

Buttressed DeVega's Annuloplasty for Severe Tricuspid Regurgitation

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Summary. DeVega's tricuspid annuloplasty has become known as a useful surgical procedure for secondary tricuspid regurgitation. However, reportedly mild to moderate tricuspid regurgitation was observed late after surgery in some patients with left ventricular dysfunction or pulmonary hypertension. Semicircular annuloplastic sutures torn from the tricuspid annular ring are considered to be one of the probable causes in such cases. Therefore, we propose a modification of DeVega's tricuspid annuloplasty, in which we add buttressed sutures around semicircular buried sutures. Among 26 patients who showed moderate or severe tricuspid regurgitation associated with mitral valve diseases between July 1992 and September 1994, this technique was applied successfully in six. All patients had a +3 or +4 tricuspid regurgitation associated with severe mitral valve lesion, chronic atrial fibrillation and moderate cardiomegaly. Late postoperative echocardiographic examination revealed 0 or +1 regurgitation in all patients. This procedure is simple, safe and may be useful for preventing semicircular sutures torn from the tricuspid annular ring in the late postoperative stage.

Key words—DeVega's annuloplasty.

INTRODUCTION

Several annuloplastic procedures including DeVega's technique have been widely applied for moderate to severe functional tricuspid regurgitation.¹⁻⁴⁾ If tricuspid competency is obtained, the regurgitation can be expected to reduce or disappear in most patients. However, it was reported that some patients with marked tricuspid annular dilatation resume mild to moderate regurgitation a few years after the

original DeVega's annuloplasty, especially in those who had a reduced left ventricular function or pulmonary hypertension associated with mitral valve diseases.²⁻⁴⁾ The reported recurrence rate of tricuspid regurgitation was 33 or 34%,^{2,4)} with 6 to 8% of patients requiring reoperation.^{3,4)} Revuelta reported sutures torn from the tricuspid annular ring and strung across the tricuspid orifice as if "a guitar string" was one of the probable causes of the exacerbation of tricuspid regurgitation.⁵⁾ In this article we report our modification of the DeVega's technique in which we add some buttressed sutures with pledgets around semicircular buried sutures.

PATIENTS AND METHODS

Between July 1992 and September 1994, of 26 patients with moderate to severe tricuspid regurgitation associated with mitral valve disease, six patients were selected for this buttressed DeVega's technique. Patients who had a tricuspid annular diameter of 6 cm or more (3 1/2 fingers' width or more) were selected for the procedure. Patients who had tricuspid stenosis associated with regurgitation due to rheumatic etiology were excluded from the selection. Patient characteristics are listed in Table 1, and pre- and postoperative hemodynamic data in Table 2. Subjects consisted of a male and five females, their ages ranging between 52 and 71 years with a mean \pm a standard deviation of 62 ± 7 years. Chronic atrial fibrillation was observed in all patients. Three patients (No. 3, 4 and 5) showed cardiac cachexia. The body surface area ranged between 1.05 and 1.57 m², and cardio-thoracic ratio between 67 and 87%. Moderate hepatomegaly was seen in three patients (No. 3, 5 and 6). New York Heart Association functional grading was III in four and IV in two patients. Two patients with rheumatic etiology had received a

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Table 1. Patient characteristics

Age (y.o.)	Sex	Rhythm	BSA (m ²)	CTR (%)	NYHA	Pathology	Prev op	Mitral op	
1	52	F	Af	1.49	67	III	MSR rheuma	MVP	SJM 25
2	57	F	Af	1.31	74	III	MR degene	No	repair
3	65	F	Af	1.23	84	IV	MSR rheuma	No	SJM 29
4	69	F	Af	1.05	78	IV	MSR rheuma	No	SJM 27
5	55	F	Af	1.30	87	III	MSR rheuma	CMC	SJM 27
6	71	M	Af	1.57	70	III	MR degene	No	SJM 31

M: male; F: female; Af: atrial fibrillation; BSA: body surface area; CTR: cardio-thoracic ratio; NYHA: New York Heart Association functional grading; Pathology: pathology of mitral valve; MSR: mitral stenoregurgitation; MR: mitral regurgitation; rheuma: rheumatic; degene: degenerative; Prev op: previous mitral valve operation; MVP: mitral valve plasty; CMC: closed mitral commissurotomy, Mitral op: operative procedure for mitral lesion, or model and size of prosthetic valve; SJM: St. Jude Medical Heart Valve Prosthesis.

Table 2. Pre- and postoperative hemodynamic data

	Preop catheterization data				Echocardiographic data			
	PAP (mmHg)	RAP (mmHg)	LVEF	MR	T-diameter (cm)	pre TR	post TR	post TS (m/sec)
1	50/25	18	0.61	2°	6.0	+3	+1	1.23
2	25/10	4	0.37	4°	6.5	+3	+1	0.42
3	47/14	16	0.63	3°	6.5	+3	0	*
4	60/37	28	0.42	4°	6.0	+4	0	0.63
5	32/15	9 (v=13)	0.61	3°	7.0	+4	+1	1.4
6	52/25	24	0.42	4°	7.5	+4	+1	*

PAP: pulmonary artery pressure, systole/diastole; RAP: mean right atrial pressure; LVEF: left ventricular ejection fraction; MR: grading of mitral regurgitation estimated by the left ventriculogram according to Seller's classification; T-diameter: tricuspid annular diameter measured at cardioplegic cardiac arrest; pre TR: tricuspid regurgitation before the surgery; post TR: tricuspid regurgitation after the surgery; post TS: maximum flow velocity measured by doppler echocardiography after the surgery. *: not measured.

previous mitral valve surgery 15 years and 22 years before, respectively. Mitral valve surgery was indicated for severe regurgitation or moderate regurgitation with stenosis less than 1 cm². A moderate or marked increase in the pulmonary artery pressure and in the right atrial pressure was observed in four patients, and the left ventricular ejection fraction was less than 0.42 in three patients (Table 2). The mitral valve was repaired following the Carpentier technique in one patient and replaced with a St. Jude Medical prosthetic valve in five patients (Table 1). Severity of tricuspid regurgitation was determined according to Miyatake's classification.⁶⁾

Surgical techniques

If tricuspid annular size shows moderate to severe dilatation without organic change, a semicircular DeVega's technique and annuloplasty will be indicat-

ed to achieve competency of the tricuspid valve. We performed the buttressed DeVega's annuloplasty in six patients who had a tricuspid annular diameter of more than 6 cm.

A parallel 2-0 Prolene suture with Teflon felt pledget is placed through the free wall side of the tricuspid annular ring starting from the anteroseptal commissure. It is continued along the anterior and posterior annular ring in a clockwise direction to a point slightly beyond the posteroseptal commissure just beside the coronary sinus ostium. Another rectangular pledget is used at the end of this suture. Following this, three or five 4-0 Ticron sutures with spaghetti are placed around the buried semicircular sutures (Fig. 1).

We tie the annular sutures until the orifice size becomes the same as cylindrical obturator with a diameter of either 27 mm or 29 mm. If competency is achieved or tolerable under the heart beating state,

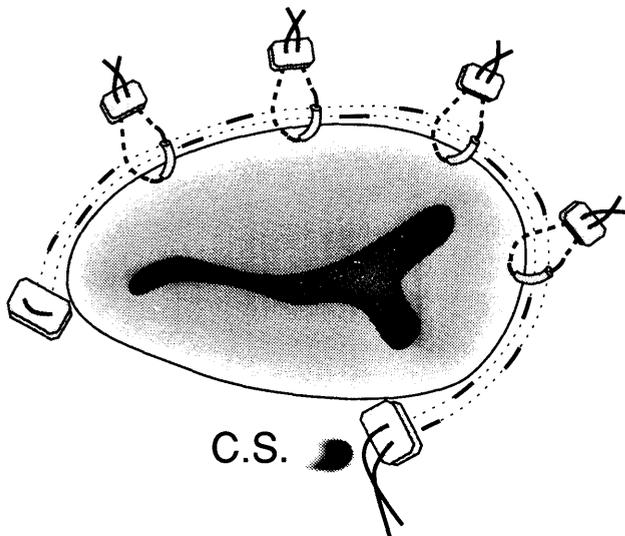


Fig. 1. Parallel 2-0 Prolene sutures with Teflon felt pledget are placed through the tricuspid annular ring. Four or five 4-0 Tifron sutures with spaghetti are then placed around the buried semicircular sutures. C.S.: coronary sinus.

the buttressed 4-0 sutures with Teflon pledget are tied after the semicircular annuloplasty sutures are fixed.

RESULTS

Neither low cardiac output syndrome nor high right atrial pressure was observed in any patients after surgery. Doppler echocardiography revealed 0 or +1 tricuspid regurgitation before the discharge and 4 to 16 months after the surgery. Maximum flow velocity through tricuspid valve determined by doppler echocardiography ranged 0.4-1.4 m/sec after the surgery (Table 1).

DISCUSSION

With DeVega's technique, moderate or severe tricuspid regurgitation associated with left heart lesions is successfully diminished or eliminated in most patients.¹⁻⁴ Persistent pulmonary hypertension and reduced left ventricular function are considered to be the main causes of the exacerbation of tricuspid regurgitation late after the surgery;²⁻⁴ however, incomplete tricuspid annuloplasty or sutures torn from the tricuspid annular ring are assumed to be another cause.⁵ We also experienced such a type of annulo-

plasty failure in a patient with reduced left ventricular function 13 months after DeVega's annuloplasty.

Some articles have described a modification of DeVega's technique⁷⁻⁹ or other types of annuloplastic procedures for anterior and posterior annular dilatation.^{10,11} Imamura et al. emphasized the importance of ligation of knots at their roots, and that the target annulus diameter should be 33 mm or 35 mm based on the measurement of normal individuals.⁷ In our experience before 1980, the target annulus diameter of 35 mm resulted in residual regurgitation on early postoperative months in some patients. Therefore, since 1980, we have routinely constricted the tricuspid annulus to the same size as the obturator size of 27 mm (in patients with smaller constitutions or patients receiving small mitral valve prosthesis of 25 mm size) or 29 mm until competency is achieved. No reports have described optimal annular diameter in DeVega's tricuspid annuloplasty. In the ring annuloplasty using a Carpentier ring, ring sizes of 32 or 34 mm are frequently used in the tricuspid position in Japanese patients. If rings of these sizes are used, 29 mm or 31 mm in tricuspid orifice diameter will be given because the prosthetic ring is about 3 mm in width. In the present series as shown in Table 2, we found only a slight transvalvular gradient of the tricuspid valve without any signs suggesting valve stenosis (e.g. flow turbulence). The present technique allows satisfactory repair of tricuspid valve with a good compromise between stenosis and regurgitation.

Antunes et al. reported the usefulness of a modified suture technique by incorporating a oval Teflon pledget in each bite.⁹ We doubt, however, whether their technique can prevent the semicircular sutures torn from tricuspid annular ring, as Tyers pointed out.¹² In contrast, our technique can ensure the semicircular sutures against tearing the annulus both theoretically and practically. Further observation and a larger series of patients will be needed to determine the long-term benefits of the procedure.

In conclusion, we wish to report that our modification of DeVega's tricuspid annuloplasty for severe tricuspid regurgitation associated with mitral valve diseases shows excellent short-term results.

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