

Surgical Treatment of Tricuspid Regurgitation in Combined Valvular Disease

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Abstract

Ninety-nine patients were operated upon for tricuspid regurgitation (TR) in combined valvular disease. According to surgical procedures for the tricuspid valve, two groups resulted in "repaired" and "ignored," including 60 patients in the former group and 39 in the latter. There is no significant difference between the two groups in the preoperative data, except right atrial pressure ($P < 0.04$). The repaired group included insertion of 41 Carpentier rings, 11 De Vega annuloplasties, 2 Kay's annuloplasties, and 6 tricuspid valve replacements. Early and late mortalities in the repaired group were 6.7% and 8.3%, respectively. In the ignored group, they were 5.1% and 7.7%, respectively. Long-term postoperative assessments (mean of forty-nine months) were done in 28 patients in the repaired group and in 21 patients of the ignored group. Residual TR developed in more than 50% of the repaired group patients, in whom tricuspid annuloplasty (TAP) was performed with the insertion of a Carpentier ring. On the other hand, residual TR was present in 33.3% of the ignored group patients. The authors presently recommend TAP by the De Vega's method in patients with mild or moderate TR and tricuspid valve replacement in patients with

severe TR. Progressive heart failure secondary to TR developed in several patients of the ignored group. This consideration has prompted a more aggressive approach to the management of TR in combined valvular disease.

Introduction

The management of tricuspid regurgitation (TR) associated with mitral and/or aortic valvular disease still remains controversial. Presently, indications for the management of TR are often based on relatively unreliable clinical, hemodynamic, and operative data since there is no gold standard for determining the severity of TR.¹⁻³ Some surgeons recommend tricuspid annuloplasty (TAP),^{1,4} and others, valve replacement (TVR).⁵ Conservative management is also recommended in patients with mild functional TR,⁶ in which the reversibility of TR is expected postoperatively following adequate relief of left-sided lesions. The purpose of this study is to review a series of 99 patients with TR associated with mitral and/or aortic valvular disease during the past ten years and to present methods of managing such patients.

Materials and Methods

From August, 1978, to January, 1988, 467 patients with acquired valvular disease were operated upon at Kagoshima University Hospital. Ninety-nine of these patients had TR associated with mitral and/or aortic valvular disease. According to the surgical procedures in treating the tricuspid valve, two groups resulted: "repaired" and "ignored." Surgeons, either unaware of or unconvinced by the hemodynamic diagnosis and after digital assessment, decided to ignore tricuspid valve surgery for the ignored group patients. The repaired group included 60 patients (31 females and 29 males), whose ages ranged from twenty-five to sixty-four years with an average of forty-six years. The ignored group included 39 patients (24 females and 15 males), whose ages ranged from twenty-three to sixty-six years (average fifty).

The preoperative New York Heart Association (NYHA) functional class, the duration of preoperative symptoms, cardiothoracic ratio (CTR), and catheterization data are presented in Table I. There is no significant difference between the two groups in the preoperative data, except right atrial pressure ($p < 0.04$). Table II shows operative methods performed. The tricuspid operations included insertions of 41 Carpentier rings, 11 De Vega annuloplasties, 2 Kay's annuloplasties, and 6 tricuspid valve replacements. The preoperative evaluation and the type of operation performed on left-sided lesions are presented in Tables I and II.

The indications for operation on the tricuspid valve were based on the clinical, hemodynamic, and surgical data. All patients with organic disease and those with functional disease who had more than Grade II regurgitation were operated upon. However, slight differences in surgical procedures were present among the three staff surgeons. In all patients the operation was performed through a median sternotomy. After finger palpation of the tricuspid valve, both cavae were independently cannulated. Cold blood cardioplegia and topical cooling with ice slush were used for myocardial protection during aortic cross-clamping.

The postoperative assessment of TR by the method of two-dimension echocardiography and continuous color Doppler echography was performed forty-nine months (mean duration)

TABLE I
Preoperative data in 99 patients with tricuspid regurgitation

| | Tricuspid | | p Value |
|--|-----------------|----------------|----------|
| | Repaired (n=60) | Ignored (n=39) | |
| Age (yr) | 46±10 | 50±12 | NS |
| Male/female | 29/31 | 15/24 | |
| NYHA functional class | | | |
| II | 13 | 14 | |
| III | 27 | 21 | |
| IV | 20 | 4 | |
| Duration of preoperative symptoms (yr) | 16.0±9.0 | 13.1±7.0 | NS |
| Cardiothoracic ratio (%) | 67±11 | 67±11 | NS |
| Catheterization | | | |
| Right atrial pressure (mmHg) | 21±12 | 11±4 | p < 0.04 |
| Pulmonary artery pressure (mmHg) | 56±22 | 50±17 | NS |
| Pulmonary pressure/systolic pressure ratio | 0.48±0.20 | 0.40±0.16 | NS |
| Ejection fraction (%) | 64±14 | 63±15 | NS |

NYHA = New York Heart Association,
Values = Mean ± SD

after operation. These data are available in 28 patients of the repaired group and in 21 of the ignored group.

Results

Early death (within thirty days after operation) occurred in 4 of the 60 patients (6.7%) in the repaired group. The causes of death were low-output syndrome (LOS), hemorrhage, intestinal infarction, and acute renal failure, respectively. Late death occurred in 5 patients (8.3%) caused by multiple organ failure (MOF) in 4 and cerebral hemorrhage in 1 (Table III). The operative mortality rate was higher among patients undergoing TVR (50%) than among pa-

TABLE II
Operative procedures in 99 patients with tricuspid regurgitation

| Procedure | No. of Patients |
|--------------------|-----------------|
| Tricuspid repaired | |
| MVR + TAP | 44 |
| MVR + AVR + TAP | 6 |
| MVR + TVR | 5 |
| MVR + AVR + TVR | 1 |
| Others | 4 |
| | 60 |
| Tricuspid ignored | |
| MVR | 32 |
| MVR + AVR | 2 |
| OMC | 2 |
| Others | 3 |
| | 39 |

MVR=mitral valve replacement, AVR=aortic valve replacement, TVR=tricuspid valve replacement, TAP=tricuspid annuloplasty, OMC=open mitral commissurotomy.

TABLE III
Operative results and causes of death in 99 patients with tricuspid regurgitation

| | Tricuspid | |
|----------------------------|-----------------|----------------------------|
| | Repaired (n=60) | Ignored (n=39) |
| Early death | 4 (6.7%) | 2 (5.1%) |
| Low-output syndrome (1) | | Low-output syndrome (1) |
| Hemorrhage (1) | | Unknown (1) |
| Intestinal infarction (1) | | |
| Acute renal failure (1) | | |
| Late death | 5 (8.3%) | 3 (7.7%) |
| Multiple organ failure (4) | | Multiple organ failure (3) |
| Cerebral hemorrhage (1) | | |

tients undergoing TAP (11.1%). Two of 3 patients dying after TVR were cases of reoperation and triple valve replacement. Five of the 9 operative deaths (including early and late) occurred in patients who had received Carpentier rings (Table IV). Early death in the ignored group occurred in 2 patients, 1 of whom died of LOS and the other died of unknown cause. Three additional patients died late after operation; the cause of death was MOF in each case (Table III).

TABLE IV
Operative results of surgical procedures in 60 patients with tricuspid regurgitation

| | Tricuspid Valve Replacement N=6 | Tricuspid Annuloplasty | | |
|-----------------|------------------------------------|-------------------------|----------------|------------|
| | | Carpentier Ring N=41 | DeVega N=11 | Kay N=2 |
| Early death (%) | 2 (33.3) | 3 (7.3) | 1 (9.1) | 0 (0) |
| Late death (%) | 1 (1.67) | 2 (4.9) | 0 (0) | 0 (0) |
| Total | 3 (50.0) | 5 (12.2) | 1 (9.1) | 0 (0) |

Residual TR with more than Grade II regurgitation was present in 15 of the 28 patients (53.6%) in the repaired group. Each of them had received a Carpentier ring. In these patients, preoperative CTR, right atrial pressure (V wave), pulmonary systolic arterial pressure, and pulmonary pressure/systemic pressure ratios were $71 \pm 12\%$, 16 ± 11 mmHg, 67 ± 32 mmHg, and 0.51 ± 0.24 , respectively, indicating marked cardiac enlargement and severe pulmonary hypertension (Table V). Residual TR was not present in the patients undergoing TVR. On the other hand, residual TR was present in 7 of the 21 patients (33.3%) in the ignored group. Significant TR developed in 1 of these patients fourteen months after mitral valve replacement (MVR) despite complete correction of the left-sided lesion, which was confirmed with postoperative echocardiography. The preoperative evaluation of these patients, shown in Table V, reveals marked cardiac enlargement and moderate pulmonary hypertension.

TABLE V
Residual tricuspid regurgitation and preoperative data

| | Tricuspid Valve Repaired (N=28) | Tricuspid Valve Ignored (N=21) | p Value |
|--|---------------------------------|--------------------------------|---------|
| Causes with residual tricuspid regurgitation (%) | 15 (53.6%) | 7 (33.3%) | NS |
| Preoperative data | | | |
| Cardiothoracic ratio (%) | 71 ± 12 | 68 ± 7 | NS |
| Right atrial pressure (mmHg) | 16 ± 11 | 8 ± 4 | NS |
| Pulmonary systolic pressure (mmHg) | 67 ± 32 | 47 ± 20 | NS |
| Pulmonary pressure/systemic pressure | 0.51 ± 0.24 | 0.38 ± 0.23 | NS |

Values = Mean \pm SD

Discussion

Organic or functional involvement of the tricuspid valve may occur in patients with rheumatic valvular disease independent of hemodynamic factors.⁷ Organic TR associated with mitral and/or aortic valvular disease has been estimated to occur in 17% to 52% of patients,

whereas functional TR has been reported to occur in 48% to 83%.^{1,2,4,8,9} In our patients with mitral and/or aortic valvular disease, TR was found in 21.2% (99/467 patients).

Regardless of the underlying mitral and/or aortic valvular disease, methods of assessing the severity of TR are needed for considering surgical correction. There is, however, at present, no gold standard for determining the severity of TR. Angiography is not reliable for assessing the severity of TR.^{10,11} Echocardiography proves useful in diagnosing TR, but attempts to assess TR quantitatively have not been validated.³ Doppler methods are valuable in semiquantitative diagnosis of TR, and the combined use of a right atrial systolic turbulence scale with analysis of flow-velocity traces from the venous system may improve the noninvasive assessment of the degree of TR.³

Breyer et al⁵ suggested that digital examination of the tricuspid valve before cardiopulmonary bypass was the most accurate method of assessing the severity of TR. Others have disagreed with the reliability of digital palpation, reporting cases in which obvious TR had disappeared at operation as a result of altered circulatory hemodynamics induced by anesthesia or hemorrhage.^{1,12} It may be difficult for the finger to feel jet regurgitation in severe TR, because the more severe the TR is, the less jet regurgitation appears. Therefore, the severity of TR may not be accurately quantified by digital examination of the tricuspid valve although it is a reliable means of establishing or confirming a diagnosis of TR. Thus, until newer methods of preoperatively quantitating the severity of TR are developed, a comprehensive evaluation of clinical, hemodynamic, and surgical data is essential for determining the presence and the severity of associated TR.

To our surprise, residual TR developed in more than 50% of our patients in whom TAP was performed with the insertion of a Carpentier ring. There is a potentiality that a Carpentier ring may fix the movement of the annulus, especially at the time of systolic phase. Meanwhile, the De Vega semicircular annuloplasty, although its procedure has not been fully evaluated at our clinic, has produced good to excellent results. Therefore, despite not enough of the necessary data to evaluate the operative method, we presently recommend TAP by the De Vega's method in any patient with mild or moderate TR. On the other hand, in patients with severe and even moderate TR, TVR has become the procedure of choice in our clinic because of our unsatisfactory results with the Carpentier ring. TVR is also recommended in any patient with severe TR in whom pulmonary and right atrial and ventricular pressures are not expected to improve postoperatively, abnormal tricuspid valve structure is found at operation, and adequate relief of the left-sided lesion is not anticipated.¹³ Not surprisingly, the mortality rate in our patients was much higher among patients undergoing TVR than among those undergoing TAP, since severe cases accompanying triple valve replacement and reoperation were found in the former group.

There was no significant difference in the results between the operative and nonoperative management of TR associated with mitral and/or aortic valvular disease in our clinic. Nonoperative management of TR has been fraught with problems. Most centers recommend conservative management only in patients with mild, functional TR that may be "reversible" following complete repairs of left-sided lesions. Incomplete repairs of left-sided lesions may have marked effects on the pulmonary circulation, which may lead rapidly to right ventricular decompensation and TR. Although our experience with conservative treatment of patients with

mild TR has generally been satisfactory, careful selection is mandatory. Simon et al¹⁴ suggest that TR is not invariably decreased after mitral valve operations despite improved hemodynamics. Pluth and Ellis¹⁵ agree that an aggressive approach in treating TR is warranted.

Conclusion

In the present study, there was no significant difference between the results with operative management and with conservative therapy. However, progressive heart failure secondary to TR developed in several patients treated with this conservative approach. These considerations have prompted a more aggressive approach to the management of TR associated with mitral and/or aortic valvular disease.

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