Experience with the Björk-Shiley Prosthetic Valve

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SUMMARY

Gratifying results were obtained with the Björk-Shiley prosthesis in this series of 63 patients. The surgical mortality of the entire series was 7,9%. Late morbidity was negligible.

Of 8 patients who had right-sided valvular replacement, 1 died on the operating table, and the 7 surviving patients did extremely well, with no late morbidity.

We believe this to be a satisfactory prosthesis which can effectively be used for right-sided valvular replacement.

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In 1969 a new type of artificial valvular prosthesis was proposed for aortic valve replacement,[1] and later for mitral valve replacement as well,[2,3] by Dr V. O. Björk in conjunction with Shiley Laboratories, Inc. This latest in a long series of prosthetic devices designed to simulate normal valve function, is a tilting disc valve with central flow characteristics. Heart valve replacement utilising the Björk-Shiley aortic and mitral valve prosthesis was begun at this centre in March 1973. The experience with patients receiving this prosthesis and the follow-up to date will be discussed.

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PATIENTS AND METHODS

All 63 patients who underwent aortic, mitral and/or tricuspid valve replacement utilising Björk-Shiley prosthetic heart valves, from March 1973 to May 1974, are reviewed. Their ages ranged from 5 to 69 years and 9 of the patients were 60 years of age or older. All patients were classified as either functional class III or IV by the New York Heart Association criteria. No patient was denied surgery because of severity of disease.

Pre-operatively, the patients had standard investigations including full left and right cardiac catheterisation and, in selected cases, coronary angiography. Extracorporeal circulation with moderate to marked hypothermia was used during the operative procedure. Other associated procedures such as commissurotomy or annuloplasty of other valves, or resection of aortic or ventricular aneurysms, were performed, in addition to valve replacement when indicated.

Postoperatively, all patients were placed on anticoagulation therapy, being maintained on warfarin sodium unless there were strong specific contra-indications. All patients were followed at regular intervals from 2 to 14 months postoperatively to assess their clinical status. In addition, 4 patients with right-sided prostheses were recatheterised 6 - 9 months postoperatively. At the time of haemodynamic evaluation, a complete study of the patient was carried out.

For the purpose of valve insertion, 2 - 0 Tycron mattress sutures without pledgets were used throughout the entire series. When all sutures are placed, the valve is pulled down into the supra-annular position and all sutures are tied and cut. Complete anoxic arrest is utilised for the period of tying in the prosthesis. All residual remnants of

the valve and its annulus are pulled up behind the sewing ring so that the ventricular side of the valve is completely free of tissue that might proliferate and interfere with the normal functioning of the valve.

SURGICAL RESULTS

There were 85 valves replaced in these 63 patients (Table I). Of these valves, 28 were placed in the mitral position with no surgical deaths; 10 were utilised in the aortic position, and in this group 1 patient died 10 days after the procedure.

The patient who died (detailed in Table II) had a complicated lesion consisting of a double-outlet right ventricle, pulmonary stenosis and an aneurysm of the right ventricle. In addition, he had the following left-sided lesions: dissection and thrombosis into the sinus of Valsalva of the non-coronary cusp; aortic valve incompetence and an aneurysm of the ascending aorta. After a total repair was done, the patient did well but unfortunately died of cardiac tamponade 10 days postoperatively.

Fifteen patients underwent aortic and mitral valve replacement, with 2 deaths (Table III).

In a separate group of patients with existing or coexisting right-sided valvular disease, the following right-sided replacements were done (Table IV). One patient had a pulmonary valve replaced for a severe congenital pulmonary valve ring stenosis. Tricuspid valve replacements were done on 2 patients. One who had a patent ductus with severe pulmonary hypertension and an Eisenmenger situation, died on the operating table; the other was operated on for a traumatic VSD and destruction of the tricuspid valve. The remaining 5 patients had coexisting rheumatic tricuspid or pulmonary valve disease in conjunction with either mitral or aortic valve lesions. Severe organic disease of these right-sided valves necessitated replacement.

In the whole series, 8 patients underwent right-sided replacements. After surgery, recatheterisation studies were done on 4 of these patients.

TABLE I. HEART VALVE REPLACEMENT USING THE BJÖRK - SHILEY PROSTHESIS

Position	No. of patients	Surgical mortality	%
Mitral valve	28	0	—
Aortic valve	10	1	10,0
Tricuspid valve	2	1	50,0
Pulmonary valve	1	0	—
Aortic and mitral valves	15	2	13,3
Mitral and tricuspid valves	3	0	—
Pulmonary and mitral valves	1	0	—
Aortic, mitral and tricuspid valves	1	0	—
Mitral and tricuspid annuloplasty	1	0	—
Aortic and mitral valve replacements, and tricus annuloplasty	1	1	100,0

Surgical mortality of the entire series 7,9%.

SHORT NOTES ON FOUR CASES RECATHETERISED

Case 1

A Black male of 5 years of age who was diagnosed as having pulmonary valve stenosis, had a complete examination and the diagnosis was confirmed on cine angiography. Blood pressure in the right ventricle was 193/9 in comparison with a left ventricular pressure of 100/6 mmHg.

TABLE II. DETAILED DISCUSSION OF EVENTS PRECEDING THE DEATH OF THE PATIENT WHO DIED AFTER AORTIC VALVE REPLACEMENT

Lesion	Repair	Postoperative course
Double-outlet right ventricle	Graft repair	External demand pacemaker.
Infundibular pulmonary	Resection	After 3 days, the patient spontaneously reverted to sinus rhythm
Aneurysm of the RV	Suture	48 hours postoperatively, anticoagulant therapy with Warfarin was administered
Dissection into and thrombosis of the sinus of Valsalva of the non-coronary cusp of the aorta	Wedge section and suture	PA dropped below 5% on 8th postoperative day
Aortic valve incompetence	Aortic valve replacement with Björk-Shiley prosthesis (ABP 27)	Patient died from cardiac tamponade on 11th postoperative day—0300.
Aneurysm of the ascending aorta	Resection of the aneurysm and replacement thereof with a woven Teflon graft	
Heart block	Pacemaker	

TABLE III. BREAKDOWN OF SURGICAL MORTALITY

Site	No. of patients	Time of post-operative death	Cause of death
Aortic and mitral valve replacement	2	15 h	Anoxia due to a blocked endotracheal tube
		38 h	Ventricular arrhythmia and cardiac arrest
Aortic and mitral valve replacement and tricuspid annuloplasty	1	6 h	Ventricular arrhythmia and cardiac arrest
Tricuspid valve replacement	1	During operation	PDA with Eisenmenger situation and severe organic tricuspid valve incompetence; patient died on the operating table
Aortic valve replacement	1	10 days	Cardiac tamponade

TABLE IV. RIGHT-SIDED REPLACEMENTS WITH BJÖRK-SHILEY PROSTHESIS

Site	No.	Surgical mortality
Pulmonary valve	1	0
Tricuspid valve	2	1
Mitral and tricuspid valve	3	0
Mitral and pulmonary valve	1	0
Mitral, aortic and tricuspid valve replacement	1	0
Total	8	1

At pulmonary valvotomy, a severe valve ring stenosis was found with extremely shortened and thickened valve leaflets. The valve was excised and replaced with a 17 APB Björk-Shiley prosthesis and the right ventricular outflow was reconstructed with a pericardial patch.

The patient did well and was restudied $7\frac{1}{2}$ months postoperatively (Fig. 1). The right ventricular pressure was down to normal.

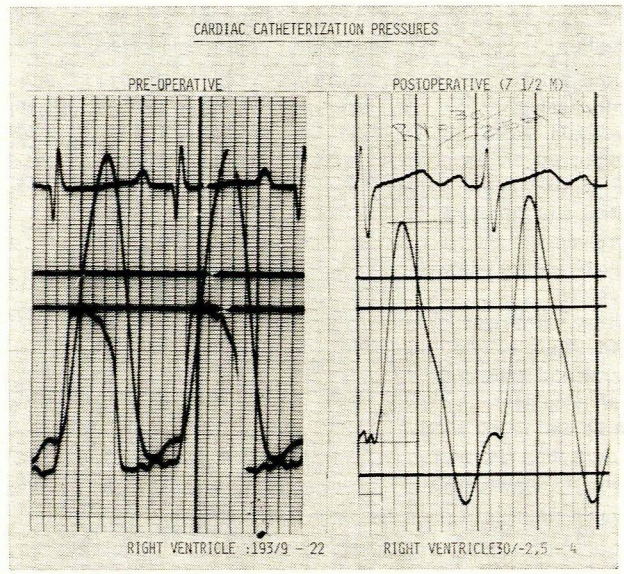

Fig. 1. Case 1. Pre- and postoperative cardiac catheterisation pressures.

Case 2

A 23-year-old Black male was diagnosed as having a traumatic VSD. He had been stabbed in the right chest 3 months before admission. Cardiac catheterisation confirmed this diagnosis and severe tricuspid valve incompetence was demonstrated.

At operation, a 3 cm long traumatic VSD was found in conjunction with a cleft of the anterior leaflet of the tricuspid valve — the chordae and papillary muscle to this leaflet were severed. The VSD was closed with interrupted 00 Tycron sutures, reinforced with Teflon pledgets. The tricuspid valve was replaced with a 31 MBRP Björk-Shiley prosthesis.

Postoperatively this patient did well. Recatheterisation was performed 7 months after surgery and the right atrial pressure was found to be reduced although still elevated (Fig. 2).

Case 3

An 11-year-old Black female was admitted *in extremis* suffering from mitral and tricuspid incompetence. At operation severely destroyed and incompetent valves were found. They were excised and replaced with a 29 MBRP and a 31 MBRP Björk-Shiley prosthesis, respectively.

After an uncomplicated postoperative course, the patient was restudied 9 months later and the pressures were found to be within normal limits (Fig. 3) and the heart was markedly decreased in size (Fig. 4).

Case 4

A 30-year-old Black male, after 5 weeks of medical treatment for subacute bacterial endocarditis, was deterio-

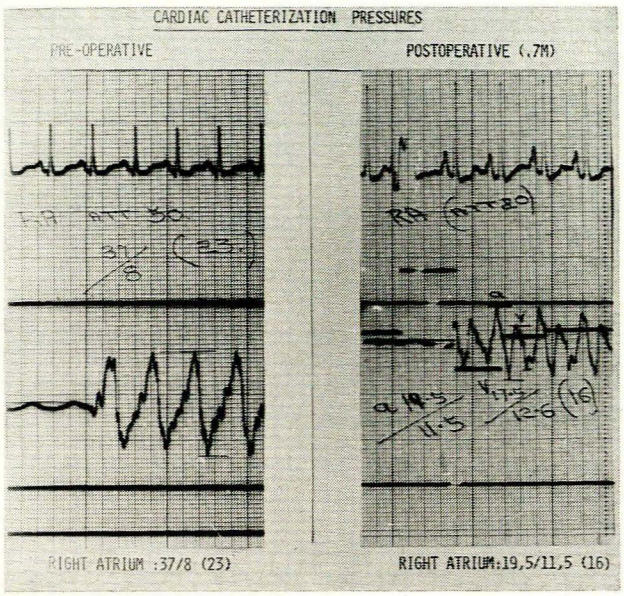

Fig. 2. Case 2. Pre- and postoperative catheterisation pressures.

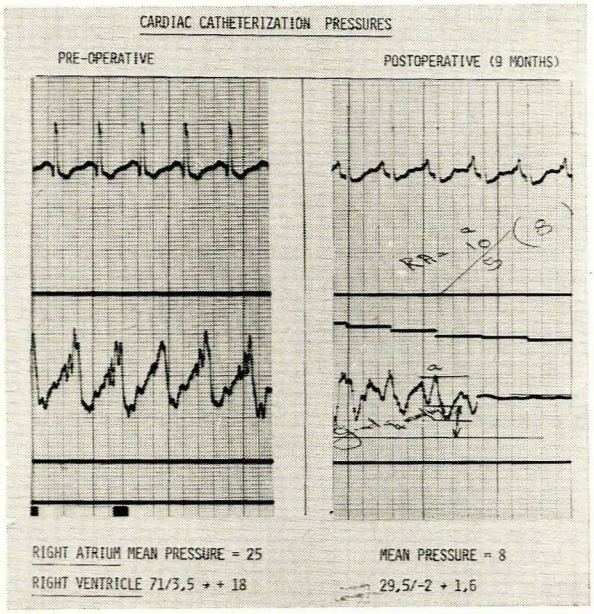

Fig. 3. Case 3. Pre- and postoperative catheterisation pressures.

rating rapidly owing to haemodynamic disturbances. Cardiac catheterisation confirmed free incompetence of the mitral, aortic and tricuspid valves.

The patient was operated on immediately and the severely destroyed valves were replaced with 27 MBRP, 27 ABP and 31 MBRP prostheses, respectively. He recovered remarkably and was restudied 8 months postoperatively. The pressures were found to be normal (Table V) and the heart had returned to normal size (Fig. 5).

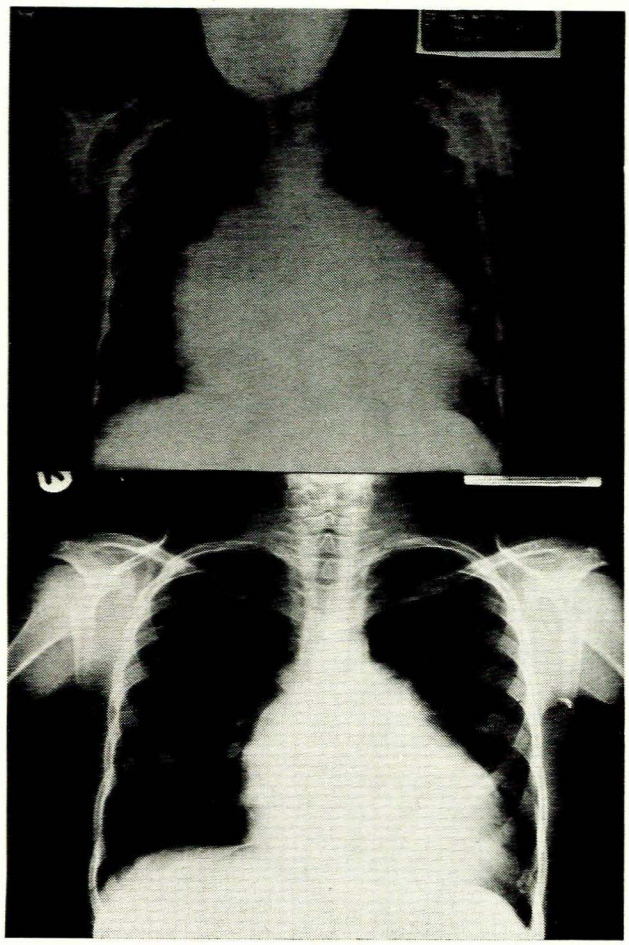

Fig. 4. Case 3. Pre- and postoperative X-ray studies.

TABLE V. MITRAL, AORTIC AND TRICUSPID VALVE REPLACEMENT

Cardiac catheterisation pressures (mmHg)

Pre-operative	Postoperative (3 mo.)
Right atrium 29/15(22)	**11/0,5(5,5)**
Right ventricle 54/3,5 — 21,5	**32,5/—2— +3**
Left ventricle 110/50	**110/75**
Wedge pressure 42/25(32,5)	**10/2,5(7)**

LATE RESULTS

As shown in Table VI, 2 patients died after mitral valve replacement. One patient died 6 weeks after the procedure of chronic pyelonephritis. This patient was extensively treated pre-operatively for the infection, but because his cardiac condition deteriorated, he was operated upon. After surgery he suffered severe infection of the urinary tract, and he eventually died of acute renal failure, complicated by secondary lung infection.

The second patient, a 14-year-old Black female, was readmitted to hospital 6 months after surgery in an

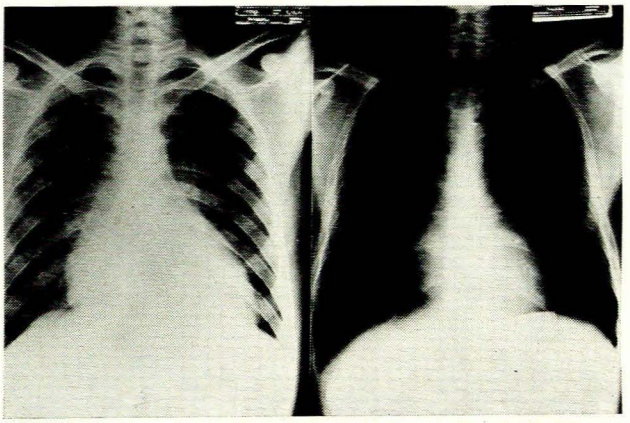

Fig. 5. Case 4. Pre- and postoperative X-ray studies.

TABLE VI. LATE RESULTS

Site	No. of patients	Lesion
Morbidity		
Mitral valve	**1**	**Cerebral embolism—transient effects**
Mitral valve	**1**	**Paraprosthetic leak**

Site	No. of patients	Time of death	Cause of death
Late deaths			
Mitral valve	**2**	**6 months post-op.**	**Acute myocarditis**
		6 weeks post-op.	**Renal failure—due to chronic pyelonephritis**

extreme condition with tachyarrhythmia. The diagnosis was myocarditis and she died 24 hours after admission. A postmortem examination was refused.

Late morbidity was negligible. One patient had an embolic episode with transient cerebral symptoms. After control of his anticoagulant therapy, he left hospital without any residual lesion.

One patient has a paraprosthetic leak which we do not think warrants replacement at this stage.

DISCUSSION

The haemodynamic advantages of this central-flow prosthesis with its optimal ratio between tissue, annulus and orifice diameter, has been demonstrated.[4,5] It allows greater flow across the valve, resulting in better cardiac output and less cardiac work. The ability to use smaller valve sizes without sacrificing the low gradient[4] owing to the greater valve orifice for a given tissue diameter, allows better results with both the elderly female with a small annulus, and young children and adolescents with future growth potential.

The single-hinged design allows for less trauma to the disc, as does the fact that the disc rotates with each cardiac cycle.[5,6] Since the disc does not overlap the valve annulus, less haemolysis is produced and this is confirmed by the patients followed-up postoperatively. In addition, the free-floating disc is able to respond to high frequency rates, which is a decided advantage with tachycardias and the higher pulse rate in children. The pyrolyte carbon disc represents an advance in the durability of the valve apparatus.[9]

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