

A Case Report of Valve Dysfunction Associated with Abrasion of the Delrin Disk Used in Early Björk-Shiley Mitral Valves Requiring Resurgery

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A 39-year-old woman had undergone mitral valve replacement (MVR) (29-mm Björk-Shiley Delrin disk) at 6 years of age. Severe mitral regurgitation, aortic regurgitation, and left ventricular dilatation were detected by echocardiography in October 2006, and MVR (ON-X 25 mm) and aortic valve replacements (St. Jude Medical Regent, 21 mm) were performed in December. The Delrin disk of the previous prosthetic valve, located at the position of the mitral valve, was markedly abraded, broadening the clearance from the valve seat. The post-operative course was smooth without complications, and the patient was discharged, walking by herself, on day 19 after surgery. A Delrin disk was used for the tilting valve in early Björk-Shiley valves, but has been replaced by pyrolytic carbon because of problems with durability of the Delrin material. Follow-ups of patients who have undergone procedures using Delrin disks are necessary, with consideration of valve replacement. (Ann Thorac Cardiovasc Surg 2009; 15: 126–128)

Key words: Björk-Shiley valve, Delrin

Case Report

Patient: A 39-year-old woman

Chief complaint: Exertional dyspnea

Past medical history: None in particular

History of the present illness: The patient underwent mitral annuloplasty by annulus plication of the anterior and posterior commissures for mitral valvular annulus

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enlargement associated mitral insufficiency at 6 years of age. She later underwent mitral valve replacement (MVR) with a 29-mm Björk-Shiley Delrin disk (BSD) valve for residual regurgitation during the same hospitalization period, followed by treatment at the outpatient clinic of our department. The patient had been aware of dyspnea during hard exercise for several years.

In October 2006, regurgitation at the prosthetic mitral and aortic valves and left ventricular enlargement were noted on echocardiography. Cardiac catheterization was performed in November 2006. Moderate mitral regurgitation and severe aortic regurgitation were detected by left ventriculography and aortography, respectively. Surgery was indicated, and the patient was admitted to our department.

Illness on admission: The patient's height was 161.5 cm, and body weight was 57.2 kg. A grade 3 diastolic murmur was detected in the 2nd intercostal region at the left sternal margin, and a grade 2 pansystolic murmur was evident in the apical region. The prosthetic valve clicking sound was normal.

Chest X-ray photograph: The cardiothoracic ratio was 61.5%. No abnormality was noted in the cardiac shadow or lung field.

Blood chemistry: Red blood cell count, $335 \times 10^4/\mu\text{L}$; hemoglobin, 7.8 g/dL; mean corpuscular concentration, 26.3%; mild anemia showing. LDH (364 IU/L) and total bilirubin (0.7 mg/dL) were within the normal ranges. There were no other abnormal findings.

Electrocardiography: Sinus rhythm. The heart rate was 50 beats/min.

Echocardiography: Severe aortic regurgitation and severe mitral regurgitation were detected. The left ventricular diastolic and systolic dimensions were 75 mm and 55 mm, respectively, and the ejection fraction was 61%.

Cardiac catheterization: Moderate mitral regurgitation and severe aortic regurgitation were detected by left ventriculography and aortography, respectively. Coronary arteriography detected no significant stenosis. Pulmonary arterial pressure, 34 mmHg/10 mmHg; mean pulmonary arterial wedge pressure, 11 mmHg; mean right atrial pressure, 6 mmHg; cardiac output, 4.32 L/min; and cardiac output index, 2.70 L/min/m².

Aortic valve replacement and MVR were performed in December 2006.

Surgical findings: The prosthetic mitral valve was observed. The entire Delrin disk was markedly abraded and partially striated (Fig. 1). The prosthetic valve was removed, and a new prosthetic valve (On-X 25 mm, Medical Carbon Research Institute, Austin, TX) was sutured. The aortic valve was observed. Because a perforation was noted in the left coronary cusp, regurgitation associated with it was diagnosed. The aortic valve was excised, and a prosthetic aortic valve (21-mm St. Jude Medical Regent, St. Paul, MN) was sutured to the supra-annular position.

Postoperative course: The absence of regurgitation around the prosthetic valves was confirmed by echocardiography after surgery. No abnormality was detected on the open-angle valve test. Postoperative febricula was protracted, but remitted spontaneously. Oral mexiletine administration was initiated for frequent ventricular extrasystole. No other complications occurred, and the patient was discharged, returning home 19 days after surgery.

Discussion

A Björk-Shiley valve is a mechanical tilting single-leaf valve widely used worldwide. The disk material used for the early valves from 1969 was acetal resin (Delrin), and it was sold until 1979. Delrin is a polyacetal resin made

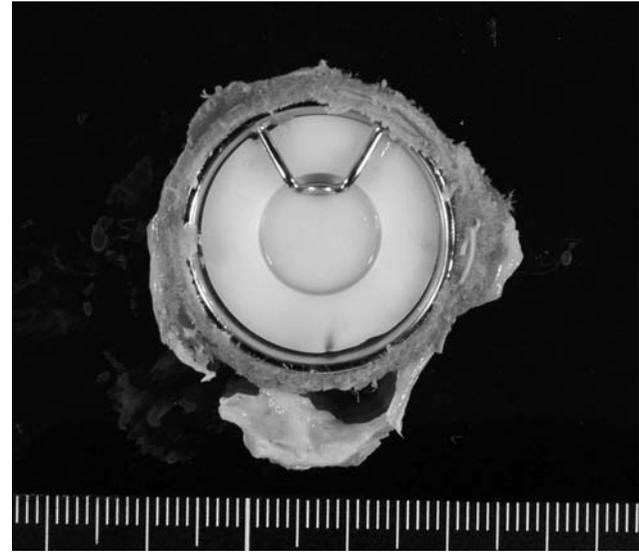


Fig. 1. Photograph of the excised prosthetic mitral valve.

A maximum gap of 0.7 mm was present between the valve seat and the disk. Striation of the lower part was also noted.

from formaldehyde. In Japan, a total of 2,597 valves were sold from November 1970 to April 1975.¹⁾ The Delrin disk was initially considered to be durable for more than 50 years,²⁾ but distortion of the disk by absorption of steam and dysfunction resulting from deformity have been reported.^{3,4)} Accordingly, the material of the tilting valve was changed to pyrolytic carbon in 1971.⁵⁾

To our knowledge, in Japan 8 cases of BSD valve dysfunction, including our case, have been reported in which disk abrasion and striation occurred because of contact with the strut, and they required replacement (Table 1).⁶⁻¹⁰⁾ Hirai et al. followed 99 cases of replacement with BSD valves for a maximum of 21.6 years. They performed resurgery for prosthetic valve dysfunction in 12 cases and noted similar findings in 6 excised valves.¹⁾

In the valve excised from this patient, the maximum gap from the valve seat had been markedly increased to 0.7 mm (from the initial value of 0.18 mm) because of disk abrasion. This abrasion itself may have been the cause of regurgitation, but Mazzucco et al. reported that the disk moved excessively in the seat, promoting insufficiency.¹¹⁾ The disk was partially striated, as reported previously, which may have resulted from concentrated abrasion of the strut-contacting region, demonstrating that rotary motion securing the structural durability of the disk was lost. Since this striation was formed several years after the valve replacement,^{2,4)} the guaranteed duration of rotary motion after implantation is questionable.

Considering the pathology, disk-abrasion induced

Table 1. Cases of Björk-Shiley Delrin disk valve replacement reported in Japan

Case	Author Year	Age Sex	Previous operation Year	Follow-up (yr) Redo year	Explanted valve Appearance	Malfunction
1	Takamoto et al. ⁶⁾ 1981	33 M	TVR 1974	7 1981	Marked disk Wear & indentation	Insufficiency (disturbed opening)
2	Misumi et al. ⁷⁾ 1989	52 M	AVR 1973	10 1984	Marked disk Wear & indentation	Insufficiency (valve thrombosis)
3	Misumi et al. ⁷⁾ 1989	45 F	MVR 1974	11 1984	Marked disk Wear & indentation	Insufficiency
4	Katsumata et al. ⁸⁾ 1993	55 F	MVR 1973	18 1991	Marked disk Wear & indentation	Insufficiency
5	Abe et al. ⁹⁾ 1996	48 M	MVR 1974	20 1994	Marked disk Wear & indentation	Uncertain
6	Aoyagi et al. ¹⁰⁾ 1999	61 F	AVR 1974	23 1997	Marked disk Wear & indentation	Insufficiency
7	Aoyagi et al. ¹⁰⁾ 1999	51 F	AVR 1973	24 1997	Marked disk Wear & indentation	Insufficiency
8	Masumoto et al. 2009	39 F	MVR 1973	33 2006	Marked disk Wear & indentation	Insufficiency

yr, year; M, male; F, female; TVR, tricuspid valve replacement; AVR, aortic valve replacement; MVR, mitral valve replacement.

prosthetic valve dysfunction may not progress rapidly, and thus early diagnosis of prosthetic valve dysfunction is difficult, as reported by Misumi et al.⁷⁾ and Katsumata et al.⁸⁾ This may be overlooked by a general outpatient examination. For these patients, close observation by echocardiography in consideration of valve replacement is necessary.

Conclusion

Disk-abrasion induced valve dysfunction occurred in a patient 33 years after MVR with an early Björk-Shiley valve using a Delrin disk, and valve replacement was necessary.

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