Journal of Medicine in Scientific Research

Manuscript 1049

Subject Area: Cardiothoracic Surgery

Outcome of suture annuloplasty (De Vega) versus ring annuloplasty for functional tricuspid valve regurgitation concomintant with mitral valve surgery

TAREK Elshazly OMRAN

ASHRAF ZAHRA

ORIGINAL STUDY

Outcome of Suture Annuloplasty (DeVega) Versus Ring Annuloplasty for Functional Tricuspid Valve Regurgitation Concomintant With Mitral Valve Surgery

Tarek E. Omran [a,*], Ashraf I. Zahra [b]

[a] Cardiothoracic Surgery, Department, Faculty of Medicine, Tanta University Hospital, Egypt
[b] Cardiothoracic Surgery Department at Shebin El, Kom Teaching Hospital, Egypt

Abstract

Background: **The optimal surgical technique for functional tricuspid regurgitation (TR) repair is still a topic for ongoing research. The DeVega technique is still used frequently in developing countries. Thus, this study aimed to compare the outcomes of tricuspid valve repair using DeVega versus ring annuloplasty for managing severe functional TR during mitral valve surgery.**

Methods: **This retrospective chart review included 66 patients. The study included patients with simultaneous tricuspid valve repair during mitral valve intervention. The patients were recruited from 2018 to 2022. The study had two groups: the first group included 50 patients who underwent the DeVega technique (Group A), and the second group included 16 patients who underwent tricuspid repair with a ring (Group B).**

Results: **The mean age did not differ significantly, and it was 36.1 ± 4.6 years in Group A versus 38.4 ± 2.4 years in Group B ($P = 0.06$). Females accounted for 64% of patients with DeVega versus 56% of patients with ring annuloplasty ($P = 0.578$). Mitral valve replacement was performed in 39 patients (78%) in Group A and 12 patients (75%) in Group B ($P > 0.99$). Ischemic time was comparable between the groups (60.3 ± 3.78 vs. 59.06 ± 2.91 min; $P = 0.234$). The cardiopulmonary bypass time was significantly longer with ring annuloplasty (92.54 ± 22.57 vs. 109.56 ± 28.58 min; $P = 0.017$). There was no difference in postoperative inotropic use between the groups (16 (32%) vs. 4 (25%); $P = 0.596$). The duration of mechanical ventilation (6.78 ± 1.76 vs. 5.96 ± 1.85 h; $P = 0.114$), ICU stay (2.08 ± 0.4 vs. 2.06 ± 0.57; $P = 0.876$), and hospital stay (7.96 ± 1.07 vs. 8.25 ± 0.86; $P = 0.328$) were not significantly different between groups. The postoperative degree of TR ($P = 0.163$) and after one year ($P = 0.119$) were comparable between groups.**

Conclusions: **DeVega annuloplasty could effectively manage severe TR concomitant with mitral valve surgery. The results of DeVega repair were comparable to those of ring annuloplasty after one year.**

Keywords: DeVega annuloplasty, Ring annuloplasty, Tricuspid regurgitation, Tricuspid valve repair

1. Introduction

Functional (secondary) tricuspid valve regurgitation (TR) is the most common cause of tricuspid valve disease, and it occurs secondary to annular dilatation because of a left-sided lesion [1]. Surgery is indicated in patients with severe TR, and other criteria, such as annular diameter, right ventricular function, and dilatation, should be accounted for in decision-making for tricuspid valve surgery [2,3]. Several studies have reported the development of moderate TR after conservative management during surgery for the mitral valve [4,5]. Therefore, many surgeons follow a more aggressive approach for managing moderate or lower degrees of TR concomitant with left-side surgery [6].

Various surgical options and prostheses are available for managing TR, and the superiority of

Received 15 July 2023; accepted 25 July 2023.
Available online 12 January 2024

* Corresponding author at: Cardiothoracic Surgery, Department, Faculty of Medicine, Tanta University Hospital, Egypt.
E-mail address: tarek.omran@med.tanta.edu.eg (T.E. Omran).

https://doi.org/10.59299/2537-0928.1049

one technique over the other has not been clearly demonstrated [5,7]. Tricuspid valve repair with a prosthetic ring is currently the gold standard technique for managing TR [5]. Early results of DeVega annuloplasty were satisfactory [8]; however, the technique was associated with a high recurrence rate of TR over the long-term follow-up, and its use has decreased worldwide [9]. Despite the less frequent use of the DeVega technique for tricuspid valve repair, it still has economic value in developing countries [4,10] and is used frequently in our center. Therefore, the objective was to compare the outcomes of tricuspid valve repair using DeVega versus ring annuloplasty for managing severe functional TR concomitant with mitral valve surgery.

2. Patients and methods

2.1. Patient selection

In this study, a retrospective cohort design was used to investigate 66 patients who underwent tricuspid valve repair during mitral valve surgery at Shebin El-Kom Teaching Hospital between 2018 and 2022. All patients had severe secondary (functional) TR and had repair for the incompetent tricuspid valve. Patients who had other types of cardiac procedures (such as coronary artery bypass grafting or aortic valve surgery), moderate or lower TR degree, reoperative cardiac surgery, or emergency surgery were excluded from the study. The patients were grouped based on the tricuspid valve repair technique. Group A ($n = 50$) consisted of patients who underwent the DeVega technique, while Group B ($n = 16$) included patients who underwent ring annuloplasty. The Ethical Committee of Shebin El-Kom Teaching Hospital approved this study.

2.2. Data and outcomes

To conduct this study, the necessary data were obtained from the medical records. The collected information included age, gender, type and size of the mitral valve prostheses, mitral valve procedures, and cardiopulmonary bypass and ischemic times. Postoperative outcomes were also recorded, including mechanical ventilation duration (in hours) and length of stay in the postoperative cardiac intensive care unit and hospital (in days). Furthermore, the degree of tricuspid valve regurgitation was assessed and compared between the two groups during the immediate postoperative period and again after one year.

2.3. Operative techniques

All patients underwent surgery via a full median sternotomy, with the commencement of CPB (cardiopulmonary bypass) using aortic and bicaval cannulation and warm blood cardioplegia. The mitral valve procedure was performed transeptally or through a left atriotomy incision, according to the surgeon's preference. Tricuspid valve repair was performed through a right atriotomy. In all patients, tricuspid valve repair was carried out on cardiopulmonary bypass after the aortic cross-clamp was removed. The DeVega technique was used, which involved plicating the tricuspid annulus from the anteroseptal to the posteroseptal commissure using two polyproline pledgeted sutures.

2.4. Statistical analysis

For this study, the statistical analysis was conducted using SPSS v.22 (IBM Corporation, Chicago, IL, USA). Mean and standard deviation were used to express continuous data, which were compared using either the t test or Mann–Whitney test as necessary. Qualitative data are presented as numbers and percentages and were analyzed using the chi-squared or Fisher exact test if the cells had a low frequency. Statistical significance was considered when the P value was less than 0.05.

3. Results

3.1. Comparison of preoperative and operative data

The mean age in Group A was 36.1 ± 4.6 years versus 38.4 ± 2.4 years in Group B. Females accounted for 64% in Group A versus 56% in Group B. Age ($P = 0.06$) and sex ($P = 0.578$) were not significantly different between the groups. Mitral valve replacement was performed in 39 patients (78%) in the DeVega group and 12 patients (75%) in the ring annuloplasty group ($P > 0.99$). Mechanical mitral valve sizes were comparable between the groups ($P = 0.371$). The ischemic time was comparable between the groups (60.3 ± 3.78 vs. 59.06 ± 2.91 min; $P = 0.234$); however, the cardiopulmonary bypass time was significantly longer with ring annuloplasty (92.54 ± 22.57 vs. 109.56 ± 28.58 min; $P = 0.017$) (Table 1).

3.2. Comparison of postoperative outcomes

Postoperative inotropic use between both groups did not differ significantly [16 (32%) vs. 4 (25%); $P = 0.596$]. The duration of mechanical ventilation

Table 1. Preoperative and operative data in patients with DEVega and ring annuloplasty.

	DeVega ($n = 50$)	Ring repair ($n = 16$)	P value
Gender- Female (n, %)	32 (64%)	9 (56.3%)	0.578
Age (Y) (mean ± SD)	36.1 ± 4.6	38.4 ± 2.4	0.060
Mitral valve surgery (n, %)			>0.99
Repair	11 (22%)	4 (25%)	
Replacement	39 (78%)	12 (75%)	
Mitral valve types (n, %)			>0.99
Mechanical	37 (94.87%)	12 (100%)	
Tissue	2 (5.13%)	0	
Mechanical valve size (n, %)			0.371
27	15 (40.54%)	2 (16.67%)	
29	18 (48.65%)	8 (66.67%)	
31	4 (10.81%)	2 (16.67%)	
Ischemic time (min) (mean ± SD)	60.3 ± 3.78	59.06 ± 2.91	0.234
Cardiopulmonary bypass time (min) (mean ± SD)	92.54 ± 22.57	109.56 ± 28.58	0.017

(6.78 ± 1.76 vs. 5.96 ± 1.85 h; $P = 0.114$), ICU stay (2.08 ± 0.4 vs. 2.06 ± 0.57; $P = 0.876$), and hospital stay (7.96 ± 1.07 vs. 8.25 ± 0.86; $P = 0.328$) were comparable between groups. No operative mortality was reported in our series. There was no difference in the postoperative degree of TR ($P = 0.163$). There were 35 patients available for follow-up after one year in the DeVega group and 10 patients in the ring group. We did not report a difference in the degree of TR after one year ($P = 0.119$) between the groups (Table 2).

4. Discussion

The optimal management of functional TR associated with mitral valve lesions is still the subject of ongoing research. Surgery is indicated for symptomatic patients with severe TR [11]. Patients with mild or moderate TR left untreated during left-sided valve surgery experienced TR progression and reduced functional status and survival [12]. Several surgical options are available for managing TR, including ring annuloplasty, DeVega repair, and bicuspidization. The DeVega technique is a simple approach for managing severe TR, with good early outcomes [13]. However, DeVega repair could lead to a high recurrence of tricuspid valve incompetence, and ring annuloplasty showed superior protection against recurrent TR compared to DeVega repair [14]. On the other hand, the efficacy of DeVega annuloplasty was demonstrated in several studies, and the technique regained popularity in some centers for several reasons [4,10]. The DeVega technique is associated with shorter operative times and is still valuable in developing countries with low resources.

This study compared the outcomes of DeVega versus ring annuloplasty in patients with severe TR concomitant with mitral valve surgery. The baseline and operative data were comparable between both approaches; however, DeVega had shorter cardiopulmonary bypass times. Postoperatively, there was no difference in inotropic use, duration of mechanical ventilation, ICU stay, or hospital stay. There was a similarity in the postoperative degree of residual TR and the recurrence of TR after a one-year follow-up.

Several studies have compared DeVega with other annuloplasty techniques. Similar to our research, Abdelfatah and colleagues found no differences

Table 2. Postoperative outcomes in patients with DEVega and ring annuloplasty.

	DeVega ($n = 50$)	Ring repair ($n = 16$)	P value
Inotropic support (n, %)	16 (32%)	4 (25%)	0.596
Mechanical ventilation (hours)	6.78 ± 1.76	5.96 ± 1.85	0.114
ICU duration (days) (mean ± SD)	2.08 ± 0.4	2.06 ± 0.57	0.876
Hospital stay (days) (mean ± SD)	7.96 ± 1.07	8.25 ± 0.86	0.328
Degree of postoperative TR (n, %)			0.163
Trivial	16 (32%)	9 (56.25%)	
Mild	29 (58%)	5 (31.25%)	
Moderate	5 (10%)	2 (12.5%)	
Severe	0	0	
Degree of TR after one-year follow-up (n, %)	($n = 35$)	($n = 10$)	0.119
Trivial	4 (11.4%)	4 (40%)	
Mild	10 (28.6%)	3 (30%)	
Moderate	18 (51.4%)	2 (20%)	
Severe	3 (8.6%)	1 (10%)	

between DeVega and band annuloplasty in the one-year outcomes after tricuspid repair [15]. Similarly, Khallaf and colleagues reported no difference in the one-year outcomes between DeVega and ring annuloplasty [16]. These studies showed that DeVega is comparable to other techniques after a one-year follow-up; however, they did not assess the long-term durability of the DeVega technique. Murashita and associates compared the DeVega technique with flexible bands in 162 patients, and they reported better long-term outcomes and freedom from recurrent TR with flexible bands [17]. Matsuyama et al. compared DeVega and ring annuloplasty in 45 patients with secondary TR over a mean follow-up period of 39 months and reported a higher recurrence rate with DeVega [18]. Similarly, Bernal and colleagues reported better freedom from reoperation with ring tricuspid valve annuloplasty in patients with rheumatic heart disease [19].

Moreover, Tang and coworkers demonstrated improved survival in patients with ring annuloplasty [20]. These results showed comparable outcomes in the short-term follow-up, and longer studies favored ring annuloplasty. However, the types of tricuspid annuloplasty prostheses have different outcomes, and it was previously shown that the outcomes with rigid rings could be superior to those with flexible bands [5]. Furthermore, the dominant pathology in our region is rheumatic, which could have affected the outcomes; therefore, the primary valve pathology and the types of tricuspid valve prostheses should be considered when interpreting the results of these studies.

4.1. Study limitations

The retrospective design is a major limitation. The tricuspid repair technique depended upon the surgeon's preference and the rings' availability. Patients' characteristics might have affected the outcomes rather than the surgical techniques themselves. The study is also limited by the small patient number in total and the small number of patients who had ring annuloplasty specifically. The small number of patients limited the statistical analysis, and multivariable analysis was not feasible. However, the study showed comparable one-year outcomes between DeVega and ring annuloplasty, and it is recommended to perform a study with a longer follow-up.

4.2. Conclusions

DeVega annuloplasty could effectively manage severe functional TR during mitral valve surgery in comparison to ring annuloplasty. The results of DeVega repair were comparable to those of ring annuloplasty regarding the degree of TR after a one-year follow-up.

Conflicts of interest

None declared.

References

[1] Watt TMF, Brescia AA, Williams AM, Bolling SF. Functional tricuspid regurgitation: indications, techniques, and outcomes. Indian J Thorac Cardiovasc Surg 2020;36(Suppl 1): 131–9.
[2] Algarni KD, Arafat A, Algarni AD, Alfonso JJ, Alhossan A, Elsayed A, et al. Degree of right ventricular dysfunction dictates outcomes after tricuspid valve repair concomitant with left-side valve surgery. Gen Thorac Cardiovasc Surg 2021 Jun;69:911–8.
[3] Vahanian A, Beyersdorf F, Praz F, Milojevic M, Baldus S, Bauersachs J, et al. 2021 ESC/EACTS Guidelines for the management of valvular heart disease. Eur J cardio-thoracic Surg 2021;60:727–800.
[4] Fawzy HF, Morsy AA, Serag AR, Elkahwagy MS, Sami G, Wahby EA, et al. Should moderate functional tricuspid regurgitation be repaired during surgery for rheumatic mitral valve disease? Heart Lung Circ 2020 Oct 1;29(10): 1554–60.
[5] Algarni KD, Alfonso J, Pragliola C, Kheirallah H, Adam AI, Arafat AA. Long-term outcomes of tricuspid valve repair: the influence of the annuloplasty prosthesis. Ann Thorac Surg 2021 Nov 1;112(5):1493–500.
[6] Calafiore AM, Foschi M, Kheirallah H, Alsaied MM, Alfonso JJ, Tancredi F, et al. Early failure of tricuspid annuloplasty. Should we repair the tricuspid valve at an earlier stage? The role of right ventricle and tricuspid apparatus. J Card Surg 2019;34:404–11.
[7] Al-Elwany SE, Mubarak YS, Kamal YA. Outcome of MC3 ring annuloplasty for moderate and severe functional tricuspid regurgitation associated with rheumatic mitral valve disease. Cardiothorac Surg 2019;27:5. https://doi.org/10.1186/s43057-019-0007-7.
[8] Konishi Y, Tatsuta N, Minami K, Matsuda K, Yamazato A, Chiba Y, et al. Comparative study of Kay-Boyd's, DeVega's and Carpentier's annuloplasty in the management of functional tricuspid regurgitation. Jpn Circ J 1983;47:1167–72.
[9] McCarthy PM, Bhudia SK, Rajeswaran J, Hoercher KJ, Lytle BW, Cosgrove DM, et al. Tricuspid valve repair: durability and risk factors for failure. J Thorac Cardiovasc Surg 2004;127:674–85.
[10] Nosair A, Elkahely M, Nasr S, Alkady H. Tricuspid three-dimensional ring versus fashioned flexible band annuloplasty in management of functional tricuspid valve regurge: comparative long term study. Cardiothorac Surg 2020;28:13. https://doi.org/10.1186/s43057-020-00023-2.
[11] Otto CM, Nishimura RA, Bonow RO, Carabello BA, Erwin JP, Gentile F, et al. 2020 ACC/AHA guideline for the management of patients with valvular heart disease: a report of the American college of cardiology/American heart association joint committee on clinical practice guidelines. Circulation 2021;143. e72–e227. Available from: https://www.ahajournals.org/doi/abs/10.1161/CIR.0000000000000923.
[12] Kwak J-J, Kim Y-J, Kim M-K, Kim H-K, Park J-S, Kim K-H, et al. Development of tricuspid regurgitation late after left-sided valve surgery: a single-center experience with long-term echocardiographic examinations. Am Heart J 2008;155: 732–7.

[13] Chidambaram M, Abdulali SA, Baliga BG, Ionescu MI. Long-term results of DeVega tricuspid annuloplasty. Ann Thorac Surg 1987;43:185−8.
[14] Charfeddine S, Hammami R, Triki F, Abid L, Hentati M, Frikha I, et al. Plastic repair of tricuspid valve: carpentier's ring annuloplasty versus De VEGA technique. Pan Afr Med J 2017;27:119.
[15] Ihab Abdelfatah AO. Early outcome of tricuspid repair for functional tricuspid regurgitation associated with rheumatic mitral valve disease; modified flexible band annuloplasty vs. suture annuloplasty. J Egypt Soc Cardiothorac Surg 2014;22:13−20.
[16] Khallaf AN, Saleh HZ, Elnaggar AM, Rasekh FS. Tricuspid valve repair by DeVega technique versus ring annuloplasty in patients with functional severe tricuspid regurge. J Egypt Soc Cardio-Thoracic Surg 2016;24:131−4. Available from: https://www.sciencedirect.com/science/article/pii/S1110578X16300025.
[17] Murashita T, Okada Y, Kanemitsu H, Fukunaga N, Konishi Y, Nakamura K, et al. Long-term outcomes of tricuspid annuloplasty for functional tricuspid regurgitation associated with degenerative mitral regurgitation: suture annuloplasty versus ring annuloplasty using a flexible band. Ann Thorac Cardiovasc Surg 2014;20:1026−33.
[18] Matsuyama K, Matsumoto M, Sugita T, Nishizawa J, Tokuda Y, Matsuo T, et al. De Vega annuloplasty and Carpentier-Edwards ring annuloplasty for secondary tricuspid regurgitation. J Heart Valve Dis 2001;10:520−4.
[19] Bernal JM, Pontón A, Diaz B, Llorca J, García I, Sarralde JA, et al. Combined mitral and tricuspid valve repair in rheumatic valve disease: fewer reoperations with prosthetic ring annuloplasty. Circulation 2010;121:1934−40.
[20] Tang GHL, David TE, Singh SK, Maganti MD, Armstrong S, Borger MA. Tricuspid valve repair with an annuloplasty ring results in improved long-term outcomes. Circulation 2006;114(1 Suppl):I577−81.