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Original Research Paper

Cardiology

A STUDY OF TRICUSPID VALVE SURGERY DONE IN PATIENTS UNDERGOING MITRAL VALVE REPLACEMENT SURGERY FOR RHEUMATIC HEART DISEASE IN OUR INSTITUTE.

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KEYWORDS :

INTRODUCTION

The tricuspid valve also known as the 'forgotten valve' separates the right atrium and the right ventricle . It is has three leaflets/cusps as the name aptly suggests, the leaflets being anterior, posterior and septal . The tricuspid valve is afflicted commonly secondary to disease of the left heart that lead to pulmonary hypertension, in turn leading to functional tricuspid regurgitation. Primary involvement of the valve may lead to regurgitation or stenosis.Symptoms of tricuspid valve involvement are primarily extracardiac, but the use of two dimensional echocardiography has made it possible to pick up theses lesions earlier.

Tricuspid valve repair has been well documented and accepted in patients who are undergoing mitral valve surgery. The extrapolation of this work to cases of mild to moderate tricuspid regurgitation is also being carried out and studied. [1]The American Heart Association and the European Society of Cardiology both recommend tricuspid repair for severe tricuspid regurgitation in patients undergoing mitral valve surgery (Class I indication) .[2] It is thus prudent to perform tricuspid repair concomitantly in patients undergoing surgery for mitral valve lesions, so as to correct the lesion and preventing further progress of the right heart disease. This would prevent the immediate as well as late term complications that might occur with an uncorrected tricuspid valve lesion.

Preoperative two dimensional echocardiography is used to evaluate the degree of tricuspid valve involvement by measuring the tricuspid annular diameter, right heart dimensions, pulmonary artery systolic pressure and severity of the tricuspid regurgitation.

AIMS AND OBJECTIVES

1. The aim of the study was to evaluate early outcomes in patients undergoing tricuspid valve surgery along with mitral valve surgery in a tertiary level hospital .
2. The objective of the study was to evaluate the indications for surgery, procedures undertaken, changes in the right heart parameters and to assess the post operative outcome after such surgery.
3. Finally, to study the post operative well being of patients, NYHA class and duration of the hospital stay in these patients .

MATERIALS AND METHODS

This study was conducted over a two year time period, from January 2011 to December 2012, and included patients undergoing tricuspid valve surgeries with concomitant mitral valve replacements. Twenty two patients were included in the study.

The inclusion criteria consisted of:

1) Patients over the age of 12 years undergoing mitral valve replacement with concomitant tricuspid valve repair.
2) Patients with severe tricuspid regurgitation and a tricuspid valve annulus of more than 40mm and/or tricuspid stenosis requiring tricuspid valve repair.
3) All patients undergoing mitral valve replacement with concomitant tricuspid valve repair between January 2011 to December 2012.

The exclusion criteria consisted of:

- Patients below the age of 12 years.
- Patients undergoing double valve replacements with tricuspid valve repair.
- Patients undergoing tricuspid valve replacements.

It was a retrospective study and data was obtained through an extensive review of the patients' hospital records and data from the echocardiography databases.

Signs and symptoms such as dyspnoea, palpitation, pedal oedema, ascites, JVP were recorded.Investigations like chest x-ray, electrocardiography and echocardiography were included. Echocardiographic parameters included evaluation of the mitral valve, tricuspid valve, myocardial contractility and chamber dimensions. The details are as shown in the proforma. Postoperatively the above variables were reanalysed and a comparison was made. Also the NYHA class, post op rhythm, duration of hospital stay post operatively and the complications developed were analysed.

Patient demographics were included.

Preoperative risk factors, significant past surgical operations carried out were also noted.

Transesophageal echo if available was used peroperatively and the findings confirmed.

Preoperatively the patients were given intravenous antibiotics at induction. Cefuroxime and Amikacin was used routinely, while it was replaced with Ceftazidime and Augmentin for patients with altered renal parameters or sensitivity to Amikacin .Radial and femoral arterial access was established in all patients and a jugular venous line was also put . The patients were catheterised, a rectal temperature sensing probe was put and the patients were positioned for the operation.The chest was painted with and the patient draped appropriately with provisions for a right sided chest tube. A midline sternotomy was made, thymus divided, pericardium opened, adhesions taken down if any, systemic heparinisation done. Aorto-bicaval cardiopulmonary bypass was utilised in all the patients. Myocardial protection was achieved by antegrade cold blood cardioplegia . The mitral valve was excised and replaced via a longitudinal left atriotomy. The aortic cross clamp was released with the patient in head low position, root on suction and the left atrium partially closed and underwater. After routine de-airing, with a good rhythm , the patient completely rewarmed, the Fogarty was removed and the left atrium was closed under water.

The tricuspid valve was accessed through a longitudinal right atriotomy and the valve as well as its subvalvar apparatus was assessed . The degree of tricuspid regurgitation was visualised and the valve was sized accordingly . Tricuspid annuloplasty was done using interrupted , nonpledgeted 2- 0 ethibond sutures and the ring was sutured in place taking care to avoid the region above the anteroseptal commissure and the medial half of the septal leaflet so as to avoid injuring the conduction bundle . Post procedure the valve was again tested to look for any significant regurgitation.

In cases of tricuspid stenosis, commissurotomy was done upto 2mm from the annulus so as to make the leaflets more pliable .The right atrial closure was done and the patient was weaned off bypass. Protamine was given after routine decannulation and 2 right ventricular pacing wires were put in all patients .A right pleural drain was put if warranted, pericardial and mediastinal drains were placed and the chest closed in layers in the routine fashion.Postoperatively the patients were extubated the following day. A routine 2D echo

was done in the earl y post operative period (prior to 2 weeks post op) to assess the valve functions and the status o f the repair .Permanent pacemaker insertion was done in patients with complete heart block. Pericardiostomy was done if the patient had a significant pericardial collection.The patients post operative echo findings were obtained by reviewing the echo data records and the pictures, if available on the echo machines . The hospital stay was calculated with the help of the date of the operation and the date of discharge in the in - patient records. Information about the post op functional status was gained from the discharge charts .

Statistical analysis was done with the SPSS v16 software.Qualitative characters were compared by the Chi-square test. The quantitative outcomes were compared by the students t- test.

The pre and post op comparison of the procedure was analysed using the paired t-test. The improvement in the patient's condition after the procedures were compared by the students t-test.

RESULTS

A total of 22 patients were included in the study.

There were 7 males (31.82%) and 15 females (68.18%)

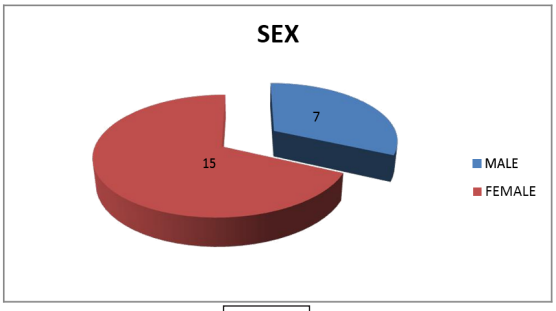

FIGURE 1

The age varied from 14 years to 61 years with a mean age of 37.59 years.

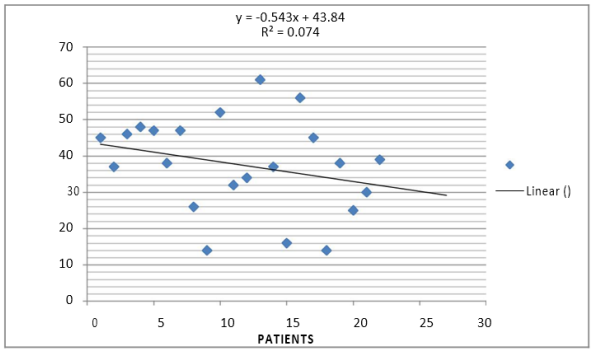

FIGURE 2

The body surface area ranged from 0.95 to 1.81 with a mean of 1.39.

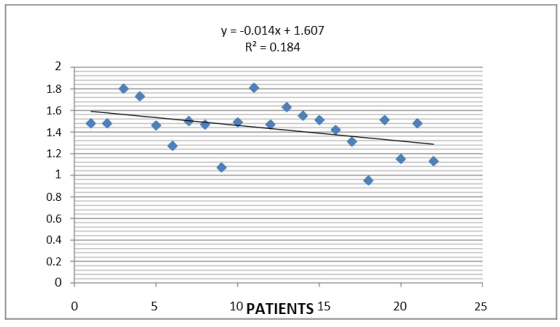

FIGURE 3

The majority of the patients presented in NYHA class II (72.73%,n=16), with 22.73% (n=5) in NYHA class III and 4.54% (n=1) patients in NYHA class IV.

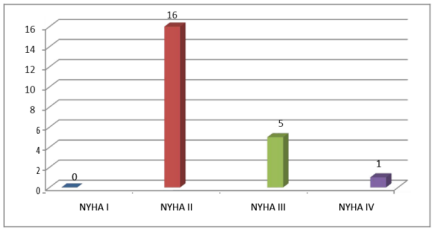

FIGURE 4

95.45% patients had an elevated JVP (n=21) on presentation with 40.91% patients presenting with hepatomegaly (n=9). 9.1% patients had pedal oedema at presentation (n=2).

Three patients had undergone balloon mitral valvotomy (BMV), 2 had undergone closed mitral valvotomy (CMV), 1 had undergone an open mitral valvotomy with an atrial septal defect cloure and 1 had undergone both BMV and CMV in the past.

The co-morbidities included hypothyroidism (n=3), epilepsy (n=1), mycotic aneurysms (one patient for a cerebral aneurysm and another for a popliteal aneurysm,n=2) and culture negative infective endocarditis (n=1).

Most patients were in atrial fibrillation (77.27%,n=17) while few were in sinus rhythm (22.73%,n=5) preoperatively. All patients had cardiomegaly on their chest roentgenogram.

On auscultation 15 patients had the classical murmur of tricuspid regurgitation with Carvallo's sign being positive (n=68.18%).

Twenty patients (90.91%,n=20) had severe TR at presentation in both the groups put together. The tricuspid annulus ranged from 38 to 50mm in those with severe TR and 36 to 42 in those with TS . In those with severe TR alone, the mean tricuspid annular diameter was 42.29 mm, while the mean tricuspid annular diameter indexed to body surface area was 28.49 mm/m^2. In those with severe TS+TR, the mean tricuspid annular diameter was 39.4 mm, while the mean tricuspid annular diameter indexed to body surface area was 32.55 mm/m^2.

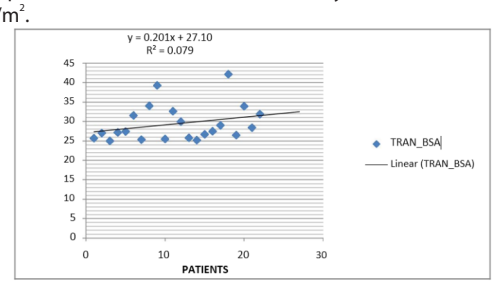

FIGURE 5

The overall mean TR velocity was found to be 387.93 cm/sec in those with TR alone and 412.33cm/sec in those with TS+TR. The mean TR gradient in patients with TR alone was calculated to be 64.41 mm Hg, while it was 69.2 mm Hg in those with TS+TR. The correlation table between the calculated SPAP from the TV velocity and the TR gradients is as below:

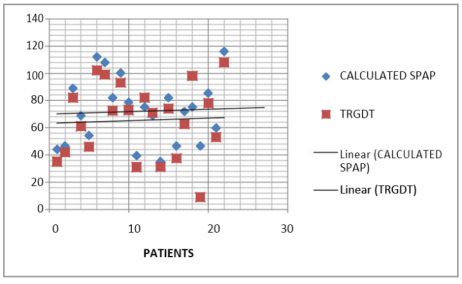

FIGURE 6

The mean right ventricular diameter in diastole in those with TR was 23.94 mm and 21.4

mm in those with TS+TR. The mean ratio of the RV:LV diameters was 0.54 in patients with TR alone and 0.45 in patients with TS+TR.

Right ventricular dimensions were also measured in 8 patients in those with TR alone and the mean values of length and width were 69 mm and 34.88 mm respectively.

In patients having TR alone (n=17), mitral stenosis was the predominant primary lesion seen in 47.06% patients (n=8), mitral regurgitation was found in 35.3% cases (n=6) and combined mitral stenosis with regurgitation was found in 17.64% patients (n=3). In those with TS+TR (n=5), mitral regurgitation was the predominant concomitant lesion (60%, n=3) and combined mitral stenosis and regurgitation was found in (40%, n=2) patients.

Mitral valve replacement with tricuspid annuloplasty was carried out in 17 patients and mitral valve replacement with tricuspid commissurotomy was done in 5 patients.

Of the 17 patients undergoing annuloplasty, 9 (52.94%) underwent a Carpentier Edwards ring annuloplasty and 8 (47.06%) underwent a MC3 ring annuloplasty.

Those patients who underwent a tricuspid commissurotomy did not undergo a concomitant annuloplasty.

Post operatively 15 (68.18%) patients remained in atrial fibrillation, 6 (27.27%) patients remained in sinus rhythm and 1 (4.55%) patient developed a complete heart block, needing a permanent pacemaker implantation.

One patient with TS+TR , developed intractable ventricular fibrillation with low cardiac output and expired in the immediate post operative period.

The TR grade improved in patients post operatively, with 10 (45.45%) patients having only mild tricuspid regurgitation, 6 (27.27%) patients having moderate TR and only 5 (22.73%) patients having severe TR. Out of the severe TR that persisted in the 5 patients, 2 patients had severe TR preoperatively while 3 patients had TS+TR. The paired differences of those having TR alone was calculated as shown in Table 1.

TABLE 1

PAIRED DIFFERENCES			
TR GRADE (PRE AND POST OP)			
PAIR	MEAN	STD. DEVIATION	SIG.(2TAILED)
TRGR	2.88	332	.000
POTRGR	1.53	7.17	

A comparison of the tricuspid annular diameters pre and postoperatively have been made and are represented as in the diagram below and in Table 2 as shown.

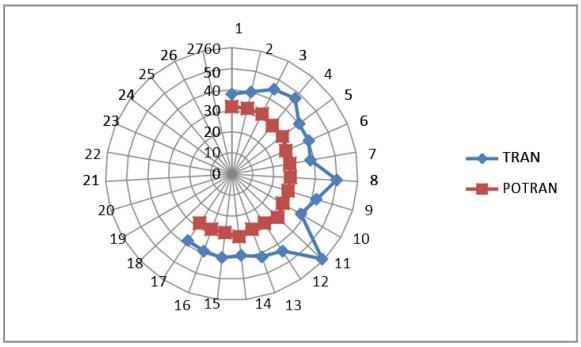

FIGURE 7

TABLE 2

TRICUSPID ANNULAR DIAMETERS (PRE AND POST OP)			
PAIRED DIFFERENCES			
PAIR	MEAN	STD. DEVIATION	SIG.(2TAILED)
TRGR	42.29	5.520	.000
POTRGR	29.8	1.590	

The average post op tricuspid annular diameter measured 29.18 mm in those with TR alone and tricuspid annular diameter indexed to body surface area was 19.73 in the same patients.

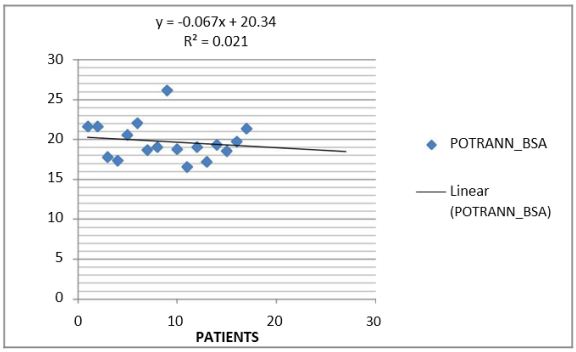

FIGURE 8

The mean overall post operative TR velocity was found to be 315.49 cm/sec in those with TR alone and 335cm/sec in those with TS+TR. The paired differences in those with TR alone is as calculated in Table 3 and the correlation table between the calculated post op SPAP from the TV velocity and the post op TR gradients are shown as below .

TABLE 3

PAIRED DIFFERENCES			
TV VELOCITY (PRE AND POST OP)			
PAIR	MEAN	STD. DEVIATION	SIG.(2TAILED)
TVV2	387.93	76.930	0.016
POTVV2	315.49	60.629	

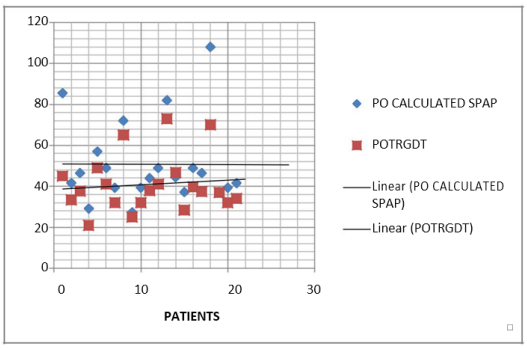

FIGURE 9

The mean post operative tricuspid gradient in the TR group was was 40.31 mm Hg and 43.25 mm Hg in the TS group and the paired differences of those with TR alone is as calculated in Table 4.

TABLE 4

PAIRED DIFFERENCES			
TR GRADIENT (PRE AND POST OP)			
PAIR	MEAN	STD. DEVIATION	SIG.(2TAILED)
TRGDT	64.41	24.4	.007
POTRGDT	40.31	13.4	

Right ventricular diameter in diastole post operatively had a calculated mean of 19.29 mm in the TR group and 19.75 mm in the TS group, the calculated paired differences in those with TR alone is as shown in Table 5.

TABLE 5

PAIRED DIFFERENCES			
RV DIAMETER IN DIASTOLE (PRE AND POST OP)			
PAIR	MEAN	STD. DEVIATION	SIG.(2TAILED)
RVDD	23.94	8.771	.006
PORVDd	19.29	5.429	

The ratio of the RV/LV internal diameters was found to be 0.40 in the TR group and 0.44 in the TS group. The pre and post op paired differences are as shown in Table 6.

TABLE 6

PAIRED DIFFERENCES			
RV DIAMETER IN DIASTOLE (PRE AND POST OP)			
PAIR	MEAN	STD. DEVIATION	SIG.(2TAILED)
RVDd_LVID	.5382	.25740	.018
PORVDd_LVID	.4047	.10584	

The right ventricular longitudinal dimension in 8 patients post operatively was found to be 59.88 mm and the width was 32.25 mm and were matched to the same patient's pre operative values. The pre and post op comparisons are as shown in Table 7.

TABLE 7

PAIRED DIFFERENCES			
RV DIMENSIONS-LENGTH AND WIDTH (PRE AND POST OP)			
PAIR	MEAN	STD. DEVIATION	SIG.(2TAILED)
RV DIM_L	69.00	10.184	.041
PORVDIM_L	59.88	9.963	
RVDIM_W	34.88	6.999	.464
PORVDIM_W	32.25	11.323	

DISCUSSION

This was a retrospective descriptive study carried out in a tertiary centre in South India over a period of 2 years from January 2011 to December 2012. The results were analysed and tabulated.

There were 22 patients who had moderate to severe TR and underwent tricuspid valve repair, based on existing guidelines There were 17 patients (77.27%) who had predominant TR and 5 patients (22.73%) having predominant TS . Patients with TS all had severe TR, but had commissural fusion indicating rheumatic involvement. They did not undergo annuloplasty.

There was an overall female preponderance (68.18%) in the study group with a mean age of 37.59 years.

On analysis of the symptoms, it was found that majority of the patients presented in NYHA functional class II (72.73%), 95.45% patients had an elevated JVP and 9.1% patients presented with pedal oedema.

In those with TR, 6 patients had undergone prior surgical procedures in the form of balloon mitral valvotomy (n=2), closed mitral valvotomy (n=1), an open mitral valvotomy with an atrial septal defect cloure (n=1) , while one had undergone a BMV and CMV in the past in the TS group.

In patients with mitral valve stenosis, those who underwent a procedure to ameliorate the mitral lesion were more likely to develop a significant functional tricuspid regurgitation.

The commonest co-morbidy in the presenting age group was hypothyroidism (n=3). 2 other patients had mycotic aneurysms, 1 had culture negative infective endocarditis and 1 was a known epileptic, but none of these directly correlated with the development of a severe tricuspid lesion.

The majority of patients were in atrial fibrillation in those having TR alone (n=12). One patient who had severe TR reverted to sinus rhythm after the procedure while there were 2 new onset atrial fibrillation cases in those having severe TR preoperatively. In those with TS+TR, all 5 were in atrial fibrillation preoperatively with one being in sinus rhythm post operatively. One out of the 17 patients undergoing a ring annuloplasty, developed a complete heart block post operatively and needed a permanent pacemaker implantation The smallest tricuspid annulus for which a ring was placed was 38 mm. The lowest tricuspid annular diameter indexed to body surface area was 25 mm/m^2 in patients with only TR who underwent an annuloplasty. Rings in our study have been used for patients with a slightly lower annular diameter than recommended classically, but it turns out that the cut off for the annular diameter indexed to body surface area is much higher in our patients than that which is recommended ($21mm/m^2$). This is likely to be due to of the relatively smaller body surface area of our patients.

In patients with TR requiring annuloplasty (n=17), 9 patients (52.94%) underwent a Carpentier Edwards ring annuloplasty and 8 patients (47.06%) underwent a MC3 ring annuloplasty. The TR grade showed a significant improvement post operatively ($p<0.001$,Table 1) with the TR grade decreasing by 1 grade in 29.41% of the patients (n=5) and by 2 grades in 52.94 % of the patients (n=9). It remained unchanged in 17.65% of the patients (n=3).

In those undergoing the Carpentier's ring annuloplasty (n=9), the TR grade improved by 1 grade in 22.22% of the cases (n=2), by 2 grades in 55.56% of the cases (n=5) and remained unchanged in 22.22% (n=2) of the cases.

In those undergoing the MC3 ring annuloplasty (n=8), the TR grade improved by 1 grade in 37.5% of the cases (n=3), by 2 grades in 50% of the cases (n=4) and remained unchanged in 12.5% (n=1) of the cases.

In those with TS who underwent commissurotomy without annuloplasty , the tricuspid regurgitation remained severe in 75% (n=3/4) of the patients.

The pulmonary arterial systolic pressures as calculated from the tricuspid velocities was correlated with the TR gradients and the graphs charted were found to be concurrent pre and postoperatively (Figures 6 and 9). There was a significant decrease in the TR gradients post operatively ($p<0.01$, Table 4) although there was no significant change in the TV velocity ($p=0.109$, Table 3) probably suggesting persisting pulmonary arterial hypertension or erroneous tracings secondary to atrial fibrillation.

There was a significant post operative decrease in the RV dimensions especially the RV length ($p<0.05$, Table 7) and the RV/LV internal diameters ($p<0.05$, Table 6) in diastole suggesting prompt offloading of the right ventricle following annuloplasty.

The mean hospital stay post operatively was 8 days in the patients undergoing annuloplasty, while it was 7 days in those undergoing a mitral valve replacement alone.

Post operatively 90.91% (n=20) patients were in NYHA functional class II symptoms. One of the 17 patients undergoing an annuloplasty, developed worsening of symptoms

(NYHA IV) and was managed by aggressive diuretics and subsequently improved. This same patient was readmitted for recurrent symptoms of congestive cardiac failure. He had developed a prosthetic valve dysfunction of the mitral valve which was managed conservatively.

Another patient (undergoing a tricuspid commissurotomy alone) developed intractable ventricular arrhythmia in the immediate post op period and expired. This was also included in the NYHA IV category.

LIMITATIONS OF THE STUDY

The following are the limitations of the study:

1) It is a short term retrospective study.
2) As we have only recently started doing ring annuloplasties, our sample size has been relatively small.
3) The features of right ventricular volume overload need further assessment over a longer time frame to know the impact of the annuloplasty on the long term well being of the patient.
4) A comprehensive assessment of improvement in the patients' quality of life can only be ascertained by a long term follow up which we are assessing in an ongoing study.

CONCLUSIONS

The following conclusions were deduced from the above findings:

1) Tricuspid annuloplasty is well indicated in patients undergoing mitral valve replacements, when the tricuspid regurgitation is severe and most probably required in moderate tricuspid regurgitation as well.
2) Patients undergoing tricuspid commissurotomy should undergo a concomitant annuloplasty in cases of severe TS with TR and significant annular dilatation.
3) In the immediate post op period of patients undergoing annuloplasty, features of right ventricular volume overload decreased significantly when compared to pre operative levels.
4) The functional class improves significantly post operatively after a concomitant annuloplasty.
5) The overall hospital stay was not significantly different from those who had undergone only a mitral valve replacement.
6) Mitral stenosis is known to be associated with more functional TR. This study reiterates the fact that it is beneficial to do an annuloplasty in cases with functional TR.
7) In view of the smaller size of the tricuspid annulus in our population, it may be may be suitable to do an annuloplasty in patients with smaller annular diameters than the recommended cut off of 40mm.

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