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ORGANIC TRICUSPID VALVE REPAIR WITH AUTOLOGOUS GLUTARALDEHYDE FIXED PERICARDIAL PATCH: A SINGLE CENTER RESULTS

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ABSTRACT: AIM AND OBJECTIVE: The aim of this study was to determine the effectiveness and results of repair of Organic Tricuspid Valve disease. **INTRODUCTION:** since tricuspid valve disease most often found in association with other valve disease. Isolated tricuspid valve disease is rare. Pattern of involvement of tricuspid valve disease shows functional (75%) and primary (organic) in (25%). Surgical repair of organic tricuspid valve disease often fails because of abnormal valve. This usually leads to limited options. This study examines our experience of tricuspid valve repair with autologous pericardium for organic tricuspid valve disease. **MATERIAL AND METHODS:** From Jan 2014 to May 2015, 22 patients underwent repairs for organic tricuspid valve disease. The patient aged 15 to 65 years and all were in New York Heart Association (NYHA) class of III or IV. All patients presented with severe tricuspid disease coexisting with other cardiac pathology, usually left-sided heart valve disease. Repair techniques included Commissurotomy, division of secondary chordae, Glutaraldehyde treated autologous pericardial patch augmentation of tricuspid valve leaflets, anterior papillary muscle advancement etc with or without ring/suture annuloplasty. Follow-up duration was 3 to 18 months. **RESULTS:** No deaths or late reoperations occurred. All patients demonstrated clinical improvements on follow up. Echocardiographic studies before hospital discharge showed less than mild tricuspid regurgitation in all patients except one. **CONCLUSIONS:** Large majority of organic tricuspid valve regurgitation is repairable with acceptable early results. Tricuspid stenosis and mixed tricuspid valve disease are more challenging. In the latter group, it is a judgment call whether to accept a suboptimal result or replace the valve.

KEYWORDS: Organic tricuspid valve repair, Glutaraldehyde fixed path.

INTRODUCTION: Tricuspid valve regurgitation is most often functional regurgitation (75-80%) but sometimes it is organic (20-25%) and treatment of such valves is either repair or replacement. Organic tricuspid valve disease is mostly rheumatic. Ebstein anomaly, endomyocardial fibrosis, endocarditis and trauma account for a smaller percentage of cases. Pacemaker related tricuspid disease is increasingly seen.¹ Tricuspid regurgitation is more commonly seen compared to stenosis or mixed disease.² Annuloplasty techniques are effective in functional tricuspid insufficiency but are not effective in cases where the mechanism of tricuspid regurgitation is more than mere annular dilatation. It has been well established that the rate of

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early and late mortality rate is higher after tricuspid valve prosthetic replacement compared with valve repair.³⁻⁵

The data on repair of organic tricuspid valve disease are scant.^{6,7} Currently we use glutaraldehyde fixed pericardial patch tricuspid leaflet augmentation, division of secondary chordae, anterior papillary muscle advancement techniques in addition to a stabilizing annuloplasty.

Inclusion and Exclusion Criteria: No patients with Organic Tricuspid Valve disease were excluded from consideration of Tricuspid Repair.

MATERIAL AND METHODS: This study was conducted in the department of cardiothoracic and vascular surgery, department of cardiac anesthesiology and department of cardiology From January 2014 to May 2015, 165 patients underwent surgical treatment for rheumatic valvular heart disease at our center. Tricuspid valve regurgitation assessed echocardiographically using color Doppler mapping in at least 2 orthogonal planes, assessment of vena contracta width and the direction and size of the jet and grading of tricuspid regurgitation was done.⁸ Pulmonary artery hypertension was classified by pulmonary artery systolic pressure; mild <50 mm hg, moderate 50-69, severe ≥ 70 . All patients with moderate to severe tricuspid valve regurgitation underwent tricuspid valve repair. Techniques used in the repair of tricuspid valve included commisurotomy, segmental annuloplasty or prosthetic ring annuloplasty, and patch augmentation of leaflet. In most patients, a ring annuloplasty or de Vega's repair was done to yield tricuspid valve competency. In 22 patients who had organic tricuspid valve disease because of abnormality of leaflet tissues, we used pericardial patch augmentation of affected leaflet and successfully restore tricuspid valve competence while preserving the native tricuspid valve. For this study we reviewed the records of these 22 patients, which included demography clinical histories, pre and per operative echocardiograms, operative notes, and follow-up data. We routinely performed post-operative echo on day 6 and after 1 month of surgery as per our protocol.

The diagnosis of organic tricuspid valve disease was made primarily from the echocardiographic findings of severe regurgitation in 16 patients. 6 patients who were diagnosed with functional tricuspid regurgitation by preoperative TTE were found to have Organic tricuspid valve disease intraoperatively. Coexisting mitral valve disease was present in all patients and mitral and aortic valve lesion was present in 4 patients. Of the latter four patients 1 patient was post mitral valve replacement with struck mitral valve with severe aortic regurgitation.

Operative Techniques: Standard median Sternotomy with bicaval cannulation for cardiopulmonary bypass was used in all cases. The heart was arrested with antegrade cold blood cardioplegia through the aortic root. In patients with aortic regurgitation initially retrograde cardioplegia was used followed by coronary ostial cardioplegia. Cardioplegia was repeated every 20 minutes. The tricuspid valve was exposed through an oblique right atriotomy. After inspection of the tricuspid valvular pathology, a piece of autologous pericardium was harvested and fixed in 0.6% glutaraldehyde solution for 10 minutes, and then taken out and rinsed 3 times with normal

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saline, ready for use. Mitral or aortic valve replacement or other intracardiac procedures were done before the tricuspid valve was addressed.

The dominant mechanism of tricuspid insufficiency was identified. Leaflets whose effective height was inadequate either due to fibrosis or due to severe tethering on account of right ventricular dilatation were augmented with autologous pericardium. A commissure to commissure incision was made 2mm from the leaflet hinge along the base of the leaflet, thus creating an elongated oval defect in the leaflet. Secondary chordates were divided if deemed necessary for improvement of leaflet motion. The width of the defect (W) was measured while the free edge of the leaflet was being held in opposition to the opposite leaflet. The length of the deficit (L) was also measured. The glutaraldehyde-treated pericardial patch was then fashioned into an oval-shaped strip, the width of which was determined by $W + 0.5$ cm, and the length by $L + 0.5$ cm. The patch was sewn into place with 5-0 continuous polypropylene suture, thereby widening the leaflet and ensuring at least a 7 mm coaptation.

Commissurotomies were done if significant commissural fusion was limiting orifice area or leaflet mobility. In one case with Ebstein's anomaly, anterior papillary muscle advancement towards the septum was carried out.

For tricuspid regurgitation with significant annular dilation, modified De Vega annuloplasty or ring annuloplasty was performed. The latter was preferred if the patient was able to afford the additional cost of a prosthetic ring. In patients with evidence of chronic right ventricular dysfunction or pulmonary hypertension, a prosthetic ring was deemed essential.

With the pulmonary artery occluded, tricuspid competency was examined by injecting saline into the right ventricle through the valve with a bulb syringe.

Assessment and Follow-Up: Tricuspid valve competence was examined intraoperatively by direct inspection on saline test and by trans esophageal echocardiography (TEE) in operating room. Postoperatively, all patients had routine TTE examination before hospital discharge. This was repeated at 1 months and 3 month.

RESULTS: Demography and clinical characteristics - of all 22 patients 12(55%) were female and 10 (45%) were male. Age range between (15 year to 65 year). All patients were in New York heart association (NYHA) class III or IV. Ten patient had clinical sign of right side failure including pedal edema in 23% (5 patient) hepatomegaly along with hyperbilirubinemia in 45%(10 patients) and ascites in 5 patients (23%). Four patients underwent earlier interventions for mitral valve includes balloon mitral Valvotomy in two patients, closed mitral Valvotomy in one patient and mitral valve replacement in one patient who presented with struck mitral valve. In our study one patient had mild pulmonary artery hypertension, 15 patients had moderate hypertension and 6 patients had severe pulmonary artery hypertension. (Table 1)

Surgical Repair: All patient underwent tricuspid valve repair along with mitral valve replacement, in 4 cases aortic valve was also replaced. 2 patients had leaflet augmentation and no annuloplasty. Leaflet augmentation along with modified de Vega's repair was done in 11 patients while flexible ring was used in 9 patients. Septal leaflet was augmented in 6 patients

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while 14 patients underwent anterior leaflet augmentation. In 2 cases both septal and anterior leaflets were augmented. One patient required anterior papillary muscle advancement. There were no early or late deaths. Range all patients underwent intraoperative TEE where mild TR was present in 6 patients while moderate TR was present in 1 patient. Transthoracic echo was done on day 6 showed mild TR in 6 patients while one patient showed moderate TR with TS with gradient of 4 across TV, all patient received diuretics in post-operative course. Postoperatively, 1 patient required reexploration for bleeding, no patient developed heart block. Most of the patient discharge on post-operative day 8 and mean hospital stay was 8 ± 3.12 days. (Table 2)

Follow-up was complete in this group, and the follow-up duration range was 3 to 18 months. No late death or cardiac reoperation occurred. Symptomatic improvements were noted in all patients and, as determined by their response to the telephone inquiry, all patients stayed in New York Heart Association (NYHA) class II with a fairly good life quality. (Table3).

The most recent follow-up echocardiograms showed no signs of dehiscence of the patch. Patient who had tricuspid stenosis in post-operative period doing well till his last follow up 6 month postoperatively.

	n=22 (100%)
Male	55%
Female	45%
Pedal edema	23%
Hyperbilirubinemia	45%
Ascites	23%
NYHA class III/IV	100%
Mitral regurgitation	
Mild	4.5%
Moderate	68.2%
Severe	27.3%
Early interventions(prior to CABG)-	
Balloon mitral Valvotomy	9.0%
Closed mitral Valvotomy	4.5%
Mitral valve replacement	4.5%
Nil	82%

Table 1: Demographics and preoperative characteristics

Tricuspid valve repair technique	
Patch augmentation only	9.1%
Patch augmentation + ring annuloplasty	40.9%
Patch augmentation+ de Vega's	50%
Leaflet augmentation	
Septal leaflet	27.3%
Anterior leaflet	63.6%
Septal + anterior leaflet	9.1%

Table 2: Surgical procedure for tricuspid valve

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Tricuspid valve regurgitation	
Mild	27.3%
Moderate	4.5%
Nil/trace	68.2
Heart block	Nil
Re-exploration	4.5%
NYHA class I/II	100%

Table 3: Post-operative outcome

DISCUSSION: Tricuspid valve is involved in approximately 30% cases of rheumatic heart disease. Out of which 20-25% had organic tricuspid valve lesion. Most of the tricuspid valve lesion are functional and well managed by either suture or ring annuloplasty, but patient with organic tricuspid valve where pathologic process involved leaflet, commissure and sometimes chordal apparatus and annulus. In such cases correction at annulus level only does not restore tricuspid valve function, and patient require additional surgical maneuvers at leaflet, chordal or Papillary muscle level. Sometimes repair is to work and needs Tricuspid Valve Replacement. Sometimes a sub-optimal repair seems preferable to a replacement as Prosthetic valve replacement for tricuspid valve results in poor long term outcome as well as poor hemodynamic performance at this position. In India most of these patient belongs to poor or low socioeconomic status where finance for mitral valve replacement is big deal so valve replacement at tricuspid valve is certainly the last choice. Pericardial patch augmentation was well reported in literature. Tang et al⁽⁶⁾ reported a series of 31 patients where anterior tricuspid leaflet was augmented and results were excellent with this technique. They also mentioned that using low concentration of glutaraldehyde leads to low incidence of patch calcification. In our series we used 0.6% glutaraldehyde for fixation and till our last follow up no patient showed any calcification. All patient were doing well except one patient who underwent septal leaflet augmentation but post augmentation he had eccentric TR at poster septal commissure level where suture commisuroplasty was done, after that he showed central mild TR on saline test. Post operatively this patient showed tricuspid valve stenosis with gradient of 4 in echocardiography with moderate central TR, he is on diuretics and doing well. Most of our patient showed retraction of either anterior leaflet or septal leaflet, we augmented the affected leaflet along with commisurotomy and wherever required few chordate excision (those causing retraction). one patient required anterior papillary muscle advancement along with leaflet repair. Proper assessment of TTE preoperatively and prepare pericardial patch.

CONCLUSION: On basis of our experience, we believe that large majority of organic tricuspid valve disease is repairable with the techniques described. Prosthetic replacement should rarely be necessary and should be the last resort. Sometimes a suboptimal repair may be preferable to prosthetic replacement.

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