MITRAL VALVE REPLACEMENT WITH MECHANICAL VALVES IN CHILDREN UNDER TWO YEARS OF AGE

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Repair of severe congenital mitral valve disease during the first years of life is still a therapeutic challenge.¹ Mechanical valves are the most viable alternative when reconstructive procedures have failed because in this age range early calcifications and very fast deterioration are likely to occur with bioprostheses.¹⁻³ Most authors are reluctant to perform mitral valve replacement (MVR) in young infants because of higher morbidity and risk of anticoagulation.⁴ Here we report on 14 children who underwent MVR with mechanical prostheses before 2 years of age.

Patients and methods. Between December 1985 and December 1999, 14 children (median age, 5.6 months; median weight, 5.9 kg) underwent MVR with mechanical prostheses for untractable congestive heart failure, elevated pulmonary artery pressure, or both. Mitral lesions and associated cardiac malformations are shown in Table I. Eleven (78%) patients had previous procedures before MVR (Table I), with an attempted mitral valve repair in 6 (43%) patients. The mitral valve was exposed through the right atrium and the interatrial septum in 9 patients and through the left atrium in the remaining 5 patients. Resection of the subvalvular mitral apparatus was performed in all patients. Table II summarizes the MVR characteristics.

Results. In-hospital mortality was 3 of 14, with 2 early deaths (preoperative brain damage and periprosthetic mitral regurgitation with death at redo operation) and 1 late death after 7 months in the intensive care unit. One patient (patient 8) required implantation of a pacemaker for postoperative atrioventricular block. One patient (patient 10) had transient left ventricular dysfunction.

No hemorrhage was observed. One patient experienced valve thrombosis 3 months after discharge and fully recovered after thrombolytic therapy. At last follow-up examination (mean follow-up was 5.7 ± 4 years; range, 4 months to 13 years), all patients were doing well (New York Heart Association class II, 1 patient; New York Heart Association class I, 10 patients), mean pulmonary pressure was less than 25 mm Hg, and left ventricular function was normal without any treatment but oral anticoagulation. Three patients required repeated MVR 5, 6, and 11 years, respectively (mean, 7.3 ± 2.4

years), after the first MVR (Table II). Indication for MVR was mitral stenosis with symptoms. There was no operative mortality or morbidity in these 3 patients.

Discussion. Our study demonstrates that in young children with severe mitral lesions not amenable to repair, MVR with mechanical valves is a reasonable alternative. In early series, mortality was high, and an atrioventricular canal was considered to increase the risk of early death. In our series the postoperative mortality rate (<30 days) of MVR in children younger than 2 years of age was 14% ($n = 2$; ie, close to the figures of MVR in older children).^{2,3} However, comparison between noncontemporary series is not possible because intraoperative management and postoperative care improved dramatically. The new models of bileaflet mechanical valves, featuring a titanium ring, enable the surgeon to rotate the prosthesis after implantation. Implantation of the valve in the supra-annular position may enable us to choose a larger prosthesis and also to avoid creation of subaortic obstruction.⁵ Resection of all the submitral apparatus, which is usual in MVR in children and infants, has not impaired the left ventricular function. Transprosthetic mean gradient was acceptable despite the size or the position of the mitral prosthesis. This transprosthetic gradient was measured by using Doppler ultrasonography and could probably be overestimated.

Because of an infant's growth, the prosthesis can become restrictive, and repeated MVR is then required. The sizes of prostheses implanted during this reoperation (25, 21, and 23) were not far from adult sizes. Therefore, we anticipate that the total number of reoperations for MVR that an infant operated on at a very young age will undergo is a priori no more than that of an older child undergoing primary implantation.

Oral anticoagulant therapy is feasible in infants. Rough guidelines have been proposed to adapt the treatment to age and weight ranges. Factors that may have an effect, such as the infant's weight, drug interactions, and diet, must be taken into consideration. It is our policy to give antivitamin K to all children receiving a prosthetic valve. There are, however, centers that prefer using aspirin and dipyridamole. Although we did not use this alternative therapy, the risk of anticoagulation appeared acceptable in our study. Indeed, only 1 patient (patient 2) had thrombosis of the mitral prosthesis 3 months after implantation. There was no mortality or reoperation related to valve thrombosis, as has been reported in other series.²⁻⁴

In conclusion, this study demonstrates that MVR with mechanical valves in young infants is a reasonable alternative when mitral valve repair cannot be carried out or has

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Table I. Demographic data at time of MVR, associated lesions, and previous procedures

Patient . No	Age (mo)	Weight (kg)	Type of mitral valve dysfunction	Associated lesions	Previous procedures (age)
1	2	4	MR	Incomplete AVC	—
2	2	4.6	MR	Aortic and subaortic stenosis	Aortic valve dilation (3 d)
3	5	5.1	MR	Complete AVC	AVC repair, MV repair (4 mo)
4	5	5.1	MR	—	MV repair (3 mo)
5	5.5	5	MR	Aortic stenosis	Aortic valve dilatation (1 mo)
6	7	6.7	MS	—	—
7	8	5.8	MR	Aortic stenosis	Aortic valve dilatation (3 d)
8	9	5.5	MR	VSD, subaortic stenosis	VSD closure, subaortic stenosis resection, MV repair, creation of ASD (5 mo)
9	14	8	MS	Coarctation, bicuspid aortic valve, subaortic stenosis, supra-MS, PDA	Ligation of PDA (13 mo)
10	15	8.7	MS	Aortic annulus hypoplasia, supra-MS, coarctation	CoA repair (9 mo), resection of supra-MS and MV repair (11 mo)
11	16	10.7	MR	Incomplete AVC	AVC repair, MV repair (6 mo)
12	18	8.5	MR	Subaortic stenosis	Resection of subaortic mitral tissue (2 mo)
13	19	8.6	MS	Mild aortic stenosis	—
14	22	8.3	MR	Aortic stenosis	Surgical aortic valvotomy, MV repair (1 mo)

MR, Mitral regurgitation; AVC, atrioventricular canal; VSD, ventricular septal defect; MS, mitral stenosis; MV, mitral valve; ASD, atrial septal defect; PDA, patent ductus arteriosus; CoA, coarctation of the aorta.

Table II. MVR procedure and follow-up

Patient	First MVR			Concomitant procedures	Postoperative death	Second MVR			Follow-up (mo)	Mean pressure gradient (mm Hg; mean, 7.7 ± 2.4 mm Hg)
	Prosthesis type	Size (mm)	Position (A/SA)			Delay (y)	Prosthesis type	Size (mm)		
1	CM	16	A/SA	Ostium primum closure and incision of the coronary sinus tectum	9 d					
2	CM	16	SA	Ross-Manouguian procedure					4	4
3	CM	16	A	—		5	SJM	25	86	6
4	CM	16	A	—					20	10
5	CM	18	A	—		6	SJM	21	98	7
6	SJM	19	A	—					155	12
7	SJM	19	A	—					102	8
8	CM	16	SA	—					20	4
9	CM	16	SA	Subaortic stenosis resection, coarctation repair, creation of ASD					7	10
10	CM	16	SA	Widening of left atrium, creation of ASD					86	11
11	SJM	21	A	—					47	4
12	SJM	21	A	—		11	CM	23	140	9
13	CM	16	SA	Creation of ASD	7 mo					
14	SJM	23	A	—	5 d					

A, Annular position; SA, supra-annular position; CM, CarboMedics; SJM, St Jude Medical; ASD, atrial septal defect.

failed. In these rare but always complex situations for decision making, mortality was not high, and morbidity was low. Long-term anticoagulation with antivitamin K was feasible in infants with a low rate of severe complications. Finally, hemodynamic status and prosthesis function were excellent in all survivors at last follow-up.

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