** II **Class** III **Class** IV	 80 (53.3%) 46 (30.7%) 22(14.7%) 2 (1.3%)	 59 (39.3%) 55 (36.7%) 32 (21.3%) 4 (2.7%)	<0.001**
Low Cardiac Output	61 (40.7%)	83 (55.3%)	<0.001**
Arrhythmias AF Permanent heart block requiring pacing Transient heart block (<24 hours)	 4 (2.7%) 4 (2.7%) 2 (1.3%)	 5 (3.3%) 2 (1.3%) 0 (0.0%)	0.102
Re-exploration for bleeding	13(8.7%)	9 (6.0%)	0.04
Sternal Re-suturing	15 (10.0%)	15 (10.0%)	1.000
Stroke	0 (0.0%)	5 (3.3%)	0.024*
Renal Complications Renal impairment (Cr. >3.1) Renal failure (need dialysis)	 8 (5.3%) 5 (3.3%)	 5 (3.3%) 0 (0.0%)	0.007*
Resisual TR **Trivial or Mild** **Moderate** **Severe**	 138 (92%) 12 (8%)	 97 (64.6%) 34 (22.7%) 19 (12.6%)	0.04
Mean gradient on TV	2.68±0.97	3.82±0.77	0.134
Systolic PAP (mmHg)	41±8.87	33.89 ± 6.99	0.001*
RV dysfunction	59 (39.3%)	26 (17.3%)	0.001*
Ventilation duration (hours)	10.9±2.4	12.3±3.7	0.07
ICU stay (days)	2.6±0.6	2.2±0.5	0.090
Hospital stay (days)	7.81±1.51	8.11±1.56	0.100
Mortality	6	3	0.13

NYHA: New York Heart Association; TR: Tricuspid Regurge, Cr: Creatinine; PAP: Pulmonary Artery Pressure, RV: right ventricle. TV: tricuspid valve

Postoperative echocardiographic data showed a persistently high mean systolic pulmonary artery pressure in TVr group (41.31±8.87), (P value ≥ 0.05) but it significantly decreased from 47.31±8.05mmHg to 33.89±6.99mmHg in the TVR group, (P value ≤ 0.001).However, postoperative RV dysfunction was higher in TVR group (59 patients, 39.3%) than inTVr group (26 patients,17.3%),(P value ≤ 0.001).

Follow up echocardiographic data showed that 97 patients (64.6%) in the repair group had mild tricuspid valve regurge (TR),34 patients (22.7%) had moderate TR, and 19 patients (12.6%) had severe TR; however, there were 138 patients (92%) in the replacement group had a mild or trivial TR, and 12 patients (8%) had moderate TR, (P value < 0.05).

The multivariate analysis showed that a higher preoperative NYHA classification, renal impairment, liver dysfunction, postoperative bleeding, failed prior repair, and RV dysfunction were significant predictors of death.

Discussion

Isolated clinically significant tricuspid valve disease requiring surgical intervention is uncommon, that is evident by the presence of 67% of patients of this series were performed in conjunction with left sided heart valve operations.

The optimal surgical strategy, either tricuspid repair or replacement, remains controversial. The controversy becomes more complex when TV is primarily affected as the published experience too limited to dictate the optimal surgical technique. Therefore, this study was conducted to address the debate whether repair is durable and reproductive or replacement is the way to avoid high frequency of reoperation for those patients who are often critically ill.

Iscan and his colleagues **(Iscan et al., 2007)**studied tricuspid valve replacement for primary tricuspid valve disease on 42 patients between 1987 and 2004. The main pathology was rheumatic in 64% of their population. They reported suboptimal short and long-term results of tricuspid valve replacement in comparison to those of left-sided valve replacements, probably due to different structural and geometrical characteristics of right ventricle and the low pressure venous system hemodynamics. They identified etiology, clinical presentation and pulmonary vascular hemodynamics as major determinants of the outcome.

A retrospective study of repair of rheumatic tricuspid valve disease was done by Sarralde and his colleagues **(Sarralde et al., 2010)**, from 1974 to 2007, on 299 consecutive patients. Despite early good results (7.4% in hospital mortality), they reported poor long term result; with high late mortality (51.2%) and valve-related reoperations (35%) which were associated with a high mortality rate (24.5%). They reported age, NYHA functional class IV, and post clamping time as significant predictors

of late deaths. They explained the long term high incidence of valve dysfunction and mortality due to progression of the rheumatic disease.

Mangoni and his associates **(Mangoni et al., 2001)** described the clinical outcome of 15 consecutive patients undergoing isolated TVR. Short and long-term outcomes demonstrated poor survival and a high rate of serious postoperative complications Three-year mortality, including in-hospital deaths, was 60% particularly in patients with rheumatic heart disease and previous mitral valve replacement.

A larger study, by Raikhelkar and associates **(Raikhelkar et al., 2013)**, had been conducted on 56 patients who underwent isolated TV surgery over 12-year period. 48.2% of their population underwent TV repair and 51.8% underwent TV replacement. They reported better results compared to Magoni et al **(Mangoni et al., 2001)** results. The early mortality was 14.2 % and no statistically significant difference in early and late survival rates between repair and replacement surgery.

In a study conducted on 132 patients underwent tricuspid valve replacement by biological and mechanical prosthesis, Songur et al **(Songur et al., 2014)**reported an early mortality of 19 patients (14%), almost half of them (47%) was due to severe myocardial depression. Reoperation was reported in 11 patients (8.3%), valve thrombosis was observed in 6 patients (4.5%), and thromboembolic or bleeding events were experienced in 24 patients (18%). They found survival rate of 74% of patients over 12 years after TVR.

Singh and associates **(Singh et al., 2006)** had conducted a study on 250 patients underwent surgery for organic TV disease from 1979 to 2003. They found a higher morbidity and in-hospital mortality after tricuspid valve replacement. Tricuspid valve repair was associated with a significantly better midterm outcome and event free survival than replacement. However, recurrent moderate to severe TR were more in the repair group. There were no significant differences in valve-related mortality reoperation rates between the two groups of patients. The multivariate predictors of survival included TV replacement as a significant predictor of mortality in addition to age, male gender, poor left ventricular function, preoperative renal failure, preoperative stroke history, and concomitant mitral valve surgery. They recommended repair whenever possible in patients with organic tricuspid disease.

Analysis of records of 54,375 patients underwent tricuspid valve surgery, between 2000 and 2010 by Kilic and coworkers**(Kilic et al., 2013)**concluded that The repair rates for tricuspid valve surgery were increasing significantly and they suggested tricuspid repair when technically feasible, as a potential candidate for outcome improvement. They have reported an operative mortality of 9.6% and defined predictors of increased mortality including older age, increasing serum creatinine, tricuspid valve

replacement, chronic lung disease, cerebrovascular accident, diabetes mellitus, urgent or emergency status, reoperation, congestive heart failure.

In a meta-analysis discussing TV repair versus replacement, Choi **(Choi et al., 2018)**have recommended tricuspid valve (TV) surgery for (i) patients with severe primary tricuspid regurgitation (TR) and accompanying symptoms or right heart failure and (ii) patients with severe or progressive functional TR who underwent left-sided valve surgery. They demonstrated increased all-cause mortality after tricuspid valve replacement compared to the repair in patients with TR; however, there were no differences in reoperation rates and valve-related events between both techniques.

On the contrary of the previous reports, our results showed a good outcome for tricuspid valve surgery in patients with rheumatic valvular affection regarding the early mortality (3%) and the morbidity. Despite the mortality is higher in the replacement group, which can be explained by the fact that the sicker patients were in the TVR group, there was no significant difference in other outcomes between both groups. Moreover, the present study showed that tricuspid valve repair has no statistically significant survival benefit when compared to replacement on mid-term follow up**.** In addition, recurrent severe TR was reported in repair group (16.7%) rather than replacement group but with no statistical significance between both groups.

Our findings go along with many other literatures. A propensity analysis of outcomes of 315 patients underwent tricuspid valve repair and replacement has been done by Morac et al **(Moraca et al., 2009)**. They found no difference of tricuspid valve repair over replacement and recommended tricuspid valve replacement for patients if there is a reasonable chance for recurrence of regurgitation after repair.

Chang and coworkers **(Chang et al., 2017)** had studied 360 patients with severe tricuspid regurgitation underwent tricuspid valve surgery. 78% of their patients had rheumatic etiology. The early mortality was around 3% in both groups. There was no difference in early mortality overall survival and freedom from cardiac death between both groups. Higher NYHA functional class, total bilirubin>2 mg/dL, initial central venous pressure, and cardiopulmonary bypass time were independent predictors of early mortality. Older age, LV dysfunction (EF <40%), and hemoglobin <10 g/dL were independent predictors of late cardiac mortality.

In a study of tricuspid valve replacements, Sung et al **(Sung et al., 2009)** have reported low hospital mortality (1.4%). They recommended performing early TVR before development of irreversible right ventricular failure and with optimal perioperative management to achieve improved outcome.

Buzzati and associates **(Buzzatti et al., 2014)** have studied long term outcomes afterTV replacements after

previous left-sided heart valve surgery. They reported acceptable mortality rates (6%) especially if performed in the absence of ascites, significant RV dysfunction and pulmonary hypertension. They referred the impaired long term outcomes to the global high-complexity profile of these patients.

We think the heterogeneity of results in the literature due to (1) the great differences in baseline patient characteristics. Moreover, the outcomes might be related partly or mostly to the surgery for the simultaneous left sided valves lesions; (2) the primary pathology of the tricuspid valve is heterogeneous in the literature **(Iscan et al., 2007; Mangoni et al., 2001)**and even not stated **(Choi et al., 2018; Kilic et al., 2013)**in some other reports. We believe that the etiology of the tricuspid valve dysfunction is one of the main determinants of the severity of the disease and the choice of surgery either repair or replacement, hence the variable outcomes; (3) the tricuspid valve replacement was reserved, in most of the published replacement series**(Buzzatti et al., 2014; Iscan et al., 2007; Mangoni et al., 2001; Raikhelkar et al., 2013)** to the extensively affected tricuspid valve, co-morbid preoperative conditions, or emergency situation, which subsequently affects the outcomes towards the poor side; (4) the nature of the rheumatic pathology, being a progressive disease, may have accounted for the high failure rate of the repair in our series evidenced by the presence of 33% of the replacement patients were due to failed prior repair and postoperative recurrent severe TR in the repair group.

There are limitations to the present study that must be recognized. The sample size of patients is relatively small due to rarity of the disease and the follow up was not complete (70%) and its duration was relatively short. In addition, although we enrolled only patients with rheumatic pathology, there were still differences between the two groups regarding the combined valve lesions and the preoperative patient's characteristics, and these might have affected the results. Large cohort of isolated tricuspid valve disease with precise assessment of the tricuspid valve deformity and RV function with longer-term follow-up might be necessary to reach more definitive conclusions.

Conclusion

Generally, every effort should be made to salvage the native tricuspid valve during tricuspid valve surgery to maintain RV geometry and hemodynamics, and avoid the deleterious drawbacks of prosthesis. However, The questionable long-term durability of the repair due to the progression of the rheumatic disease and the comparable early and midterm survival outcome of the tricuspid valve replacement to the repair may highlight a comprehensive clinical and echocardiographic follow up examinations for the tricuspid valve disease along with early referral to tricuspid valve replacement surgery in rheumatic tricuspid valve disease if the pathology of the valve is exceeding the

annular dilatation. We believe our data support more aggressive earlier indications, before it becomes already irreversible, for tricuspid valve replacement as a potential candidate for improving surgical outcome, event free survival rates and quality of life.

Conflict of interest: None

References

- **BreyerRH, McClenathanJH, MichaelisLL, McIntosh CL, MorrowAG (1976):** Tricuspid regurgitation. A comparison of nonoperative management, tricuspid annuloplasty, and tricuspid valve replacement. The Journal of Thoracic and Cardiovascular Surgery, 72(6), 867–874.
- **BuzzattiN, IaciG, TaramassoM, NisiT, LapennaE, De BonisM,et al. (2014):**Long-term outcomes of tricuspid valve replacement afterpreviousleft-side heart surgery. European Journal of Cardio-ThoracicSurgery,46(4), 713–719.
- **ChangHW, JeongDS, ChoYH, Sung K, Kim WS, LeeYT,et al.(2017).** Tricuspid Valve Replacement vs. Repair in Severe Tricuspid Regurgitation.Circulation Journal, 81(3): 330–338.
- **ChidambaramM, AbdulaliSA, Baliga BG, IonescuMI. (1987).**Long-term Results of DeVega Tricuspid Annuloplasty. The Annals ofThoracic Surgery,43(2):185–188..
- **ChoiJW, Jang M,KimKH,HwangHY(2018).** Repair versus replacement for the surgical correction of tricuspid regurgitation: a meta-analysis. European Journal of Cardio-Thoracic Surgery, 53(4) :748–755.
- **De BonisM, Lapenna E, Taramasso M, Manca M, Calabrese MC, Buzzatti N, et al.(2012)**Mid-Term Results of Tricuspid Annuloplasty with Three Dimensional Remodelling Ring. Journal of Cardiac Surgery, 27(3):288-294.
- **IscanZH, Vural KM, Bahar I, Mavioglu L, Saritas A (2007).** What to expect after tricuspid valve replacement? Long-term results. European Journal of Cardio-Thoracic Surgery, 32(2) :296–300.
- **KilicA, Saha-ChaudhuriP, Rankin JS, ConteJV(2013).** Trends and Outcomes of Tricuspid Valve Surgery in North America: An Analysis of More Than 50,000 Patients From The Society of Thoracic Surgeons Database. The Annals of Thoracic Surgery, 96(5): 1546–1552.
- **MangoniAA, DiSalvo TG, Vlahakes GJ, Polanczyk CA, FiferMA(2001)**. Outcome following isolated tricuspid valve replacement. European Journal

of Cardio-Thoracic Surgery, 19(1) :68–73.

- **MaoB, Sun L, Zhang J, Zhou M, Zhang F(2016).** Perioperative factors associated with short- and long-term outcomes after tricuspid valve replacement. Interactive CardioVascular and Thoracic Surgery, 23(6):845–850.
- **MatebeleMP, Peters P, Mundy J, Shah P(2010).** Cardiac tumors in adults: surgical management and follow-up of 19 patients in an Australian tertiary hospital. Interactive Cardiovascular and Thoracic Surgery, 10(6): 892–895.
- **McGrathLB, Gonzalez-Lavin L, Bailey BM, GrunkemeierGL, FernandezJ.et al.(1990).** Tricuspid valve operations in 530 patients. Twenty-five-year assessment of early and late phase events. The Journal of Thoracic and Cardiovascular Surgery, 99(1): 124–133.
- **MoracaRJ, Moon MR, Lawton JS, Guthrie TJ, Aubuchon KA, Moazami N, Pasque MK, Damiano RJ(2009).** Outcomes of Tricuspid Valve Repair and Replacement: A Propensity Analysis. The Annals of Thoracic Surgery, 87(1) :83–89.
- **NishimuraRA, Otto CM, Bonow RO, Carabello BA, Erwin JP, Guyton RA,et al(2014).** 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: Executive Summary. Circulation, 129(23) 2440–2492.
- **RaikhelkarJ, Lin HM, NeckmanD, Afonso A, Scurlock C(2013).** Isolated Tricuspid Valve Surgery: Predictors of Adverse Outcome and Survival. Heart, Lung and Circulation, 22(3): 211–220.
- **RatnatungaCP, EdwardsMB, Dore CJ, Taylor KM(1998).**Tricuspid valve replacement: UK heart valve registry mid-term results comparing mechanical and biological prostheses. The Annals of ThoracicSurgery, 66(6): 1940–1947.
- **Rogers JH, Bolling SF(2009).** The Tricuspid Valve. Circulation, 119(20): 2718–2725.
- **SarraldeJA, Bernal JM, Llorca J, Pontón A, Diez-Solorzano L, Giménez-RicoJ(2010).** Repair of Rheumatic Tricuspid Valve Disease: Predictors of Very Long-Term Mortality and Reoperation. The Annals of Thoracic Surgery, 90(2) :503–508.
- **SinghSK, Tang GHL, Maganti MD, Armstrong S, Williams WG, David TE,et al2006).** Midterm Outcomes of Tricuspid Valve Repair Versus Replacement for Organic Tricuspid Disease. The Annals of

Thoracic Surgery, 82(5): 1735–1741.

- **SongurCM, Simsek E, Ozen A, Kocabeyoglu S, Donmez TA. (2014).**LongTerm Results Comparing Mechanical and Biological Prosthess inthe Tricuspid Valve Position. Heart, Lung and Circulation, 23(12): 1175–1178.
- **SungK, Park PW, Park KH, Jun TG, Lee YT, Yang JH(2009).** Is tricuspid valve replacement a catastrophic operation? European Journal of Cardio-Thoracic Surgery, 36(5): 825–829.
- **VahanianA, Alfieri O, Andreotti F, Antunes MJ, Barón-Esquivias G, Baumgartner H,et al(2012).** Guidelines on the management of valvular heart disease (version 2012). European Journal of Cardio-Thoracic Surgery, 42(4):S1–S44.