Impact of suture annuloplasty repair for moderate functional tricuspid regurgitation in rheumatic patients undergoing mitral valve replacement (Early outcome)

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Abstract

Background: In this study, we examine the outcomes of tricuspid valve repair against non-repair to see if there is a near-term progression of non-corrected moderate functional TR in patients who had mitral valve replacement for rheumatic mitral disease and if RV size and function were affected.

Objectives: To evaluate the effect of the De Vega annuloplasty for repair of moderate functional TV regurge during the left heart valve surgery in early post-operative period.

Patients and methods: A prospective randomized controlled trial will contain (forty patients aged from 25 to 55 years of both sexes)they will be divided into two groups of patients: Group A: Twenty patients with moderate functional tricuspid regurgitation who received tricuspid valve annuloplasty (TVA) in the form of De vega repair along with mitral valve replacement. Group B: Twenty patients with moderate functional tricuspid regurgitation who received mitral valve replacement without tricuspid valve annuloplasty (TVA).

Results: TR and right ventricle diameter were found to be significantly reduced in Group A. In group B, (6) individuals (30%) had developed grade IV/IV TR after 6 months, while 65% of patients developed competent tricuspid valve after 6 months in group A .Furthermore, in group B, TABSE (tricuspid annular systemic excursion) had dropped significantly to 1.7±0.2 cm.

Conclusion: In the early postoperative period, tricuspid suture annuloplasty combined with MVR can prevent the advancement of tricuspid regurgitation, right ventricular dilatation, and systolic dysfunction.

Key words: Tricuspid valve surgery, repair, suture annuloplasty, and mitral valve replacement.

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Introduction

Primary and secondary (functional) tricuspid regurgitation are the two forms of tricuspid regurgitation **(Porter et al., 2004)**.Secondary TR is caused by volume or pressure overloading of the right ventricle, which causes dilation of the right ventricle and tricuspid annulus. **(Bonow et al., 2006)**, while, left heart disease (severe aortic or mitral valve problem, or left ventricular failure),chronic pulmonary illness, and primary pulmonary hypertension are the most common causes of functional TR.(**Braunwald et al.,2005**).Functional TR, on the other hand, may be reduced or decreased if the left cardiac lesion that caused the right ventricle to become overloaded is resolved **(Maurizio et al.,2012).** TR progression affects up to 50% of all patients .Untreated TR, in combination with tricuspid annulus dilation, can result in permanent right ventricular dysfunction and failure **(Dreyfus and Bahrami ,2010).** Valve repair is preferred because tricuspid valve replacement has a high overall mortality rate **(Czer et al., 2005).** In terms of surgery-sparing techniques (for secondary dilatation of the tricuspid valve annulus with subsequent non-coaptation of the leaflets), sutures around the circumference of the annulus were initially used to narrow the annulus (the most frequently used surgery technique according to De Vega), but now annuloplasty rings are preferred for not only narrowing but also remodeling of the tricuspid annulus. The annuloplasty ring treatment has the benefit of a better long-term result of the sparing operation **(Raja and Dreyfus ,2010)** .Pulmonary hypertension, a larger RV diameter with tricuspid valve annulus dilatation, and a lower RV ejection fraction are all risk factors for tricuspid regurgitation worsening after mitral valve surgery **(Dreyfus et al.,2005).** When there is a dilated annulus (40 mm) or pulmonary hypertension, tricuspid valve repair in combination with mitral valve surgery is effective for severe TR and should be explored for less severe TR **(Vahanian et al., 2007).**The aim of our study is to assess the impact of repair versus non-repair of moderate functional tricuspid regurgitation in the early post-operative period , Among patients receiving mitral valve replacement for rheumatic mitral .

Patients and methods

Study design

Forty patients of both sexes, aged 20 to 55, are included in a prospective controlled randomized research. They will be sorted into two patient groups:

The first group A: Twenty patients with moderate functional tricuspid regurgitation underwent tricuspid valve suture annuloplasty (TVA) in the form of De vega repair along with mitral valve replacement.

The second group B: Twenty patients

with moderate functional tricuspid regurgitation who underwent mitral valve replacement without suture tricuspid valve annuloplasty (TVA). After mitral valve replacement, patients will be monitored for RV dilatation, tricuspid valve regurgitation, and right and left ventricular performance in both groups for 6 months post-operatively.

Research conducted at the National Heart Institute over the period of one year.The current study has been conducted after approval of the ethical committee at the national heart institute .Written informed consent has been obtained from all the participant after explanation of the study's aim and methods.

Inclusion criteria

1) Patients aged from 20 to 55 years.
2) Elective patients with moderate functional tricuspid regurgitation due to rheumatic mitral valve disease who had mechanical valve replacement.
3) Patients with ejection fraction above 40%.
4) Patients with normal aortic valve.
5) Not candidate for mitral valve repair
6) Normal coronary angiography.

Exclusion criteria

1) Patients with organic tricuspid valve affection whatever the etiology whether congenital, traumatic, infective endocarditis or carcinoid syndrome.
2) Patients with tricuspid valve stenosis.
3) Associated CABG with valvular disease.
4) Redo surgeries.
5) Emergency cases of mitral valve surgery.
6) Patients with ejection fraction less than 40%.
7) Patients candidate for mitral valve repair.
8) Patients with aortic valve disease.
9) Patients with severe pulmonary hypertension (above 70 mmHG).
10) Patients with infective endocarditis.
11) Patients with liver, kidney and parenchymal pulmonary disease.

Patients were subjected to the following:

A) Preoperative evaluation

NYHA classification for dyspnea, routine laboratory investigations and detailed Echocardiography (to evaluate RV diameter, TABSE (tricuspid annular systemic excursion) and the degree of tricuspid regurgitation and pulmonary artery pressure.

B) Intraoperative procedures

1. Cardiopulmonary bypass (CPB): Antegrade cold crystalloid cardioplegia were used to preserve the myocardium. Cardioplegia was

administered every 30-40 minutes at a dosage of 15-20 ml/kg.

2. Surgical techniques: In the repair group suture annuloplasty (De vega) had been done. In all patients, median sternotomy was performed, pericardium opened & suspended on right side using silk stitches. Aorto-bicaval cannulation performed after full heparinization & in the repair group tapes are passed around superior & inferior vena cavae. Then patients were put on bypass, cavae snared & aorta cross clamped. Myocardial protection was then achieved by antegrade cold blood cordioplegia every 20-30 minutes, systemic hypothermia and topical saline slush, mitral valve replacement and de-airing of the left side of the heart were done. Aorta was unclamped and heart defibrillated when necessary. In the repair group , Cavae were then re-snared, right atrium opened and tricuspid valve assessed and repaired on beating heart while still on pump. Right atrium incision was performed obliquely 1cm parallel to atrioventricular groove. The tricuspid valve was assessed to confirm that the regurge was functional (due to dilation of ring & failure of leaflet coaptation) . Tricuspid valve repair was performed by DeVega annuloplasty technique in 20 patients.

3. DeVega Annuloplasty: In group (A) , 2/0 ethibond suture double armed with 25mm 1/2 circle rounded taperpoint needle was passed in two parallel rows in tricuspid annulus starting at anteroseptal commissure on Teflon pledget & continued clockwise along anterior leaflet and posterior leaflet to end at posteroseptal commissure on another Teflon pledget. The suture is tightened & tied over 31 or 33 mm valve sizer .

Competence of tricuspid valve was then assessed by observing the tricuspid valve motion during mechanical contractions. The right atrium was then closed using continuous 4/0 prolene suture in 2 layers and patient weaned from cardiopulmonary bypass. Decannulation was then performed. Protamine then given, haemostasis ensured, mediastinum drained using two retrostenal draines and sternum closed.

4. Data recorded: 1) Operative time, time of aortic cross clamp and extra corporeal circulation, Demographic data and clinical characteristics inotropes , echocardiographic finding and pulmonary function test.

C) Postoperative data

ICU stay, ventilation, inotropic agents when indicated & post operative echo.

The Post Operative Echo: An echo was done before discharge to monitor LVEDD, LVESD, ejection fraction (EF), and severity of tricuspid regurgitation.

Statistical analysis

Data were statistically described in terms of mean standard deviation (SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student *t* test for independent samples. For comparing categorical data, Chi square (2) test was performed. Exact test was used instead when the expected frequency is less than 5. *p* values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

Preoperative Assessment

This research involved 40 patients who were receiving mitral valve replacement and had rheumatic mitral valve disease with moderate tricuspid regurgitation. The trial was completed by all of the patients, and none of them died.

The study included the preoperative data of the patients were postulated in (**Table 1**):

- Echocardiography: Tricuspid regurge grade: Total number of patients with grade II/IV were 15patients (38%) and those with grade I11/IV were 25 patients (62%). In group (A), 8 patients (40%) had tricuspid regurge grade II/IV and 12 patients (60%) had tricuspid regurge grade I11/IV. In group (B), 7 patients (35%) had tricuspid regurge grade II/IV and 13 patients (65%) had tricuspid regurge grade I11/IV. The difference between both groups is statistically non-significant (p>0.05).
- Pulmonary artery systolic pressure: The mean pulmonary artery systolic pressure value was 61.75 mmHg ± 9.358 S . D. in group (A) and was 60.75 mmHg ± 9.497 S.D. in group (B). The difference between both groups is statistically non-significant (p>0.05).
- Right ventricle dimension: The mean right ventricular dimension was 2.8 cm ± 0.300 S.D. in group (A) and 2.7 cm ± 0.41 S.D. in group (B). The difference between both groups is statistically non significant (p >*0.05).*
- Left atrial dimension: The mean left atrial dimension was 6.00 cm ± 0.78 S.D. in group (A) and 7.2 cm ± *1.007* S.D. in group (B). The difference between both groups is statistically non-significant (p >*0.05).*
- Left ventricle dimensions: The mean LVEDD value was 5.8 cm ± 0.644 S.D. in group (A) and 5.83cm ± 0.73 S.D. in group (B). The mean LVESD value was 3.9 cm ± 0.369 S.D. in group (A) and

3.94cm ± 0.428 S.D. in group (B). The difference between both groups is statistically non-significant (p > 0.05).

- Fractional Shortening: The mean fractional shortening values were 32.5% ± 3.1 S.D. in group (A) and 32.15± 3.28S.D. in group (B). The difference between both groups is statistically non-significant (p >0.05), **(Table . 1).**

Postoperative data

- Dyspnea: In group A : There were (13) patients (65%) in functional class I, (5) patients (25%) in functional class II and (2) patients (10%) in functional class III and 2 patients (10%). This improvement is of high statistical significance after 3 months (p<0.01), **(Table.2).** Furthermore, 16 patients had no dyspnea after 6 months .table (3).However, in group B, the patients had deteriorated ,as 3 patients developed NYHA class III after 6 months **(Table . 3).**

Table 1.Comparison of the preoperative data between both groups

Variables	**Group A**	**Group B**	***P value***
Males	8 (40%)	9 (45%)	>0.05
Females	12 (60%)	11 (55%)	>0.05
Mean Age	25.15 ±3.9 .	26.85±4.28	.>0.05
Cross clamp (min.)	56.4±25.3	57.9±8.7	>0.05
Total bypass time (min.)	72±12.2	73.8±12.7	>0.05
Dyspnea (NYHA)	I 0 II 0 III 14(70%) IV 6 (30%)	I II III 9(45%) IV 11 (55%)	>0.05
T.R.	0 0 I 0 II 8(40%) III 12(60%) IV 0	0 0 I 0 II 7(35%) III 13(65%) IV 0	>0.05
P.A.S.P.	61.75 mmHg ± 9.358	60.75mmHg ± 9.497	>0.05
R.V.diameter	2.8 cm ± 0.3009 S.D.	2.7 cm ± 0.4077 S.D.	>0.05
TAPSE	2.2±0.4 cm Preserved function	2.1±0.5 cm Preserved function	>0.05
L.A.	6 cm ± 0.7732 S.D..	7.2 cm ± 1.0078 S.D.	.>0.05
L.V. 1- L.V.E.D.D. 2- L.V.E.S.D.	5. 8 cm ± 0.644 S.D. 3.9 cm ± 0.369	5.83 cm ± 0.731 S.D. 3.945 cm ± 0.428	.>0.05
F.S.	32.5% ± 3.13	32.15% ± 3.281	>0.05

TAPSE (tricuspid annular systemic excursion),±SD:standard deviation, N.S.: non significant, *:statistically significant, P value < 0.05 is considered significant, op:operative, cm:centimeter.

Postoperative data

- Dyspnea: In group A: There were (13) patients (65%) in functional class I, (5) patients (25%) in functional class II and (2) patients (10%) in functional class III and 2 patients (10%). This improvement is of high statistical significance after 3 months ($p<0.01$), **(Table.2).** Furthermore, 16 patients had no dyspnea after 6 months, **(Table . 3).** However, in group B, the patients had deteriorated, as 3 patients developed NYHA class III after 6 months .**Table (3).**

Table 2. Comparison of the postoperative outcomes after 3 months

Variables	Group A	Group B	*P value*
Dyspnea (NYHA)	I 13(65%) II 5(25%) III 2(10%) IV 0	I 7(35%) II 7(35%) III 6(30%) IV 0	<0.01
T.R.	0 15 (75%) I 5(25%) II 0 III 0 IV 0	0 0 I 2(10%) II 5(25%) III 13(65%) IV 0	<0.01
P.A.S.P.	45mmHg ± 5.38	50mmHg ± 6.47	>0.05
R.V.	2.72 cm ± 0.38	2.99cm ± 0.37	>0.05
TAPSE	2.2±0.53 cm Preserved function	2.1±0.3 cm Preserved function	>0.05
L.A.	5.3cm±0.91	5.7cm ± 1.05	.>0.05
L.V. 1- L.V.E.D.D. 2- L.V.E.S.D.	 5.66cm± 0.44 3.89cm ± 0.34	 *5.65* cm ± 0.43 3.92 cm±0.33	.>0.05
F.S.	30.84%± 1.95	30.56%± 1.75	>0.05

±SD:standard deviation, N.S.:non significant, *:statistically significant, P value < 0.05 is considered significant, op:operative, cm:centimeter.

- Tricuspid valve regurgitation: Postoperative follow up after 6 months revealed that in group A: 13 patients (65%) had competent tricuspid valve without any regurgitation, 5 patients (25%) had grade I/IV , 2 patients (10%) had grade II/IV . On the other hands , 4 patients (20%) had grade I/IV, 3 patients (15%) had grade II/IV, 7 patients (35%) had grade III/IV and 6 patients (30%) had grade IV tricuspid regurgitation which is statistically highly significant ($p<0.01$), **(Table . 3).**
- RV function (TAPSE): in group A: RV function preserved after 6 months. On the other hand, in group B, RV function had impaired after 6 months), **(Table. 3).**

Table 3. Comparison of the postoperative outcomes after 6 months

Variables	Group A	Group B	*P value*
Dyspnea (NYHA)	I 16(80%) II 4(20%) III 0 IV 0	I 3(15%) II 12(60%) III 5(25%) IV 0	<0.01
T.R.	0 13 (65%) I 5(25%) II 2(10%) III 0 IV 0	0 0 I 4(20%) II 3(15%) III 7(35%) IV 6(30%)	<0.01
P.A.S.P.	35mmHg ± 6.458	51mmHg ± 5.497	<0.01
R.V.	2.63 cm ± 0.41	3.23 cm ± 0.41	0.04*
TAPSE	2.2±0.53 cm Preserved function	1.7±0.2 cm impaired function	0.03*
L.A.	5.1cm±0.74	5.5cm ± 1.2	.>0.05
L.V. 1- L.V.E.D.D. 2- L.V.E.S.D.	 5.36cm ± 0.44 3.49cm ± 0.34	 *5.75* cm ±0.41 3.82cm±0.33 .	.>0.05
F.S.	32.64%± 1.65	31.56%± 1.95	>0.05

±SD:standard deviation, N.S.:non significant, *:statistically significant, P value < 0.05 is considered significant,op:operative, cm:centimeter.

Discussion

TR is typically linked with mitral valve (MV) illnesses, and the presence of considerable TR has been found to be a predictor of poor prognosis following surgical correction of MV problems **(Nath et al.,2004 ; Scully and Armstrong ,1995)**. In patients with severe functional TR, concurrent tricuspid valve (TV) repair or replacement at the same time as MV surgery has been indicated to enhance long-term clinical results **(Bonow and Carabello, 2006 ; Kuwaki et al.,2001) .**

The decision to correct mild-to-moderate functional TR during MV surgery is debatable. Although TR can regress without TV correction following successful MV surgery **(Foster and Heidenreich,2004 ; Song et al .,2003)** , functional TR can advance even after successful MV surgery, indicating that TR should be surgically corrected even if moderate**(McCarthy et al.,2004 ;Matsuyama et al.,2003).**

Until recently, surgical avoidance of TV repair in patients with secondary TR was widely recommended, based on the mistaken assumption that TR would go away after the main LT heart disease was cured**(Braunwald et al.,2005).**For many years, the physiopathology and management of this illness have been overlooked. This conservative approach to surgery continues to impact surgical practice today, and television repair is still an all-too-rare procedure at most medical institutions. Many researchers have provided evidence in support of a more aggressive surgical treatment to STR in recent years **(Dreyfus and Bahrami.,**

2010 ; Lee et al.,2010). Approximately 1.6 million individuals in the United States suffer with moderate to severe TR, with barely 8,000 undergoing tricuspid surgery each year. This results in an extremely large number of untreated patients with secondary TR **(Stuge, and Liddicoat .,2006).**

In our study, dyspnea was present in all patients. Functional tricuspid insufficiency is almost invariably accompanied with mitral valve disease. The concomitant valve lesion often will dominate the clinical picture. Hence the symptoms are those of progressive left-sided lesion **(Silber and katz, 2001).** The development of tricuspid insufficiency acts as a decompressive mechanism for the alleviation of left-sided heart failure **(Silber and katz, 2001 ; Salazar et al.,2001).**

There was no statistically significant difference in clinical symptoms between the two groups before surgery in our investigation. Our data goes hands on hand with the study of **Nath et al .(2004).**

Regarding post-operative evaluation, there was no statistically significant difference in clinical symptoms between the two groups before surgery in our investigation.

Postoperatively,the improvement in left sided manifestations was highly significant for functional class of dyspnea and significant for orthopnea and P.N.D. with no statistical significance between the values in both groups (p>0.05) reflecting adequate left sided lesions correction. This was consistent with the data of **Dreyfus et al. (2005).**

Postoperatively, the improvement in right sided manifestations was highly significant for right hypochondrial or epigastric pain, liver size and neck vein congestion and significant for abdominal swelling, ascites and lower limb oedema for group (A), however these manifestations showed mild improvement in group (B) reflecting adequate right sided lesions correction in group (A) and failure of regression of secondary tricuspid regurge after correction of the left sided lesion in group (B), this was consistent with the data of **Kuwaki et al.(2001).**

Color Doppler flow mapping is useful for determining whether or not a repair is adequate. It correctly predicts the existence and severity of any postoperative regurge (early or late)(**Czer et al.,2005).**All of the participants in our research had healthy mitral valves. In group (A), the degree of improvement in tricuspid insufficiency was quite significant.

Lee et al, claimed that repair of tricuspid valve during the left sided heart surgery has a beneficial effect on long term prognosis of tricuspid valve competence **(Lee et al.,2010).** Regarding This improvement, out data showed that the improvement of tricuspid valve was maintained after 3 months and only one patients developed grade II/IV tricuspid regurge this deterioration is statistically non-significant (P >0.05) ,while in group (B), 6 patients deteriorated to grade IV/IV after 3 months, This deterioration is of statistical

significance (*P* <0.05) also of statistical significance is the decrease of right ventricular dimensions of group (A) and the increase of right ventricular dimensions in group (B) after 3months.

Maurizio et al. (2012) showed The improvement of LVESD and LVEDD was non-significant (P >0.05) over the in-hospital time in our research, while the improvement in left atrial dimension and worsening of ejection fraction was significant in both groups (P 0.05)**.**Furthermore , our data revealed that after 3 months, left atrial dimension and fractional shortening improvement was highly significant (P <0.01), LVESD improvement was significant (P < 0.05) and LVEDD improvement was non- significant (P > 0.05) in both groups. Left atrial dimension, LVESD, LVEDD and FS reflected the improvement of left ventricular function following successful correction of mitral valves.

Matsuyama et al. (2003) claimed that experience of recent years revealed that De Vega semicircular tricuspid annuloplasty has been associated with encouraging clinical results for treating functional tricuspid insufficiency, but postoperative follow up evaluation had suggested lack of uniform success**.**

In our study, in group (A),after 3 months , 75% of patients had early postoperative competent tricuspid valve following DeVega annuloplasty ,and 25 % of patients had grade I/IV tricuspid regurge. After 6months 65 % of patients had no regurge, 25 % developed grade I/IV tricuspid regurge and only 10% developed grade II/IV. This reflects that Devega annuloplasty is a good short-term method of tricuspid repair.

In group (B), after 3 months no patients had competent tricuspid valve, 10% of patients had grade I/IV tricuspid regurge, 25% of patients had grade II/IV tricuspid regurge and 65% of patients regressed to grade III/IV tricuspid regurge. After 6 months, 30% of patients progressed to grade IV/IV tricuspid regurge which is statistically significant. Furthermore, RV function (TAPSE), had impaired significantly in group B after 6 months.

It's crucial to note that this considerable degradation happened despite adequate valve performance on the left side. These findings are similar to those of **Yoon et al .(2010),** but the modest difference in the degree of tricuspid regurge advancement between the two investigations can be explained to the inclusion of patients who had mitral valve replacement in the first research and the long-term follow-up in the second study. In the near-term postoperative phase, tricuspid annuloplasty performed concurrently with MVR can reduce the advancement of tricuspid regurgitation, right ventricular dilatation, and systolic dysfunction **(Stuge, and Liddicoat,2006).**

Conclusion

We concluded that tricuspid valve annuloplasty-of moderate tricuspid regurgitation-can prevent subsequent progression of tricuspid regurgitation, right ventricular dilatation, and systolic dysfunction in patients who underwent mitral valve replacement with an

echocardiographically measured tricuspid annulus of 40 mm or more in the relatively near-term postoperative period .

Recommendations

To do tricuspid valve annuloplasty of moderate tricuspid regurgitation during the left heart valve surgery .

Limitation of the study

Our study showed limitations in order to a small one-center study with a short term follow-up period. Longer months of monitoring are crucial to confirm the efficacy and stability of these echocardiographic characteristics.

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