

# Mitral disc-valve variance

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This report deals with a rare complication of disc-valve prosthesis in the mitral area. A significant disc poppet and struts destruction of mitral Beall valve prostheses occurred 20 and 17 months after implantation. The resulting valve incompetence in the first case contributed to the death of the patient. The durability of Teflon prosthetic valves appears to be in question and this type of valve probably will be unacceptable if there is an increasing number of disc-valve variance in the future.

The majority of the prosthetic devices used to replace the heart valve have been used with success. Our experience during the last decade has been gratifying in that more than 65% of our patients have been relieved of their symptoms and are living relatively normal lives. However, in spite of the great convenience of rigid prosthetic heart valves, their use has also been fraught with both early and late complications. In the search for an ideal mitral prosthesis, the concept of a low-profile disc-valve was introduced by several cardiac surgeons. So far the clinical use of this kind of valve has been rewarding.

The incidence of disc variance in the mitral area is scarce (Beall, Bloodwell, Arbegast, Liotta, Cooley, and De Bakey, 1969; Robinson, Hildner, and Greenberg, 1971). This report deals with two cases that had significant erosions of both the disc poppet and struts of a mitral Beall valve prosthesis. We feel that the resulting valve incompetence contributed to the death of case 1.

## CASE REPORTS

**CASE 1** A 42-year-old white man had a mitral and aortic valve replacement on 24 May 1968 for rheumatic heart disease, severe mitral and aortic insufficiency, and congestive heart failure. He was classified functionally as IV-D (New York Heart Association). The diseased mitral valve was replaced with a large size mitral Beall prosthesis and the aortic valve was replaced with a No. 11 Starr-Edwards aortic prosthesis. Initially after operation the patient had a good result but 10 months later he developed intractable congestive heart failure. A systolic murmur was detected at the apical area. The sound of the aortic and mitral prosthesis was clear and crisp. There was evidence of haemolysis although he did not require a blood transfusion. Repeated

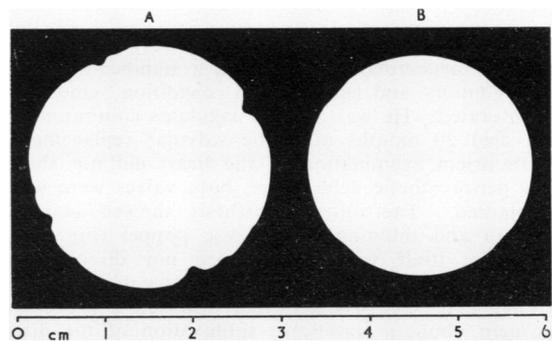


FIG. 1. (A) Case 1. A large size Beall valve disc removed from the frame. Thinning, marked notching, and erosion of the disc edge are seen. (B) Case 2. Medium size Beall valve disc.

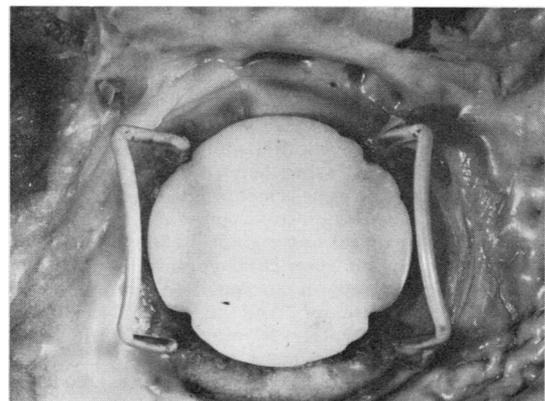


FIG. 2. Disc in situ showing equidistant deep notches and its relation to the vertical struts. The struts were slightly spread out to show the Teflon erosion in the vertical struts.

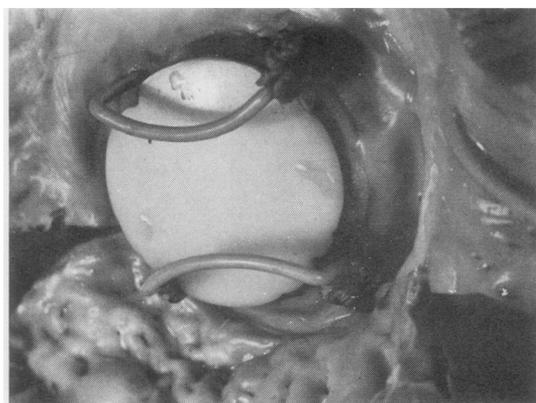


FIG. 3. View from left ventricle. Significant degree of disc subluxation. Note the thrombi formation on the struts.

haemodynamic studies revealed a very poor ventricular myocardial function and a significant mitral regurgitation and his clinical condition gradually deteriorated. He was on anticoagulants continuously. He died 20 months after the valvular replacement. Postmortem examination of the heart did not show any periprosthetic dehiscence; both valves were well implanted. The mitral prosthesis showed marked erosion and thinning of the disc poppet (Fig. 1A). The disc itself was not softened nor discoloured. The Teflon covering on all four vertical struts was eroded (Fig. 2). These severe destructive processes brought about a significant subluxation of the disc, resulting in valve incompetence (Fig. 3).

**CASE 2** A 53-year-old white man had mitral valve replacement on 2 November 1969 for rheumatic heart disease, calcific mitral stenosis and insufficiency, and congestive heart failure. He was functionally classified III-C (New York Heart Association). The diseased valve was replaced with a medium size Beall mitral prosthesis. He improved but was readmitted four months later because of dyspnoea, fatigue, and lassitude. Examination at that time revealed right ventricular hypertrophy, congestive heart failure, and a grade III/VI systolic murmur at the apex. There was no evidence of haemolysis and the blood cultures were sterile. Cardiac catheterization showed mild pulmonary arterial hypertension and normal left and right ventricular end-diastolic pressures. Cinéangiography did not reveal any significant mitral regurgitation. However, left ventricular contractility was very poor. He improved on an intensive programme of bed rest, salt restriction, and an aggressive diuretic regimen. Approximately 16 months after the operation he was again admitted to hospital because of intractable right heart failure. Repeat cardiac studies showed markedly poor left ventricular myocardial function. One month after admission the patient died. At necropsy the heart weighed 600 g, the mitral prosthesis was well implanted, and there was no

evidence of periprosthetic dehiscence. Both the left atrium and the left ventricle were dilated. There was extensive subendocardial fibrosis of the left ventricle, which had developed after the operation. The disc poppet showed notching of the edge (Fig. 1B) and the Teflon covering of the vertical struts was completely eroded.

#### DISCUSSION

Robinson *et al.* (1971) reported five cases of Beall valve disc deformities. They noted disc grooving as early as the sixteenth postoperative day. In one of their two-year survivors, the disc destruction was so extensive as to cause a significant valvular incompetence and contributed to the death of the patient. All the Beall valves used in their cases were manufactured before March 1968. Since March 1968, a new model has been commercially available. It has a compression-molded and thicker disc. The thickness of the Teflon covering the struts also has been approximately doubled.<sup>1</sup> This new model was designed in an attempt to minimize destruction. Since the introduction of the new design, we have used 160 mitral Beall valve prostheses. Sixteen patients have died in this series and in only two cases did we see this phenomenon.

The use of a low-profile disc prosthesis in the mitral area was introduced because of the mechanical and haemodynamic disadvantages of the caged ball-valve prosthesis. There was much concern about the ultimate longevity of the disc poppet since *in vitro* studies had suggested that the disc wear is not evenly distributed. By contrast, with the ball poppet the ball spins and freely tumbles so that the full impact of the stress is both reduced and evenly distributed during each cycle. Close scrutiny of the specimen (Fig. 1A) shows thinning of the disc. There were four deep and equidistant notches on the edge of the disc. There were also smaller notches close to the others. These localized areas of erosion correspond to the positions of the vertical struts. The characteristic changes in the disc can be explained by the fact that the disc poppet moves up and down more than it rotates. The Teflon covering the vertical struts was eroded. It is conceivable that after the Teflon had been eroded the bare metal struts greatly contributed to the rapid wear and tear of the disc poppet. Thrombi formed on the struts and one can only speculate on their effect on the movement of the disc.

The durability of the Teflon prosthesis appears

<sup>1</sup>Surgitool Inc., Pittsburgh, Pa.

to be in question and probably will be unacceptable if increasing numbers of cases of disc variance in the mitral area are seen. The use of a more durable material in the fabrication of the disc might eliminate this problem.

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REFERENCES

- Beall, A. C., Jr., Bloodwell, R. D., Arbegast, N. R., Liotta, D., Cooley, D. A., and De Bakey, M. (1969). Mitral valve replacement with dacron-covered disk prosthesis to prevent thromboembolism: clinical experience in 202 cases. In *Prosthetic Heart Valve*, p. 319, ed. L. A. Brewer. Thomas, Springfield, Illinois.
- Robinson, M. J., Hildner, F. J., and Greenberg, J. J. (1971). Disc variance of Beall mitral valve. *Ann. thorac. Surg.*, **11**, 11.