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Surgical Treatment of Acquired Tricuspid Regurgitation with Carpentier's Ring

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Between 1976 and 1982, nine patients underwent tricuspid annuloplasty with use of CARPENTIER's ring for acquired tricuspid regurgitation associated with mitral valvular diseases or ruptured aneurysm of the sinus VALSALVA. Of these, one patient died of low cardiac output and respiratory failure. Postoperative cardiac functions were evaluated on remaining eight patients by physical examinations, findings of roentgenogram and contrast echogram. No postoperative regurgitation of the tricuspid valve was detected by contrast echogram in any of the five patients who received this examination after operation. In six of the eight patients, postoperative physical activity improved to grade I of the classification of NYHA, whereas the improvement was limited to grade II in two other patients in whom some forms of the left side cardiac lesions (e. g. mitral regurgitation) still seemed to remain.

INTRODUCTION

Acquired tricuspid regurgitation (TR) is frequently associated with advanced mitral and aortic valvular diseases, the frequency reported to be 20–30%[1]. Most cases of TR are functionally impaired with normal leaflets and subvalvular component of the tricuspid valve. TR is produced by tricuspid annular dilatation due to right ventricular enlargement, right heart failure and other factors which results from pulmonary hyper-

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tension caused by left-sided heart diseases. Although surgical procedures such as valve replacement,[2)-4)] various annulorrhaphy,[5)-8)] and annuloplasty with a CARPENTIER's tricuspid ring[9)10)] have been utilized in order to treat patients with moderate to severe TR, their long-term results are controversial. The present authors performed tricuspid surgery with a CARPENTIER's ring (C-R) on 9 patients since 1976. Of these, one patient died post-operatively. Evaluation was reported on postoperative functioning of the heart in 7 cases 37 to 77 months after surgery and one case 3 months after surgery.

PATIENTS AND METHODS

Annuloplasty with a C-R was employed for the treatment of TR in 8 cases during a 4-year period from 1976 to 1979 and in one case in 1982. The patients comprised 2 men and 7 women, their ages ranging from 25 to 44 years with a mean age of 31 years. The causative combined left-sided heart diseases included ruptured aneurysm of sinus VALSALVA coupled with AR in one case, MS in three cases, MSR in one case, and MR in four cases. Atrial fibrillation was noted in all cases except for one case of ruptured aneurysm of sinus VALSALVA revealing sinus rhythm.

In the 6 cases which underwent surgery within 3 months after cardiac catheterization, V wave right atrial pressure ranged from 14 mmHg to 31 mmHg with a mean right atrial pressure of 11 mmHg. Physical examination revealed dilatation of the cervical vein and enlarged livers were palpable two to four fingerbreadths below the costal margin in all cases. Ascites was remarkable in one case. Jaundice was noted in one case and 4 cases were slightly jaundiced. In these 5 cases, total bilirubin concentrations were 3.8, 1.8, 1.6, 1.5 and 1.3mg/100ml respectively. Movement of the chest wall with cardiac impulse was seen in 5 cases. Cardiac thoracic ratio (CTR) varied between 67% and 84% with a mean of 75%.

According to NYHA classification, there was one case of class Ⅳ, 4 cases of class Ⅲ, and one case of class Ⅱ. Of these, 5 cases were examined by contrast echograms with ICG. Regurgitation into the enlarged inferior vena cava (IVC) and hepatic vein (HV) (Fig. 1) were noted remarkable in 4 cases.

Three cases were receiving surgery more than one year after cardiac catheterization, which disclosed a low V wave right atrial pressure varying between 4 and 7 mmHg with a mean right atrial pressure of as low as 5 mmHg at cardiac catheterization. In these 3 cases, dilatation was seen in the cervical vein at the time of operation, the liver was enlarged and palpable two to four fingerbreadths beneath the costal margin, and CTR ranged from 60% to 63% with a mean of 62%. No ultrasonic examination was made on these patients. NYHA classification was class II in every case.

Diagnoses according to clinical syndrome, CTR, right cardiac catheterization, contrast echograms, and finger examination of regurgitation during the operation were as severe TR in 5 cases and mild to moderate TR in the other 4 cases.

All the open heart surgery was performed under extracorporeal circulation. Dur-

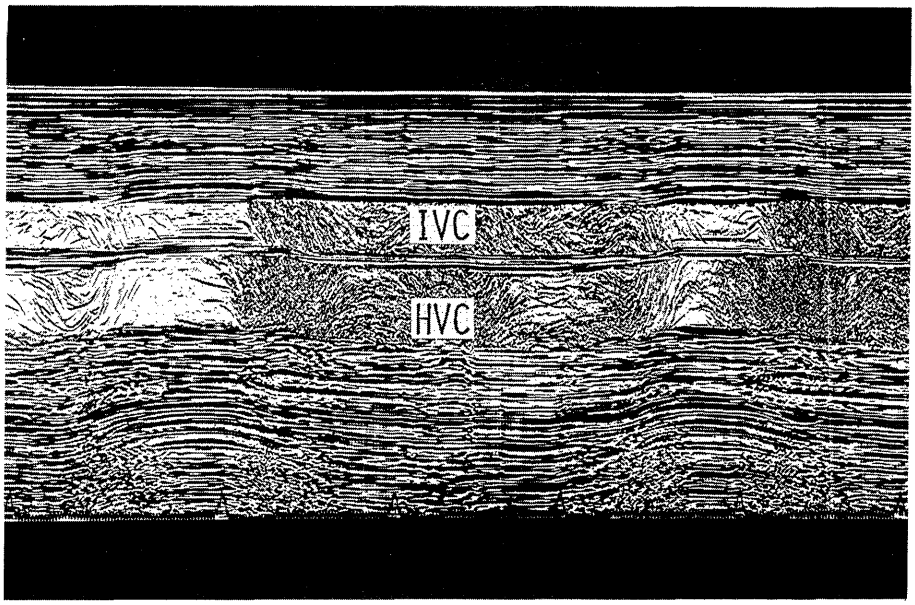

Fig. 1 Preoperative contrast echogram showing marked regragitation into the inferior vena cava (IVC) and the hepatic vein (HV)

ing the operation, thrill was palpable on the wall of right atrium in all cases. In 5 cases, strong regurgitation was palpable over the entire valve orifice on digital examination. Regurgitation was also palpable as a strong jet in the other four cases.

With regard to the operation for the causative left-sided heart failures, patch closure was carried out on ruptured aneurysm of the sinus VALSALVA and VSD, while aortic leaflet perforation, which caused AR, was closed by pericardial patch technique. Three cases of MS were treated by open commissurotomy, including one case of recommissurotomy. MVR was performed with CARPENTIER's bioprosthesis in 4 out of 6 cases of either MSR or MR; bioprosthetic valves as large as possible in size were used, 33M in one case, 31M in 2 cases, and 29M in one case. One case died of the LOS and respiratory failure. In another case, MVR was performed in 1982 with a mechanical valve (Hall-Kaster 25M).

Anticoagulation therapy with warfarin was continued postoperatively for three months in patients replaced with a bioprosthetic valve, whereas lifelong administration is scheduled for those receiving a mechanical valve.

RESULTS

Postoperative evaluation was carried out in 8 cases 3 to 77 months after the annuloplasty with a C-R. The clinical study was focused on dilatation of the cervical vein, enlargement of the liver, movement of the chest wall with cardiac impulse, CTR, and NYHA classification. In patients with severe TR, grade of TR and diameter of

IVC were compare before and after surgery by a contrast echogram (Fig. 1, Fig. 2). In one case receiving surgery in 1982, cardiac catheterization at rest was performed before and after surgery.

Dilatation of the cervical vein, enlargement of the liver, and movement of the chest wall with cardiac impulse disappeared postoperatively. Fig. 3 represents alterations in CTR, which decreased by 23% on an average with a range from 18% to 37% in 6 out of 8 cases. Although 4 cases of severe TR were included among the 6 cases, no

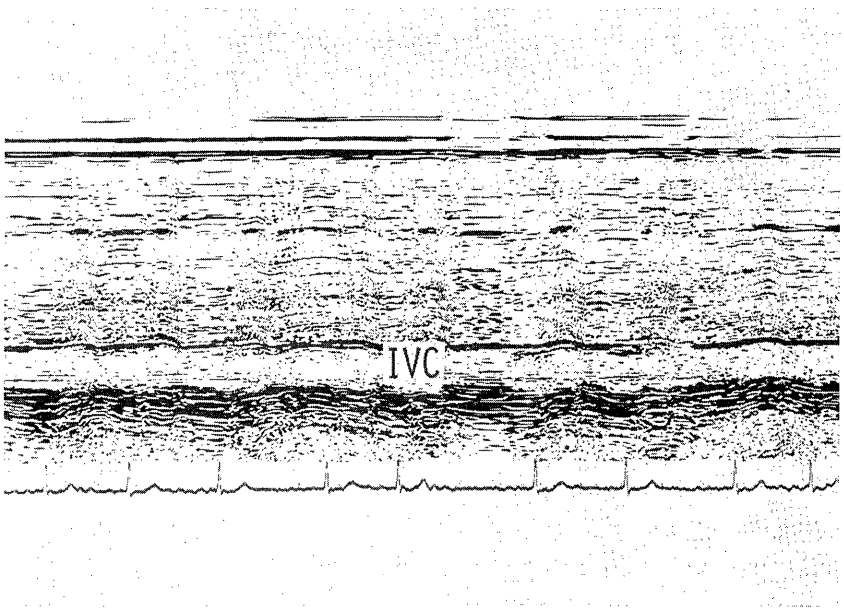

Fig. 2 Postoperative contrast echogram in the same patient as Fig. 1, showing no regurgitation

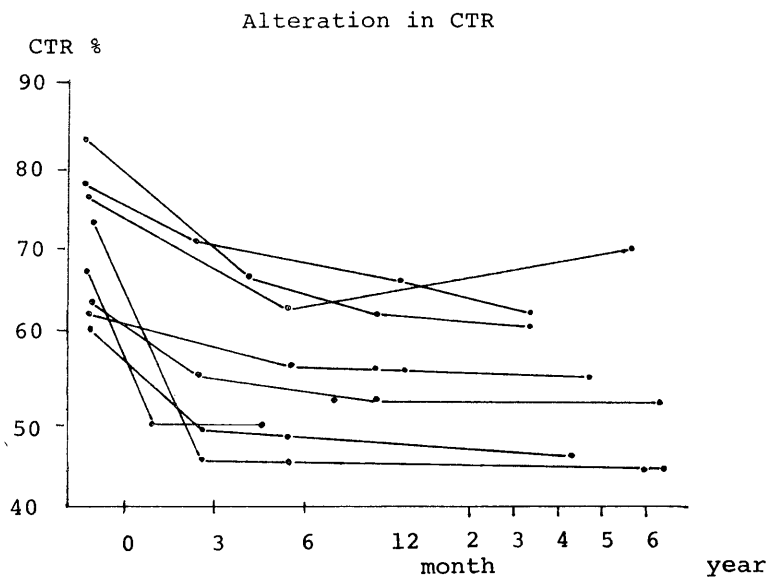

Fig. 3 Changes of cardiothoracic ratio with time after the operation

cardiac symptom was noted postoperatively. Of the 4 cases of severe TR, one case even gave birth to 2 children postoperatively. CTR decreased only by 8% and 10% in each of the other 2 cases. One case of the two underwent recommissurotomy and postoperative MR was observed. CTR, 76% before the operation, once dropped to 64% after the operation, but reincreased to 70% at present, 63 months after the operation. Occasional left cardiac failure was observed, requiring conservative therapy in the outpatient clinic. The patient engages in light work. The other case underwent MVR with bioprosthesis. CTR was 56% in this patient. The patient was slightly short of breath when climbing a slope, but complained of no difficulty in everyday life. In these two cases, enlargement in the right side of the heart was also reduced coupled with disappearance of right cardiac failure.

When classified by NYHA of the former 6 cases, improvement to class I was observed in 5 cases, of which one had been of class IV, 4 of class III, and one of class II. In the other two cases with poor reduction in CTR, one case showed improvement from class III to class II, but the other remained unchanged in class II regardless of surgery.

Regurgitation was examined by contrast echograms in 5 cases of severe TR 77, 63, 55 and 49 3 months after the operation. Regurgitation disappeared in all 5 cases including one case which developed MR after the recommissurotomy. The diameter of IVC was measured prior to, and simultaneously with contrast echography after surgery in 5 cases, except for one case in which the data before operation was not available due to the serious condition of the patient which prevented its being measured.

Comparison of the diameter of IVC before and after operation revealed reductions in the diameter from 25mm to 13mm in one case developing MR postoperatively, and from 23mm to 16mm, from 25mm to 16mm, and from 23mm to 14mm in the other cases. In one case receiving MVR after Hall Kaster, cardiac catheterization at rest two months after MVR revealed decreases in mRA from 11 mmHg to 1 mmHg and in mPA from 30 mmHg to 15 mmHg, on the agerage. No pressure difference was noted between the atrium and the ventricle on the left side of the heart.

No evidence suggesting embolic episode in either side of the heart has been observed so far in these eight cases including those receiving MVR.

DISCUSSION

According to BRUNWALD[1], as TR is mostly functional, TR will diminish gradually by greatment with only MVR and there may be essentially no difference in the postoperative course of MVR between patients with and without intercurrent TR. It is presently accepted, however, that advanced TR may cause postoperative low output state if it is left untreated. STARR[11] and PLUTH[4] *et al.* recommended that tricuspid valve replacement (TVR) be done absolutely as a treatment for advanced TR, but both short- and long-range results of TVR are not always satisfactory as yet.

KAY[5] reported that annuloplasty in which the annulus of the tricuspid valve was gathered by stitching at the site of the posterior cusp was of advantage in passing successfully the critical point immediately after the operation. The annuloplasty, however, is not always successful.

The anatomic-pathological study on TR by DELOCHE[12] disclosed that dilatation at the site of the anterior and posterior leaflets accounted for five-sixths of the cases of annular dilatation. TR surgery with a success rate of 96% was reported by CARPENTIER[9] with a prosthetic ring chosen according to the length of the basis along which the septal leaflet was joined to the valvar annulus. The ring was transplanted to the tricuspid annulus using an interrupted suture and the remolding of the orifice was completed by gathering the annulus by stitching along the bases of anterior and posterior leaflets. DE VEGA[8] reported a semicircular annuloplasty using two sutures, each of which was anchored to the anteroseptal and the posteroseptal commissures.

The 24 cases treated with DE VEGA's tricuspid annuloplasty were investigated by HEARTEN[13] one year after operation. Although improvement was observed in 14 cases mild to moderate TR and stenosis persisted in 20 and 12 cases, respectively. This unsatisfactory result was attributed to the remaining high LA and PA pressures due to incomplete repair after left heart surgery.

The postoperative results of annuloplasty using C-R (Madrid) and after DE VEGA (Montreal) were simultaneously investigated by GRONDIN averages of 10.3 and 11.5 months after the operation, respectively. The clinical, hemodynamic, and angiographic evaluations demonstrated slight residual TR and moderate TR in 16.5% and 6.5% of the cases, in which the cardiac function had been once essentially restored after contrast. This recurrence was attributed to unsuccessful or incomplete repair of the left-sided lesions. Although a variety of methods have been devised, the exact quantitation of TR is considerably difficult to ascertain in part because of involvement of artificial factors. We utilized symptomatic improvement, such as disappearance of right cardiac failure, and alterations in CTR for the evaluation of postoperative course. In addition, measurements of regurgitation and diameter of IVC by a contrast echography were made in cases of severe TR and further cardiac catheterization was carried out in one case in 1982. According to NYHA classification, six out of eight cases were identified as class Ⅰ and excellent and the other two cases with some complaints as class Ⅱ and unsatisfactory. As, in even those considered to be unsatisfactory, enlargement in the right side of the heart and right cardiac failure disappeared, the incomplete repair of the left-sided lesions was considered to hamper the improvement of symptoms. PLUTH and ELLIS[4] *et al.* reported two cases of death immediately after operation and symptoms suggesting TR and persisting right cardia failure in 48% of the survivors among patients with TR whose TR was neglected because the TR was considered to be light at the time of operation. ASANO[14] reported three cases of postoperative death in the hospital and 10 cases of aggravation among patients with neglected light TR.

SUMMARY

Postoperative course of C-R annuloplasty was evaluated depending on clinical studies, ultrasonic cardiograms, and, in part, cardiac catheterization in 7 cases 37 to 77 months after operation, and one case 3 months after operation. The results were considered to be excellent in 6 cases and unsatisfactory in two cases.

It was concluded that C-R annuloplasty would succeed when repair of accompanying left-sided heart diseases was complete. Indications for the use of C-R annuloplasty includes all patients with TR. Whether light or severe, as well as patients with a previous history of TR even if no TR is present.

REFERENCES

1) BRAUNWALD N. S., ROSE J. Jr., MORROW A. G. (1967): Conservative management of tricuspid regurgitation in patients undergoing mitral value replacement. *Circulation* 35, Suppl. 1, 63−69

2) BREYER R. H., MCCLENATHAN J. H., MICHAELIS L. L., MCINTOSH C. L., MORROW A. G. (1976): Tricuspid regurgitation: A comparison of nonoperative management, tricuspid annuloplasty and tricuspid valve replacement. *J. Thorac. Cardiovasc. Surg.* 72: 867−874

3) JUGDUTT B. I., FRASER R. S., LEE S. I. K., ROSSAL R. E., CALLAGHAN J. C. (1977): Long-term survival after tricuspid valve replacement: Results with seven different prosthesis. *J. Thorac. Cardiovasc. Surg.* 74: 20−27

4) PLUTH J. R., ELLIS F. H. Jr. (1969): Tricuspid insufficiency in patients undergoing mitral valve replacement: Conservative management, annuloplasty or replacement. *J. Thorac. Cardiovasc. Surg.* 58: 485−491

5) KAY J. H., MASSELLI-CAMPAGNA G., TSUJI H. K. (1965): Surgical treatment of tricuspid insufficiency. *Ann. Surg.* 162: 53−58

6) RASTAN H. (1976): A simple method for tricuspid annuloplasty. *Thoraxchirurgie* 24: 493−495

7) WOOLER G. H., NIXON P. G. F., GRIMSHAW V. A., WATSON D. A. (1962): Experiences with the repair of the mitral valve in mitral incompentence. *Thorax.* 17: 49−57

8) DE VEGA N. G. (1972): Laannuloplastia selectiva, regulable y permanente. *Rev. Esp. Cardiol.* 25: 555−556

9) CARPENTIER A., DELOCHE A., HANANA G., FORMAN J., SELLIER P., PIWNICA A., DUBOST C. H. (1974): Surgical management of acquired tricuspid valve disease. *J. Thorac. Cardiovasc. Surg.* 67: 53−65

10) GRONDING P., MEERE C., LIMET R., LOPEZ-BESCOS L., DELCAN J. L., RIVERA R. (1975): Carpentier's annulus and De Vega's annuloplasty: The end of the tricuspid challenge. *J. Thorac. Cardiovasc. Surg.* 70: 852−861

11) STARR A., HEN R., WOOD J. (1966): Tricuspid replacement for acquired valve disease. *Sug. Gynecol. Obstet.* 122: 1295−1310

12) DELOCHE A., GUERNON J., FABIANI J. N., MORILLO F., CATMANIAN M., CARPENTIER A., MAURICE P., DUBOST C. H. (1974): Anatomical study of rheumatic tricuspid valuvulopathies. Applications to the critical study of various methods of annuloplasty. *Arch. Mal. Coeur.* 67: 497–505

13) HEARTEN K., SEIPEL L., LOOGEN F. HERZER J. (1977): Hemodynamic studies after De Vega's tricuspid annuloplasty. *Cardiovasc. Surg.* 1: 28–33

14) ASANO K. (1980): Valvereplacement, particularly study for advance of results in valve replacement. *JPn. Assoc. for Thorac. Surg.* 29: 21–30, Nippon Kyobu Geka Gakkai Zasshi (in Japanese)