CHIRURGIE CARDIAQUE / CARDIAC SURGERY

DE VEGA TRICUSPID ANNULOPLASTY DURING MITRAL VALVE REPLACEMENT: SURGICAL EXPERIENCE IN AN AFRICAN CONTEXT

KH. YANGNI-ANGATE[1,2], C. MENEAS[1], Y. TANAUH[2], M. DIOMANDE[1], A. ADOUBI[1]

1-Department of Cardio-Vascular and Thoracic Diseases Bouake University Teaching Hospital – Bouake, Cote d'Ivoire
2-Institute of Cardiology of Abidjan, Abidjan, Côte d'Ivoire

Correspondence : Pr KH.Yangni-Angaté MD, Chairman,
Department of Cardio-Vascular and Thoracic Diseases
Bouake University Teaching Hospital – Bouake, Cote d'Ivoire.
E-mail: yangniangate@hotmail.com

Summary

The aim of this study is to evaluate the De Vega's tricuspid annuloplasty and its long-term results after mitral valve surgery. **Material and methods:** De Vega tricuspid annuloplasty (TA) technique has been performed in 42 patients with functional tricuspid regurgitation (FTR) associated with a mitral valve disease. Etiology of valve diseases was rheumatic fever in half of our cases. In order to evaluate surgical results of this technique at mid and long term, tricuspid regurgitation (TR) was quantitatively estimated by echocardiography doppler and cardiac catheterization before and after surgery. Clinical symptoms in particular right ventricular dysfunction symptoms, cardiac function and surgical results were estimated. **Results:** Hospital mortality was 4.76 % (n= 2). Causes of death were acute heart failure (n = 1) and severe right cardiac insufficiency (n= 1). The rate of residual TR was 7.14 %. Hospital mean stay was 8.8 ± 4 days (range: 6 to 22 days). Early outcome was uneventful in 90.47 % of patients. At early post-operative period, right cardiac insufficiency signs decreased in 22 patients (52.38 %) and NYHA functional class decreased without escalation of patients ($p < 0.05$) pre-operative symptoms. Atrial fibrillation disappeared in 11.2 % cases. Regression of the tricuspid leak was 2 ± 0.47 degree. At one-year follow-up, there were no difference between survival without FTR improvement and survival with secondary regression of right cardiac insufficiency signs ($p = 0.83$). However, at echocardiography, there was a significant late regression of the right cardiac insufficiency signs for the patients with left-ventricle systolic ejection fraction (LVSEF) > 45 % versus patients with LVSEF < 45% ($p = 0.046$). At 5 years follow-up cardiac catheterization tricuspid leak was absent or mild (n= 22; 57.9 %), moderate (n = 14; 36.8 %) and severe (n = 2; 5.3 %). After 10 years and 15 years, freedom from late post-operative complications after tricuspid repair with De Vega annuloplasty was100% vs 63±5% and 58±2.4% vs 18% for the patients with LVSEF> 45 % and patients with LVSEF < 45% respectively ($p <0.05$). Conclusion: De Vega technique seems to be outstandingly effective in the patients whose myocardial function was well preserved, because no immediate second recurrence of TR has been detected. However, such a long-term efficiency of De Vega's technique cannot be expected in patient's whose myocardial function would deteriorate over the time.

Keywords: Tricuspid insufficiency; mitral valve; De Vega Annuloplasty.

Introduction

Tricuspid regurgitation (TR) results from failure of coaptation of the tricuspid valve leaflets, associated with a flowing back of blood from the right ventricle to the right atrium during right ventricular systole. TR can be functional or organic. In Africa, functional TR (FTR) is most often encountered; it frequently co-exists with rheumatic mitral valve diseases. There is no parallelism between the degree of functional tricuspid regurgitation and the intensity of preoperative clinical symptoms. Indication for surgery of functional TR depends on clinical and hemodynamic severity. FTR treatment is mostly conservative. According to the authors, tricuspid annuloplasty is performed by a simple antero-posterior annular plicature according to De Vega technique[4] or tricuspid -valved bicuspidation according to Kay technique[5], or reinforced double annular suture or an autologous pericardial ring technique or the Carpentier- Edwards annuloplasty ring technique[6]. Our choice has always been DE VEGA tricuspid annuloplasty (TA) technique whose evaluation and results are the purpose of this present study.

Material and methods

Between December 1983 and November 2000, 42 patients with mitral valve disease associated with functional TR underwent surgery. All organic TR were excluded from our study. There were 22 females and 20 males. Median age was 18 years (extremes: 8 and 55 years). Etiology of mitral valve disease associated with FTR was rheumatic fever in all our patients. Clinical, echocardiographic, hemodynamic and angiocardiography data are shown in Tables Ia, Ib and Ic.

VARIABLES (n = 42)		Number (n)	%	Mean	Extremes
				-	-
Classification NYHA	II	16	38,1		
(Functional Stage)	III	18	42,9	-	-
	IV	8	19	-	-
Preexisting	Right	18	47,4	-	-
Heart failure	Left	0	0	-	-
	Left and right	20	52,6	-	-
Age of illness (ans)				6,45 ± 2,1	3-19
DIAGNOSTIC (n = 42)					
	Mitral valve disease	24	57,1	-	-
Mitral valve diseases	Mitral stenosis	6	14,3	-	-
	Mitral insufficiency	12	28,6	-	-
	Moderate	30	71,4	-	-
Tricuspid insufficiency	Severe	12	28,6	-	-
Pre-operative radiographic parameters					
	Cardio-Thoracic Index (CTI)	-	-	0.77± 0.15	0.48-067
Electrocardiographic parameters	Atrial fibrillation	26	61,9	-	-
	Sinus rhythm	16	38,1	-	-

Table Ia: Clinical, radiological and electrical pre-operative characteristics of patients

VARIABLES (n = 42)		Number (n)	%	Mean	Extremes
Echocardiographic Parameters	Pulmonary Blood pressure (mmHg)	38	90,5	128.3± 10.3	60-180
	Ejection fraction (FE %)	-	-	60.60 ± 12	33 -79
	Other rheumatic lesions	30	71,4	-	-
	Infectious endocarditis lesions	6	14,3	-	-
	Degenerative lesions	4	9,5	-	-
	Valve thrombosis	0	0	-	-
	Others	2	4,8	-	-

Table Ib: Echocardiographic pre-operative characteristics of patients.

VARIABLES (n = 42)		Number (n)	%	Mean	Extremes
Hemodynamic Parameters	RAP (mmHg)	-	-	11.67± 8.7	3-65
	PAP (mmHg)	-	-	41.2± 9.72	23-61
	RVEDP (mmHg)	-	-	37.81± 16.7	17-60
	SAP (mHg)	-	-	78 ± 10.15	50-98
	LVEDP (mmHg)	-	-	38,18 ± 13	0-100
	Cardiac index (l/min/m²)	-	-	1.78± 0.42	1.2 - 2.61

Table Ic: Hemodynamic preoperative characteristics of patients

RAP: Right Arterial Pressure; **PAP:** Pulmonary Arterial Pressure **RVEDP:** Right Ventricular End Diastolic Pressure; **LVEDP:** Left Ventricular End Diastolic Pressure

Patients were divided into 2 groups: group 1 (n = 22 patients) with a left ventricular ejection fraction (LVEF) higher than or equal to 45% and group 2 (n = 20 patients) with LVEF less than 45%. For all patients, clinical diagnosis was based on holosystolic xiphoid murmur existence (n = 42) associated

with mitral valvular pathology. Pick's pseudo-cirrhosis syndrome was present in 62% of patients. In all patients, echocardiography and cardiac catheterization coupled with angiography confirmed functional TR diagnosis (n = 42). Surgery was carried out under cardio-pumonary bypass.

Surgical procedures were tricuspid annuloplasty (TA) according to De Vega technique associated with mitral valve replacement (n = 42) by mechanical(n=30) and biological (n=12) prostheses. De Vega TA (n = 42) consisted in a double semi-circular plicature of tricuspid anulus using a doule –armed N0 2-0 braided polyester suture with two teflon corners at the antero-septal commissure and the antero-posterior commissure. Post-operative evaluation was made at midterm (1 - 2 years) and at long term (> 2 years). It consisted of assessment of clinical, electrocardiographic, radiological and hemodynamic right-sided heart parameters. These data were obtained during outpatient clinic care. Statistical analysis of continuous variables was expressed as mean ± Standard Derivations (SD). Comparisons were made using Chi-squared and Fisher tests for continuous variables. Kaplan Meier survival curves were compared by Log-Rank test. Threshold of significance was retained for a value of (p) less than 0.05.

Results

Immediate post-operative period was uneventful in 40 patients (95%). Residual rate of TR was 7.14%. At early post-operative term, patients were at NYHA functional class I or II (n = 32; 76.2%) [p<0.05]. Hospital mortality was 4.76% (n = 2). Acute heart failure was main cause of death (n = 2). Early postoperative complications (n = 6, 14.29%) were noted. Average hospital stay was 8.8 ± 4 days (extremes: 6 and 22 days). At day 5 after surgery, echocardiography assessment of De Vega TA was satisfactory. Mean follow-up was 11.33 ± 4. 26 years (extremes:3 years - 13 years). Total number of patients followed was 258 per year. Rate of patients at follow-up was 13.9%. At 1-month follow- up, there was a clinical regression of the right ventricle insufficiency symptoms in all patients.

Atrial fibrillation disappeared in 11.2% of cases. Post-operatively, echocardiography and cardiac catheterization coupled with angiography showed a reduction of TR degree and of systolic pulmonary arterial hypertension, as reported in Table II.

EVOLUTION At 1 YEAR

Variables		Pre-operative	Number (n)	A 1 year	Number (n)	P
X-Ray	CTI (mean.)	0.77 ± 0.15	42	0,62 ± 0,5	40	NS
Echocardiography	RAD (mean.) mm	128.3 ± 10.3	42	110 ± 9,5	40	NS
	EF (mean.) %	60.60 ± 12	42	62,2 ± 11,2	41	NS
	VTDVD (mean.) ml	13,3 ±3,0	38	12,5 ± 5,14	25	NS
Cardiac catheterization + Angiocardiography	POD (mean .)	11.67 ± 8.7	42	10,71 ± 8,43	25	NS
	PAP (mean .)	41.2 ± 9.72	42	36,26 ± 11,18	25	S
	BPCP (mean .)	-	-	22 ± 5,31	20	-
	PTDVG (mean .)	38,18 ± 13	42	27,48 ±9,67	20	NS
	PAO (mean .)	78 ±10.15	42	80,16 ± 8,43	25	NS
	TI grade 1	0	0	23,8 %	10	S
	TI grade 2	0	0	11,9 %	5	S
	TI grade 3	71,43 %	30	0	0	S
	TI grade 4	28,57 %	12	0	0	S

Table II: Post-operative parameters of patients.

RAD: Right Atrium Diameter; **VTDVD** : Telediastolic Volume of the Right Ventricle ; **POD** : Right Atrial Pressure; **PAP** : Pulmonary Blood Pressure; **BPCP** : Blocked Pulmonary Capillary Pressure; **PTDVG** : Left Ventricle Telediastolic Pressure;**PAO**: Systemic Aortic Pressure; **CTI** :Cardiothoracic Index; **EF** : Ejection fraction; **TI :** Tricuspid insufficiency ; **S** : Significant ; **NS** : Not significant

At midterm, mortality was nil. Postoperative complications were myocardial dysfunction (n = 1), bio prosthetic valve endocarditis (n= 2) and atrial fibrillation (n = 3). At 1-year follow-up, regression of tricuspid regurgitation at echocardiography was 2 ± 0.47 grade. In the long term, post-operative complications were lung abscess due to an infective endocarditis (n = 1) and ischemic stroke (n = 1). Over 4.5 years post-operative, patients with a severe preoperative impairment of the myocardial performance with left ventricular systolic ejection fraction

(LVSEF) less than 45% presented more post-operative complications related to worsening symptoms of right heart ailure than patients with LVSEF equal or above 45%(p= 0.04) (Figure 1).

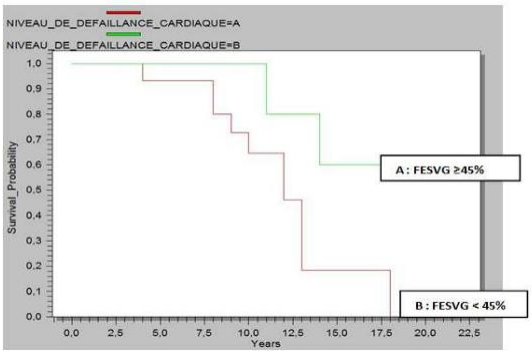

Figure 1 : *Actuarial freedom from complications after De Vega annuloplasty according to Kaplan-Meier method. (Hospital mortality excluded)*

During the first three years, symptoms of right heart failure declined and then stabilized between 3 and 4 years and then between 8 and 9 years before regressing again in patients with left ventricular systolic ejection fraction at 45% (Figure 2).

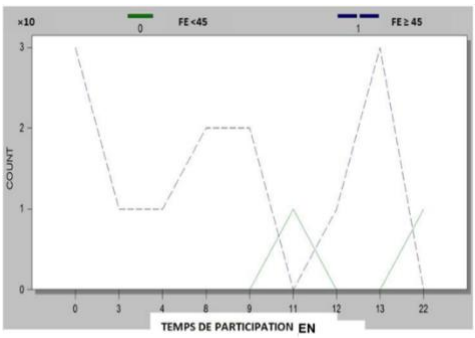

Figure 2: *Regression of right heart failure symptoms after surgery*

At 5 years, cardiac catheterization coupled with angiography showed lack or minimal tricuspid regurgitation (grade 1) (n = 22; 57.9%), moderate TR (grade 2) (n = 14, 36.8%) and significant TR (grade 3 or 4) (n = 2; 5.3%). In our study, after De Vega TA during mitral valve replacement, probability of overall survival without secondary worsening signs of right heart failure was 98%, 95% and 80 respectively at 5 years, 10 years and 15 years.

Discussion

De Vega technique has revolutionized tricuspid surgery since 1972[4]. Initially, De Vega TA was mainly reserved to moderate functional TR due to tricuspid annular dilatation[4]. This technique has the advantages of being simple and less expensive. DE Vega TA prevents mid-term right ventricular dysfunction when FTR coexists with surgical mitral valve disease[7]. Because of its advantages, and efficiency, its indication has been extended to severe FTR in our experience. Indeed, FTRs were due to mitral valve diseases, such as rheumatic mitral insufficiency and / or mitral stenosis or rheumatic mitral-aortic insufficiency[1,8,9,10]. De Vega TA was obviously suitable for tricuspid ring dilatation. Apart from technical and financial De Vega technique's advantages, exit from the heart and lung machine was easy in most cases (92.86%) according to our experience. This observation matched well with echocardiography results after tricuspid annuloplasty ring technique[11]. Our excellent results were confirmed later by the brief post-operative hospital stay of our patients as mentioned by others in literature [2,4,12.13]. From Rabago G. et al. study[14], rhythm disorders reduction was significant after De Vega TA due to its consequence such as depletion of right atrial dilatation. Significant myocardial function alteration has a positive impact on post-operative outcomes[15,16,17,18]. like we noted: similar findings have been reported in children with TR in congenital heart disease[14,19]. Furthermore, LVSEF <50%, systolic pulmonary arterial pressure (SPAP)> 60 mmHg were risk factors for De Vega TA dysfunction at mid-term when TR was severe or more before surgery[17]. According to our study, echocardiographic impact of functional tricuspid regurgitation repair

through De Vega TA at the time of mitral valve replacement was not statistically significant; it was also mentioned by CHAN[20].After surgery, at short and mid-term, clinical findings were similar to echocardiographic data when preoperative functional TR was in stage II and III: as reported by us and other authors[16,21,22,23].In a like manner, classic De Vega TA ,modified De Vega TA and tricuspid valve annuloplasty ring technique TA improved
essentially immediate post-operative NYHA functional status, immediate postoperative survival and prevented from right ventricular dysfunction[11,15]. In our study, immediate complications rate after De Vega TA was not different from Kay TA (11.9%)[5] and Carpenter-Edwards tricuspid valve annuloplasty ring technique (8.7%)[25]. Along the same line, overall survival without complication after De Vega annuloplasty was 100% vs 63± 5% at 10 years and 58±2.4% vs 18% at 15 years respectively in patients with LVSEF> 45% and with LVSEF <45%. At 10 years, survival without re-intervention was 87.9± 3% in patients with normal LVSEF according to Guenther T. et al.[26]. Despite a high rate of pre-existing heart failure episodes, late mortality is zero in our series; it was probably due to our experience of De Vega TA technique.

Conclusion

DeVega tricuspid annuloplasty remains an excellent technique with excellent results at short and long term postoperatively.

References

1. **BERTRAND E., THOMAS SY., EKRA A., N'DORI R**. A propos de 200 valvulopathies observés à Abidjan. Arch Mal Cœur Vaiss 1976 ;69 : 83-90

2. **PELTOLA T., LEPOJÄRVI M., IKÄHEI- MO M., KÄRKÖLÄ P**. De Vega's annuloplasty for tricuspid regurgitation.AnnChir Gynaecol 1996; 85(1): 40-3

3. **KULSHRESTHA P., DAS B., IYER KS**., et al. Expérience chirurgicale avec les maladies de la valve tricuspide. Transversales et évaluation écho cardiographique Doppler après la réparation de De Vega. Int J Cardiol 1989; 23 (1): 19-26

4. DE VEGA NG. Selective, adjustable and permanent annuloplasty. An original technic for the treatment of tricuspid insufficiency Esp Cardiol 1972;
25 (6): 555 -6

5. KAY GL., MORITA S., MENDEZ M., ZUBIATEP., KAY JH. Tricuspid regurgitation associated with mitral valve disease: repair and replacement. Ann ThoracSurg1989; 48 (3 Sup- pl): 93-5

6. CARPENTIER A. Based on the first remodeling ring annuloplasty performed by Prof. Charpentier 1968. In. Carpentier A. La valvuloplastie constitutive. Une nouvelle technique de valvuloplastie mitrale. Presse Med. 1969; 77:251-3

7. KIRKLIN JOHN W., BARRATT-BOYES BG.Tricuspid Valve Disease. In: Kirklin John.W;Barratt-Boyes BG. Cardiac Surgery 2003; 3rd ed; Elsevier (USA); 1: 671- 88

8. SALIK M., REHMAN A., PARVEZ R., WAHEED A., SAJID Junctional tricuspid regurgitation in rheumatic heart disease: surgical options. Ann Thorac Cardio- vasc Surg 2010; 16 (6): 417- 25

9. SARRALDE JA., BERNAL JM., LLORCA J., **et al.** Repair of rheumatic tricuspid valve disease: predictors of very long-term mortality and reoperation. Ann Thorac Surg 2010;

90(2): 503- 8 et al. The De Vega tricuspid annuloplasty. Perioperative mortality and long-term follow-up Cardiovasc Surg 1990; 31(4): 512-7

10. TETTEY M., SEREBOE L., EDWIN F., **et al**. Modified de Vega annuloplastie for functional tricuspid valve regurgitation. Ann AfrChir Thor Cardiovasc 2009; 4(1): 14-18

11. CARRIER M., PELLEGRINI M., GUER- TIN MC., **et al.** Twenty-five years' clinical experience with repair of tricuspid insufficiency.J heart Valve Dis 2004; 13(6): 952-6

12. KANTER KR., DOELLING NR., FYFE DA., SHARMA S., TAM VK. De Vega tricuspid annuloplasty for tricuspid regurgitation in children. Ann ThoracSurg2001; 72(4): 1344-8

13. MALAISRIE SC., MCCARTHY PM., MCGEE EC., et al. Contemporary perioperative results of isolated aortic valve replacement for aortic stenosis. Ann ThoracSurg 2010; 89 (3): 751 – 6

14. RABAGO G., DE VEGANG., CASTIL- LON L., **et al.** The new De Vega technique in tri- cuspid annuloplasty (resultsin 150 patients). J CardiovascSurg1980 ; 21(2) :231-8.

15. MATSUYAMA K., MATSUMOTO M., SUGITA T., **et al.** De Vega annuloplasty and Charpentier-Edwards ring annuloplasty for secondary tricuspid regurgitation Heart Valve Dis. 2001;10(4):520-4

16. RO SK., KIM JB., JUNG SH., CHOO SJ., CHUNG CH., LEE JW. Mild-to-moderate functional tricuspid regurgitation in patients undergoing mitral valve surgery. J ThoracCar-diovascSurg 2013; 146 (5): 1092-7

17. KARA I., KOKSAL C., CAKALAGAOGLU C., et al. Recurrent tricuspid insufficiency: is the surgical repair technique a risk factor? Tex heart Inst J 2013; 40 (1): 34 -41

18. SOUG H., KIM M-J., CHUNG CH., **et al.** Factors associated with development of late significant tricuspid regurgitation after successful left - sided surgery. Heart 2009; 95: 931-6

19. KANTER KR., FORBESS JM., FYFE DA., MAHLE WT., KIRSHBOM PM. De Vega tricuspid annuloplasty for systemic tricuspid regurgitation in children with univentricular physiology. J heart Valve Dis 2004; 13(1): 86 – 90

20. CHAN V., BURWASH IG., LAM BK., **et al.** Clinical and hocardiography impactoffunctionaltricuspid regurgitation repair at the time of mitral valve replacement. Ann ThoracSurg 2009;88(4):1209-15

21. TAGER R., SKUDICKY D., MUEL-LER U., ESSOP R., HAMMOND G., SARELI P. Long-term follow-up of rheumatic patients undergoing left-sided valve replacement with tricuspid annuloplasty-validity of preoperative echocardiographic criteria in the decision to perform tricuspid annuloplasty. Am J Cardiol 1998; 81(8): 1013-6

22. KHORSANDI M., BANERJEE A., SINGH H., SRIVASTAVA AR. Is a tricuspid annuloplasties ring significantly better than a De Vega's annuloplasties stitch when repairing severe tricuspid regurgitation? Int Cardiovasc Thorac Surg 2012 ;15(1) :129-35.

23. DI MAURO M., BEZAN GP. DI BALDASSARRE A., **et al.** Functional tricuspid regurgitation: an underestimated issue. Int J. Cardioi 2013 ; 168(2) : 707-15

24.SHIGENOBU M., SOGABE O. TSUJI K. SENOO Y. KO. MOTO Y., TERAMOTO S. Facteurs influant sur l'efficacité de l'annuloplastie De Vega pour insuffisance tricuspide secondaire. Acta Okayama Med 1992; 46 (2): 123-8

25. ONODA K., YASUDA F., TAKAO M., et al. Long-term follow-up after Charpentier-Edwards ring annuloplasties for tricuspid regurgitation. Ann ThoracSurg 2000 ; 70(3) : 796-9

26. GUENTHER T., MAZZITELLI D., NOEBAUER C., **et al.** Tricuspid valve repair: is ring annuloplastie superior? Eur J Cardiothorac Surg 2013; 43(1): 58-65.