Surgical treatment of patients with Wolff-Parkinson-White syndrome and associated acquired valvular heart disease

Between November 1973 and March 1993, 454 patients underwent surgical division of an accessory pathway. The surgical and electrophysiologic data for 15 of these patients who underwent concomitant operation for acquired valvular heart disease were examined. This subgroup consisted of 10 male and 5 female patients whose ages ranged from 11 to 62 years (mean 51.6 ± 9.7 years). The primary surgical indication was congestive heart failure in all cases; a concomitant history of cardiopulmonary resuscitation was present in two cases. Nine of these patients had mitral valve disease, three had aortic valve disease, two had combined aortic and mitral valve disease, and one had tricuspid valve disease. The surgical technique used for the treatment of Wolff-Parkinson-White syndrome included (1) an endocardial approach with the use of cardioplegic arrest, (2) a sharp dissection of the involved valve annulus, and (3) cryoablation. Concomitant surgical treatments of valvular heart disease included open mitral commissurotomy in five cases, mitral valve replacement in four cases, aortic valve replacement in three cases, aortic valve replacement with mitral valve commissurotomy in two cases, and tricuspid valvuloplasty (De Vega technique) in one case. Other concomitant surgical procedures included tricuspid annuloplasty with atrialized right ventricle and replacement of the ascending aorta in one case and left ventricular myectomy for hypertrophic obstructive cardiomyopathy in one case. No early deaths occurred. A successful disappearance of the delta wave and episodes of recurrent tachycardia were achieved in all 15 patients. Long-term surgical follow-up, averaging 86.2 ± 54.8 months also demonstrated no late instances or recurrence of either a delta wave or tachycardia. (J THORAC CARDIOVASC SURG 1994;108:68-72)

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A quarter of a century has passed since the first successful surgical division of an accessory atrioventricular (AV) pathway for the treatment of Wolff-Parkinson-White (WPW) syndrome was done by Sealy and associates.¹ During this period, these surgical techniques were

considered to be radical therapeutic modalities.²⁻⁶ Recently, radio-frequency catheter ablation of accessory AV pathways has proved to be safe and effective and has significantly altered the treatment of these patients, which previously depended on surgical management alone.⁷ Radio-frequency catheter ablation is now recognized as the conventional treatment for noncomplicated cases of WPW syndrome.^{8,9} As a consequence, surgical therapy for the treatment of WPW syndrome is now limited to selected cases of catheter ablation failure, cases associated with other cardiac disease necessitating operation, small children, and cases with multiple accessory AV pathways.¹⁰

To date, we have performed surgical therapy on a total of 15 patients with both WPW syndrome and associated acquired valvular heart disease. In this study, we analyzed

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Received for publication July 12, 1993.

Accepted for publication Nov. 24, 1993.

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0022-5223/94 \$3.00 + 0 12/1/53211

Table I. Surgical indications for 15 patients with WPW syndrome and associated valvular heart disease

Indication	No. of patients
Congestive heart failure	15/15
NYHA II	4
NYHA III	7
NYHA IV	4
Poor hemodynamics during tachycardia	
NYHA III	4
NYHA IV	11
Atrial fibrillation	13
Cardiac arrest	1
Cardiogenic shock	1
ERP of accessory AV pathway <250 msec	1
Refractory to antiarrhythmic agent	14

the special features of these patients and report our surgical results, including long-term follow-up.

Patients and methods

Between November 1973 and March 1993, 454 patients underwent surgical division of accessory AV pathways for the treatment of WPW syndrome at our institutes (Kanazawa University and Toyama Medical and Pharmaceutical University). Of these patients, 15 received a concomitant operation for the treatment of associated acquired valvular disease and were the subjects of this study.

These patients (group A, $n = 15$) were compared with other patients without valvular heart disease (group B, $n = 439$) with regard to the following criteria: age at time of operation, gender distribution, type of tachycardia, location of accessory AV pathways, number of accessory AV pathways, history of arrhythmia, history of cardioversion, and prior requirement for cardiopulmonary resuscitation. The following electrophysiologic characteristics were assessed: right atrial and right ventricular effective refractory periods (ERP), AV nodal ERP, antegrade ERP of accessory AV pathways, cycle length of reentrant tachycardia, and the shortest R-R interval during atrial fibrillation.

Valvular diseases noted in our patient population (group A) included mitral valve disease in nine patients (eight rheumatic and one hypertrophic obstructive cardiomyopathy), aortic valve disease in three patients (two rheumatic and one annuloaortic ectasia), aortic and mitral valve disease in two patients, and idiopathic tricuspid valve disease in one patient. Indications for operation are shown in Table I. According to the New York Heart Association (NYHA) functional classification, four patients had class II symptoms, seven had class III symptoms, and four had class IV symptoms. During episodes of tachycardia, cardiac function notably deteriorated: four patients had class III symptoms and 11 had class IV symptoms.

Surgical technique. After a median sternotomy, intraoperative electrophysiologic mapping was done with the use of a hand-held bipolar electrode initially and a catheter containing six bipolar electrodes until 1989.¹¹ This was subsequently replaced by a simpler, faster method that uses a computerized mapping system. A multiple net electrode mapping system

Table II, A. Surgical procedures for the treatment of valvular heart disease in group A

Position	No. of patients	Procedure	No.
Mitral valve	9	OMC	5
		MVR	4
Aortic valve	3	AVR	3
Aortic and mitral	2	AVR + OMC	2
Tricuspid	1	TAP*	1

OMC, Open mitral commissurotomy; MVR, mitral valve replacement; AVR, aortic valve replacement; TAP, tricuspid valve replacement.

*De Vega.

(HPM-7100, Fukuda Electric Co. Ltd., Tokyo, Japan) was developed at our institute in 1989. This system decreased intraoperative epicardial mapping time to 3 minutes, avoiding hemodynamic deterioration.

The surgical procedure for WPW syndrome was done by an endocardial atrial incision technique as reported elsewhere.⁶ Cardiopulmonary bypass was initiated and the left ventricle was vented for aortic operation if necessary. In patients with a right-sided accessory AV pathway, the pathway was interrupted during cardiopulmonary bypass with the heart beating. In patients with a left-sided accessory AV pathway, after the cold crystalloid cardioplegic solution was administered, division of the accessory AV pathway was divided.¹¹ A supraannular incision was placed 2 mm above the valve anulus and extended 2 cm on each side of the site of the accessory AV pathway. The pathway was dissected between the underlying fat tissue in the AV groove and the ventricular muscle. In all patients up to patient 5, the incision was made by a scalpel only. For subsequent patients, however, cryoablation of the ventricular muscle was done in addition to scalpel dissection. After the involved area was dissected, the atrial incision was closed with a 4-0 Prolene running suture (Ethicon, Inc., Somerville, N.J.).

The valvular lesions were treated after division of the accessory AV pathways. Mitral valve commissurotomy was done in five patients; mitral valve replacement was required in four patients; aortic valve replacement was done in three patients; combined aortic valve replacement and mitral valve commissurotomy was done in two patients; and tricuspid valvuloplasty (De Vega technique) was done in one patient (Table II, A). Additional surgical procedures are listed in Table II, B.

Statistical methods. Results are expressed as mean plus or minus the standard deviation of the mean. Univariate analysis was done with Student's t test and χ^2 test or Fisher's exact probability test when two or three elements were compared between groups.

Results

Clinical characteristics. The clinical and electrophysiologic features of patients with and without acquired valvular disease were compared (Table III). The age at operation was significantly higher in the valvular surgery group ($p < 0.01$). A significant difference was also noted between the two groups with respect to the type of tachycardia ($p < 0.05$). Atrial fibrillation was significantly more prevalent in the concomitant valvular surgery group

Table II, B. Additional procedures done in group A

Other cardiac disease	No. of patients	Additional procedure
HOCM	1	Septal myectomy
Ebstein's anomaly + aortic aneurysm	1	Hardy's procedure + Asc. Ao. replacement

HOCM, Hypertrophic obstructive cardiomyopathy; *Hardy's procedure*, tricuspid annuloplasty with plication of atrialized right ventricle; *Asc. Ao.*, ascending aorta.

Table III. Clinical characteristics of patients with WPW syndrome with (group A) and without (group B) acquired valvular disease

	Group A (n = 15)	Group B (n = 439)	p Value
Age (yr)	51.6 ± 9.7	36.8 ± 16.0	<0.01
Gender (M/F)	10/5	315/124	NS
Type of tachycardia			
AVRT	2	206	<0.05
AF tachycardia	4	56	NS
Combination of both	9	177	NS
Location of accessory AV pathway			
Left	9	262	NS
Posteroseptal	3	60	NS
Anteroseptal	0	13	NS
Right	3	154	NS
Atrial fibrillation	13 (87%)	233 (53%)	<0.01
Ventricular fibrillation or cardiac arrest	1	13	NS
History of arrhythmia (yr)	10.1 ± 11.0	12.8 ± 10.9	NS
History of cardioversion	9	133	<0.05

M, Male; *F*, female; *NS*, not significant; *AVRT*, atrioventricular reentrant tachycardia; *AF tachycardia*, tachycardia with atrial fibrillation or flutter.

(87% versus 53%, $p < 0.01$). The distribution of accessory AV pathways is shown in Table III and Fig. 1. The distribution of accessory AV pathways was similar in both groups. The most common location of an accessory AV pathway in both groups was the left free wall, whereas the least common location involved the anteroseptal wall. A history of cardioversion was more frequently encountered in group A ($p < 0.05$). No significant differences were noted with respect to ratio of gender distribution, history of arrhythmias, or cardiopulmonary resuscitation.

The electrophysiologic characteristics of the patients are summarized in Table IV. The antegrade ERP of the accessory AV pathway and cycle length of the reentrant tachycardia were significantly ($p < 0.01$) higher in the valvular surgery group. However, no significant difference between the two groups was noted with respect to the shortest R-R interval noted during atrial fibrillation.

Table IV. Findings of electrophysiologic testing for WPW syndrome with (group A) and without (group B) acquired valvular disease

	Group A (n = 15)	Group B (n = 439)	p Value
No. of accessory AV pathways	1.0	1.1 ± 0.3	NS
Type of accessory AV pathway			
Overt	11	359	NS
Concealed	2	42	NS
Intermittent	2	38	NS
Right atrial ERP (msec)	224 ± 24	221 ± 38	NS
Right ventricular ERP	218 ± 22	217 ± 35	NS
AV node ERP	288 ± 39	263 ± 41	NS
Antegrade accessory AV pathway ERP	345 ± 48	275 ± 40	<0.01
Retrograde accessory AV pathway ERP	258 ± 43	269 ± 59	NS
Cycle length of RT	376 ± 40	329 ± 57	<0.01
Shortest R-R of tachycardia	237 ± 37	225 ± 51	NS

NS, Not significant; *RT*, reentrant tachycardia.

Surgical results. No early deaths or postoperative complications occurred among the 15 patients. Postoperative electrophysiologic study was done in all cases. The delta wave had disappeared and no further episodes of recurrent tachycardia were noted after operation in any of the 15 patients.

During the average follow-up period of 86.2 ± 54.8 months (from 6 to 193 months after operation), there were no late deaths. Furthermore, there was no evidence of recurrence of the delta wave or episodes of reentrant tachycardia. Residual postoperative atrial fibrillation was noted in six patients. The frequency of postoperative atrial fibrillation was significantly higher in the concomitant valvular surgery group (17% versus 42%, $p < 0.01$). The NYHA functional classification significantly improved in all patients. All patients, with the exception of one, manifested class I symptoms after the operation.

Discussion

In 1986, we reported the results of the first 160 consecutive patients who underwent surgical intervention for WPW syndrome at Kanazawa University.⁶ Currently, radio-frequency catheter ablation plays a major role in the nonpharmacologic treatment of the WPW syndrome.^{8,9} The emergence of this procedure has dramatically reduced the need for surgical treatment of this syndrome.¹² In the near future, surgical therapy will most likely be indicated for selected cases, such as patients in whom catheter ablation therapy fails, patients with mul-

Fig. 1. Location of accessory pathways and surgical procedures for valvular disease. *AVR*, Aortic valve replacement; *OMC*, open mitral commissurotomy; *MVR*, mitral valve replacement; *TAP*, tricuspid annuloplasty.

multiple accessory AV pathways, small children, and patients with concomitant heart disease who require surgical intervention.¹⁰

In our series, patients with WPW syndrome and concomitant acquired valvular heart disease who required surgical intervention had excellent results with regard to early and late mortality. Our data demonstrate that the operation is safe and useful for simultaneous treatment of valvular disease in patients with WPW syndrome.

Clinical and electrophysiologic features. A prolongation in the antegrade ERP of the accessory AV pathway and a prolongation in the cycle length during reentrant tachycardia was noted in the concomitant surgery group (group A). Electrophysiologically, when the antegrade ERP is shorter than 250 msec, nonpharmacologic treatment should be considered for such high-risk patients.⁶ However, our series included a patient with cardiac arrest, a patient who had cardiogenic shock and required cardiopulmonary resuscitation, and nine patients who required cardioversion despite the fact that none of these patients had high-risk electrophysiologic criteria. Additionally, our data (Table IV) indicate that the shortest R-R interval during atrial fibrillation was considerably shorter than the antegrade ERP of the accessory AV pathway. These findings suggest that patients with WPW syndrome and concomitant valvular heart disease are potentially at high risk despite electrophysiologic findings.

Interestingly, the preoperative NYHA classification of 3.0 ± 0.7 at baseline worsened to 3.7 ± 0.4 during an arrhythmic attack. These findings suggest that reentrant

and atrial tachycardia result in hemodynamic deterioration in patients with valvular heart disease. Both entities, therefore, need to be treated simultaneously.

Therapeutic modality. There are clear limitations to certain pharmacologic therapies in patients with WPW syndrome and valvular heart disease. Certain antiarrhythmic agents potentially exacerbate heart failure because of their negative inotropic properties. Furthermore, digitalis preparations also shorten the refractory period of the accessory AV pathway and increase the risk of inducing ventricular fibrillation in such patients.¹² Nonpharmacologic therapy should be selected in these patients.

Moreover, if only the valvular disease is treated, untreated tachyarrhythmias may cause hemodynamic deterioration after operation and necessitate emergency interruption.

Concomitant operations. Only a few patients with WPW syndrome and valvular heart disease underwent concomitant operations in previous reports.³⁻⁵ A concomitant operation for both WPW syndrome and heart disease is complicated and lengthens the duration of surgery. Therefore, surgeons tend to avoid concomitant surgical procedures. However, surgical therapy for the WPW syndrome has a success rate of nearly 100% regardless of whether the endocardial^{12, 13} or the epicardial¹⁴ approach is used. No early or late deaths occurred as a result of concomitant surgery, which suggests that concomitant surgical procedures should be done by persons with experience in arrhythmia surgery. In our series, tachycardias associated with WPW syndrome disappeared in all cases.

The NYHA functional classification also improved after operation in all patients.

One alternative to combination surgical therapy (i.e.: valve surgery and surgery for WPW syndrome) is to perform catheter ablation preoperatively and to treat the valvular heart disease surgically.¹⁵ However, it is not necessarily advantageous, and is occasionally dangerous, to attempt catheter ablation on patients with unstable hemodynamics. Potential complications of catheter ablation include aortic valve incompetence,¹⁶ placement of the ablation catheter in the aortic valve in a left cardiac-type WPW syndrome resulting in deterioration of preexisting valvular stenosis or regurgitation, and the precipitation of fatal ventricular arrhythmias. In addition, when patients have a small left ventricular cavity and mitral valve stenosis associated with atrial fibrillation, it can be anticipated that catheter endocardial mapping with the use of a retrograde approach will be difficult. It is thought that the risk of producing thrombi is increased in patients with valvular disease. It would have been theoretically possible to perform catheter ablation for the WPW syndrome and percutaneous balloon mitral valve commissurotomy later. However, these techniques are indicated only in patients with mild mitral valve stenosis. Furthermore, the surgical approach achieves better anatomic repair or allows change from valve repair to valve replacement if needed.¹⁷ Finally, during combination operations, it is also possible to do a simultaneous maze procedure to treat atrial fibrillation, an entity that is frequently observed in patients with valvular disease.¹⁸

We thank Dr. K. Hashimoto, professor of the Department of Hygiene, Kanazawa University School of Medicine, for help in the statistical analysis and Dr. K. Aoki for allowing us to include one patient with hypertrophic obstructive cardiomyopathy whom he operated on with one of us at The Cardiovascular Institute Hospital.

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