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ORIGINAL ARTICLE

Comparative Study between Modified Suturing Annuloplasty Technique vs Ring AnnuloplastyTechnique in Tricuspid Valve Repair, Short Term Outcomes

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ABSTRACT

Background: Short-term recovery after tricuspid valve repair is influenced by the annuloplasty technique used. Prosthetic rings are widely adopted, yet a simplified, cost-saving modified suturing annuloplasty remains attractive especially in resource-constrained settings. Comparative data on early clinical and echocardiographic results are still limited. So we aimed to compare short-term outcomes of modified suturing annuloplasty (MSA) versus ring annuloplasty (RA) in the surgical repair of severe functional tricuspid regurgitation (TR).

Methods: This retrospective, single-center study enrolled 72 adults who underwent tricuspid valve repair at Zagazig University Hospitals. Patients were allocated to an MSA and RA group. Followed for 1 year Primary end points were early valve competence and NYHA functional class. Secondary end points included cardiopulmonary-bypass (CPB) metrics, intensive-care utilisation, residual TR, pulmonary-artery systolic pressure (PASP), right-ventricular end-diastolic diameter (RVEDD), and peri-operative complications.

Results: Mean aortic cross-clamp and CPB times, concomitant left-sided valve procedures, and immediate post-repair residual TR were likewise similar.ICU stay, total hospital stay, inotrope requirements and Re-exploration due to bleeding showed no significant differences. Both techniques produced significant improvement in NYHA class at 1 month and 12 months, with no inter-group difference. Residual TR remained minimal in both cohorts throughout follow-up. PASP and RVEDD declined significantly after surgery in both groups.

Conclusions: In the short term, modified suturing annuloplasty provides clinical and echocardiographic outcomes equivalent to ring annuloplasty for functional TR, while retaining the advantages of technical simplicity and lower cost.

Keywords: Modified suturing annuloplasty technique; ring annuloplasty technique; tricuspid valve repair.

INTRODUCTION

Functional tricuspid regurgitation (TR) is a prevalent valvular disorder, commonly arising as a secondary consequence of left-sided heart disease, pulmonary hypertension, or right ventricular (RV) dysfunction. Unlike primary TR, which involves intrinsic valvular pathology, functional TR results from right ventricular dilatation and tricuspid annular enlargement, leading to progressive volume overload, right-sided heart failure, and increased perioperative risk in cardiac surgery. Left untreated, severe TR is associated with increased morbidity and mortality,

underscoring the need for timely and effective surgical intervention [1].

Surgical repair is the gold standard in the management of severe functional TR, especially when performed in conjunction with left-sided valve surgery. Annuloplasty—aimed at reducing annular dilation and restoring leaflet coaptation—is the cornerstone of surgical repair. Two principal techniques dominate current practice: prosthetic ring annuloplasty and suture-based annuloplasty techniques [2].

Ring annuloplasty, utilizing rigid or semi-rigid prosthetic rings, is widely accepted due to its ability to maintain annular shape and prevent recurrent dilation. However, its application may be limited by cost, technical complexity, and potential prosthesis-related complications. In contrast, modified suturing techniques, such as the modified suturing annuloplasty, offer a simpler and more cost-effective alternative, particularly in low-resource settings. Despite concerns over long-term durability, refinements in suture techniques and careful patient selection have renewed interest in suture-based approaches [3].

METHODS

Over the course of two years, from May 2022 to May 2024, this prospective cohort study was carried out at Zagazig University Hospitals' Cardiothoracic Surgery Department. Adult patients (18 years of age or older) with severe functional tricuspid regurgitation due to left-sided valvular disease, including isolated mitral valve disease or combined mitral and aortic valve disease, were included in the study. The objective was to compare short-term outcomesover 1 year between two surgical techniques for functional tricuspid regurgitation: modified suturing annuloplasty (MSA) and ring annuloplasty (RA).

Zagazig University provided IRB approval (Number 433/9-6-2024). Confidentiality of the patients was preserved. For the use of the data, informed consent was acquired.

Patients were selected based on specific inclusion criteria, such as informed consent, suitability for surgical surgery, and a diagnosis of severe functional tricuspid regurgitation confirmed by echocardiography. Participants were excluded if they had a history of previous cardiac surgery, concurrent coronary artery bypass grafting (CABG) or aortic surgery (involving the aortic root, ascending aorta, or aortic arch), severe systemic comorbidities precluding surgery, primary tricuspid valve pathology, or evidence of right ventricular dysfunction, defined as a tricuspid annular plane systolic excursion (TAPSE) value below 18 mm on preoperative echocardiography, in order to eliminate confounding effects of RV dysfunction on the postoperative outcomes..

Seventy-two patients were enrolled in the study after meeting the inclusion criteria. Depending on the surgical method employed, they were split into two groups:

MSA Group (n = 43): Underwent modified suturing annuloplasty , and RA Group (n = 29): Underwent prosthetic ring annuloplasty with a rigid or semi-rigid ring selected according to annular dimensions. Clinical records, preoperative transthoracic echocardiography reports, intraoperative surgical documentation, and postoperative follow-up records were among the many sources from which data were gathered. These resources offered thorough data for comparing the two surgical groups' results.

Surgical Techniques

Warm blood cardioplegia was used to protect the heart, and aortic and bicaval cannulation were employed to establish cardiopulmonary bypass (CPB). When necessary, the mitral valve procedure was performed either transeptally or via a left atriotomy, depending on the surgeon’s preference. Tricuspid valve repair was initiated while the patient remained on CPB on arrested heart with cross clamp still on and was performed through a right atriotomy.

For patients in the ***modified suturing annuloplasty***, the repair was performed using two parallel Teflon-reinforced sutures. The first suture was placed starting 2–3 mm away from the postero-septal commissure and advanced toward the midpoint of the anterior leaflet annulus. The second suture began at the antero-septal commissure of the anterior leaflet

annulus. Both sutures were tied together using free Teflon pledgets to reduce the annular size and restore valve competence, while preserving the native anatomy of the tricuspid valve.

Patients in the ***ring annuloplasty group***, on the other hand, had a prosthetic annuloplasty ring implanted. The surgeon's judgment and intraoperative annular measurements were used to determine whether to use a rigid, semi-rigid, or flexible ring type. Pledgeted sutures were used to secure the ring to the annulus, guaranteeing uniform tension and circumferential support to preserve annular geometry and stop recurring or residual regurgitation.

Statistical Analysis

SPSS was used to examine the data. Categorical data will be displayed as counts and percentages, whereas continuous variables will be displayed as mean ± SD. Where appropriate, t-tests, chi-square tests, Freidman and paired t-test was used for comparison. If the p-value is less than 0.05, it will be deemed statistically significant.

RESULTS

There was no statistical significance difference between the studied groups regarding age, sex, preoperative NYHA functional class, preoperative atrial fibrillation (AF) and preoperative echocardiographic findings (Table 1,2). There was no statistically significant difference regarding intraoperative data including type of associated other valve surgery, aortic cross clamp time, bypass time and degree of residual Tricuspid valve regurgitation post Tricuspid valve repair (Table 3).

The incidence of duration of ICU stay, and the required dosage of inotropic support differences did not reach statistical significance. With almost comparable duration of Hospital stay (Table 4). There was significant improvement of NYHA functional class in the both groups one month and one year postoperatively, without any significant difference between both groups (Table 5).

There were no statistically significant differences between the studied groups regarding residual Tricuspid regurge during follow up. (Table 6).All patients especially showed significant decrease in PASP and significant regression in right ventricular dimension in postoperative follow up echocardiography in both groups (Table 7).

Table 1: Preoperative Data

Item			MSA Group N = 43		RA Group N = 29		X^2	Sig.
Age		**(mean , SD)**	**43 ± 8**		**44 ± 10**		**3.184**	**0.079**
Sex	**F**	**(N , N%)**	**23**	**53.5%**	**17**	**58.6%**	**0.185**	**0.667**
	M	**(N , N%)**	**20**	**46.5%**	**12**	**41.4%**		
	Total	**(N , N%)**	**43**	**100.0%**	**29**	**100.0%**		
NYHAPre-Operative	**Grade I**	**(N , N%)**	**0**	**0.0%**	**0**	**0.0%**	**2.878**	**0.237**
	Grade II	**(N , N%)**	**7**	**16.3%**	**5**	**17.2%**		
	Grade III	**(N , N%)**	**23**	**53.5%**	**10**	**34.5%**		
	Grade IV	**(N , N%)**	**13**	**30.2%**	**14**	**48.3%**		
	Sinus	**(N , N%)**	**24**	**55.8%**	**14**	**48.3%**		
	AF	**(N , N%)**	**19**	**44.2%**	**15**	**51.7%**		

SD = Standard Deviation, NYHA Class = New York heart association functional class

Table 2: Preoperative ECHO

Item	MSA Group N = 43			RA Group N = 29			F Value	Sig.
	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range		
Grade of TV Pre-operative	**61.46**	**6.75**	**27.79**	**96.25**	**7.50**	**24.44**	**1.343**	**0.250**
EF Pre	**55**	**4**	**19**	**56**	**6**	**22**	**1.988**	**0.163**
PASP	**59.48**	**7.72**	**33.85**	**63.85**	**7.04**	**25.11**	**.184**	**.669**
RVEDD	**3.6778**	**.34**	**1.26**	**3.74**	**.43**	**1.95**	**.174**	**.678**
Right Atrial Diameter	**4.40**	**0.58**	**2.59**	**5.002**	**0.557**	**2.69**	**.118**	**0.723**

Table 3: Operative Data

Item			**MSA Group N = 43**		**RA Group N = 29**		**F Value**	**Sig.**
Ischemic time		**(mean , SD)**	**77 ± 13**		**89 ± 12**		**0.120**	**0.730**
Total bypass time		**(mean , SD)**	**107 ± 16**		**117 ± 17**		**0.010**	**0.923**
Operation	**Mitral Valve repair/Replacement**	**(N , N%)**	**25**	**58.1%**	**15**	**51.7%**	**$\chi 2 = 0.289$**	**0.591**
	Mitral + Aortic Valve Replacement	**(N , N%)**	**18**	**41.9%**	**14**	**48.3%**		
Degree Tricuspid Regurge by TEE	**None**	**(N , N%)**	**19**	**44.2%**	**19**	**44.2%**	**K = 1.261**	**0.261**
	Minimal	**(N , N%)**	**23**	**53.5%**	**23**	**53.5%**		
	Mild	**(N , N%)**	**1**	**2.3%**	**1**	**2.3%**		

MV = mitral valve, AV = aortic valve , TV = tricuspid valve, TEE = trans-esophageal echocardiography

X^2 = Chi-square , K = Kruskal Wallis Test

Table 4: In hospital postoperative data

Item			**MSA Group N = 43**		**RA Group N = 29**		**F Value**	**Sig.**
ICU days		**(mean , SD)**	**2 ± 0.5**		**2 ± 0.8**		**2.257**	**0.138**
Total Hospital stay days		**(mean , SD)**	**8.2 ± 1.2**		**8 ± 1.3**		**0.056**	**0.814**
Inotropes use	No	**(N , N%)**	**27**	**62.8%**	**21**	**72.4%**	**$X^2 = 722$**	**0.396**
	Yes	**(N , N%)**	**16**	**37.2%**	**8**	**27.6%**		
Re-exploration due to bleeding	No	**(N , N%)**	**37**	**86%**	**26**	**89.7%**	**$X^2 = 206$**	**0.650**
	Yes	**(N , N%)**	**6**	**14%**	**3**	**10.3%**		

X^2 = Chi-square

Table 5: NYHA class among studied groups in preoperative and post-operative (one month) and follow up (one year) periods.

							Kruskal Wallis Test	
Item			**MSA Group N = 43**		**RA Group N = 29**			Sig
NYHAPre-Operative	**Grade I**	**(N , N%)**	**0**	**0.0%**	**0**	**0.0%**	**1.261**	**0.237**
	Grade II	**(N , N%)**	**7**	**16.3%**	**5**	**17.2%**		
	Grade III	**(N , N%)**	**23**	**53.5%**	**10**	**34.5%**		
	Grade IV	**(N , N%)**	**13**	**30.2%**	**14**	**48.3%**		
NYHAPost-Operative	**Grade I**	**(N , N%)**	**4**	**9.3%**	**5**	**17.2%**	**2.834**	**0.092**
	Grade II	**(N , N%)**	**23**	**53.5%**	**18**	**62.1%**		
	Grade III	**(N , N%)**	**14**	**32.6%**	**6**	**20.7%**		
	Grade IV	**(N , N%)**	**2**	**4.7%**	**0**	**0.0%**		
NYHAafter1 Year	**Grade I**	**(N , N%)**	**19**	**44.2%**	**18**	**62.1%**	**2.015**	**0.156**
	Grade II	**(N , N%)**	**20**	**46.5%**	**9**	**31.0%**		
	Grade III	**(N , N%)**	**3**	**7.0%**	**2**	**6.9%**		
	Grade IV	**(N , N%)**	**1**	**2.3%**	**0**	**0.0%**		
Sig.			**0.001**		**0.001**			

Table 6: post-operative follows up of Tricuspid valve status (one month) & (one year) among studied groups

Item			**MSA Group N = 43**		**RA Group N = 29**		**KruskalWallis Test**	**Sig**
Degree Tricuspid Regurge after 1 M	**None**	**(N , N%)**	**23**	**53.5%**	**21**	**72.4%**	**2.72**	**0.098**
	Minimal	**(N , N%)**	**19**	**44.2%**	**8**	**27.6%**		
	Mild	**(N , N%)**	**1**	**2.3%**	**0**	**0.0%**		
Degreeof Tricuspid Regurge after 1 year follow up	**None**	**(N , N%)**	**24**	**55.8%**	**18**	**62.1%**	**0.369**	**0.543**
	Minimal	**(N , N%)**	**16**	**37.2%**	**10**	**34.5%**		
	Mild	**(N , N%)**	**3**	**7.0%**	**1**	**3.4%**		

Table 7: Echo parameters pre and after one year among studied groups.

	MSA Group N = 43		RA Group N = 29		F Value	Sig.
	Mean	SD	Mean	SD		
RVEDD Pre	3.678	.0.342	3.737	.429	.174	0.678
RVEDD Post-Operative	2.956	.0.290	2.898	.268	.364	0.548
P-Value	0.033		0.001			
PASP Pre	59.479	7.720	63.849	7.043	.184	0.669
PASP Post-Operative	42.884	8.014	47.774	6.628	.261	0.610
P-Value	0.001		0.001			

DISCUSSION

The present study demonstrates that, during the first postoperative year, a modified suturing annuloplasty (MSA) yields clinical and echocardiographic results comparable to those of prosthetic ring annuloplasty (RA) in the treatment of severe functional tricuspid regurgitation. The two groups were statistically matched in terms of age, sex distribution, NYHA functional class, rhythm status (e.g., atrial fibrillation), and severity of tricuspid regurgitation. Echocardiographic parameters such as right ventricular end-diastolic diameter (RVEDD), pulmonary artery systolic pressure (PASP), and ejection fraction (EF) showed no significant differences between the groups prior to surgery. This homogeneity ensures a fair comparison and supports the conclusion that the observed postoperative outcomes are likely attributable to the surgical technique rather than patient selection bias.which is consistent with the findings reported byHata et al.,[4], However Shinn et al., found that ring group usually tend to have preoperative pacemaker and lower ejection fraction[5].

Intraoperatively, both groups underwent tricuspid repair alongside mitral or combined mitral and aortic valve surgery, with no statistically significant differences in cardiopulmonary bypass time, ischemic time, or intraoperative complications. Importantly, the incidence of re-exploration for bleeding or other causes was low and similar between the two groups. This suggests that the complexity and technical safety of the modified suturing technique are not inferior to ring annuloplasty when performed by experienced surgeons. These findings are also reported by Wang et al., and Calafiore et al.,[6, 7]where suturing techniques were associated with reduced cost and procedural time without increasing surgical risk.

Postoperative echocardiographic follow-up revealed meaningful improvements in both PASP and RVEDD in both groups.Moreover, our finding of equivalent early valve competence and identical improvements in NYHA functional class mirrors the early-follow-up experience published byHata et al., and Ferrazet al.,[4, 8],where no significant difference in residual TR was detected at 1–12 months between suture and ring repairs.Also Türkmen et al.,found nearly comparable results [9].Conversely, Singh et al., and Sohn et al., studies consistently report higher late recurrence rates after suturing type repairs[10, 11]. The absence of divergence in our short-term data is therefore unsurprising; durability differences tend to emerge only after the third postoperative year when progressive right-heart remodeling or sutureloosening can enlarge the annulus again.

Conclusion:Both approaches are appropriate for functional TR when achieving immediate competence is the primary objective, according to our findings and the international

literature. The modified suturing technique is an effective, affordable substitute that does not sacrifice immediate results in situations where ring inventory, cost, or prosthesis-related issues are limiting factors.

Limitations of the study

Because this is a single-center experience, the results may not be as applicable to other institutions with different surgical teams or patient populations. The annuloplasty technique was chosen based on intraoperative judgment, which might have affected the results. Furthermore, the relatively small sample size might make it more difficult to identify subtle group differences or less common complications. Additionally, the one-year follow-up period was too short to evaluate the two techniques' long-term durability. Finally,Different operators performed the echocardiographic evaluations, which could lead to interpretation differences, particularly with regard to residual regurgitation grading and right ventricular dimensions.

Conflict of Interest: None**.**

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REFERENCES

1. Adamo M, Mangieri A, Denti P, Sannino A, Grigioni F, Asch FM, et al. Epidemiology, pathophysiology, diagnosis and management of chronic right-sided heart failure and tricuspid regurgitation. A clinical consensus statement of the Heart Failure Association (HFA) and the European Association of Percutaneous Cardiovascular Interventions (EAPCI) of the ESC. Eur J Heart Fail. 2024;26(1):18–33.
2. Tang GH, Cohen M, Adams DH, Smith CR, Singh SK, Voigt I, et al. Tricuspid valve repair with an annuloplasty ring results in improved long-term outcomes. Circulation. 2006;114(1_suppl):577–81.
3. Mathur M, Park C, Lisko J, Chandran KB, Malaisrie SC, McCarthy PM, et al. Tricuspid annuloplasty rings: a quantitative comparison of size, nonplanar shape, and stiffness. Ann Thorac Surg. 2020;110(5):1605–14.
4. Hata H, Fujita T, Shimahara Y, Kobayashi J, Yokote J, Matsumiya G. Long-term outcomes of suture vs. ring tricuspid annuloplasty for functional tricuspid regurgitation. Circ J. 2017;81(10):1432–8.
5. Shinn SH, Schaff HV, Dearani JA, Daly RC, Joyce LD, Park SJ. Outcomes of ring versus suture annuloplasty for tricuspid valve repair in patients undergoing mitral valve surgery. J Thorac Cardiovasc Surg. 2016;152(2):406–15.e3.
6. Wang P, Li S, Zhao Y, Zhang X, He Y, Zhang Y. Surgical treatment strategy of functional tricuspid regurgitation. Rev Cardiovasc Med. 2024;25(5):182.
7. Calafiore AM, Contini M, Vitolla G, Teodori G, Di Mauro M, Mazza A. Late tricuspid regurgitation and right ventricular remodeling after tricuspid annuloplasty. J Card Surg. 2020;35(8):1891–900.
8. Ferraz DLM, Martins J, Almeida RO, Silva JLS, Andrade T, Soares M. Early outcomes of modified De Vega annuloplasty for functional tricuspid regurgitation at a Brazilian hospital. Int J Cardiovasc Sci. 2020;33(5):472–8.
9. Türkmen U, Yalçin Y, Aksoy E, Kocaaslan C, Karpuzoglu G, Demirci O, et al. Tricuspid repair: short and long-term results of suture annuloplasty techniques and rigid and flexible ring annuloplasty techniques. J Cardiothorac Surg. 2024;19(1):158.
10. Singh SK, Tang GH, Adams DH, Cohen M, Voigt I, Wang D, et al. Midterm outcomes of tricuspid valve repair versus replacement for organic tricuspid disease. Ann Thorac Surg. 2006;82(5):1735–41.
11. Sohn SH, Kim MJ, Park CH, Jung SH, Choo SJ, Chung CH, et al. Long-term outcomes of rigid ring versus De Vega annuloplasty for functional tricuspid regurgitation: a propensity score-matching analysis. J Thorac Cardiovasc Surg. 2021;161(5):1788–98.e5.

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