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CASE REPORT

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Dysfunction of an ATS valve in the aortic position: the first reported case caused by pannus formation

Abstract A 64-year-old woman underwent aortic valve replacement with a 21-mm Advancing The Standard (ATS) open-pivot mechanical heart valve for bicuspid aortic valve stenosis. In addition to the appearance of a new cardiac murmur, echocardiography performed 3 years after surgery showed a high pressure gradient across the ATS valve and a reduction in the valve orifice area. Cineradiography of the valve revealed restricted leaflet opening. Subsequent multidetector-row computed tomography clearly demonstrated pannus overgrowth on the inflow aspect of the ATS valve. During a repeat operation, subvalvular overgrown pannus was confirmed and the ATS valve was replaced with a bioprosthetic valve. This is the first reported case of prosthetic valve dysfunction resulting from pannus formation in a patient with an ATS valve in the aortic position.

Key words Mechanical heart valve · Pannus · Complications of surgery · Computed tomography

Introduction

Prosthetic valve dysfunction (PVD) caused by pannus formation is an infrequent but serious complication of heart valve replacement.[1–3] Although the precise mechanisms of pannus formation are not clearly understood, it is generally considered to be the result of a bioreaction to the mechanical and biological properties of a prosthetic valve. In addition, many factors such as prosthetic valve design, surgical techniques, infection, and inadequate anticoagulation also contribute to pannus formation.[1,2] Since the first clinical use of an Advancing The Standard (ATS) open-pivot mechanical heart valve (ATS Medical, Minneapolis, MN, USA) in 1992, more than 100000 ATS valves have been employed for valve surgery. However, dysfunction of the ATS valve in the aortic position resulting from pannus overgrowth has to our knowledge not been reported. In this paper, we describe the first case of PVD resulting from pannus overgrowth in an ATS valve in the aortic position.

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Case report

A 64-year-old woman underwent aortic valve replacement (AVR) with a 21-mm ATS valve for bicuspid aortic valve stenosis in 1999. The ATS valve was inserted in the supraannular position, perpendicular in axis to the septum, using pledgeted noneverted mattress sutures. Postoperatively, the patient was asymptomatic and free of complications. The postoperative anticoagulation level was examined by her family physician every 3 months and the prothrombin time – international normalized ratio (PT-INR) was maintained at between 1.15 and 2.13 (mean 1.60 ± 0.31). However, a new systolic ejection murmur was noted in the 4th intercostal space along the left sternal border 3 years after operation. Transthoracic echocardiography revealed deterioration of hemodynamic performance of the ATS valve. Doppler study revealed a high peak pressure gradient of 57 mmHg and a small valve orifice area of 1.25 cm^2. At the time of discharge from our hospital, the peak pressure gradient was 20 mmHg and the valve orifice area was 1.88 cm^2. The opening angle of the ATS value, calculated as the distance between the two leaflets in the fully open position on cineradiograms, was 62° (Fig. 1), clearly greater than the angles observed for normally functioning ATS valves in vivo.[4] Based on these findings, a diagnosis of obstruction of the ATS valve was made. Although intensive anticoagulant therapy with warfarin and thrombolysis with tissue plasminogen activator were performed, prosthetic valve function did not improve at all. Multidetector-row computed tomography (MDCT) revealed abnormal subvalvular tissue, which appeared to be

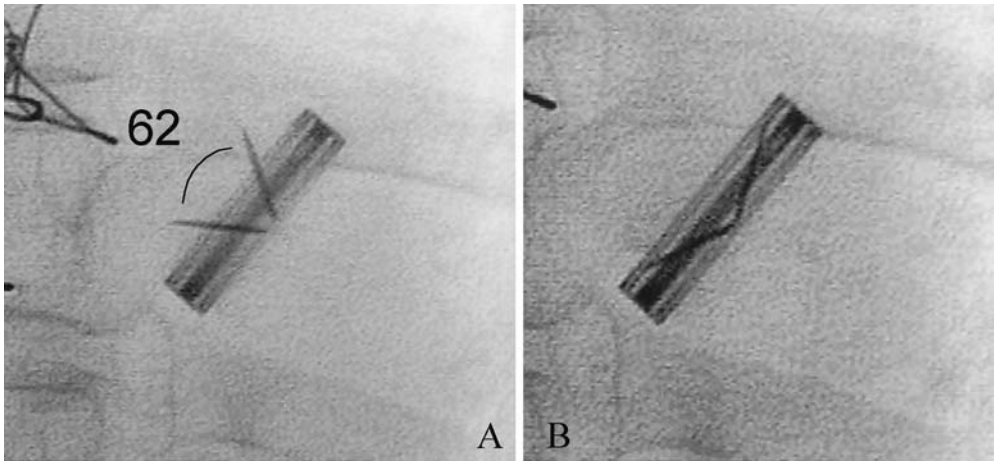

Fig. 1. **A** The opening angle, calculated as the distance between the two leaflets in the fully open position on cineradiograms, was 62°. **B** The closing angle was 130°

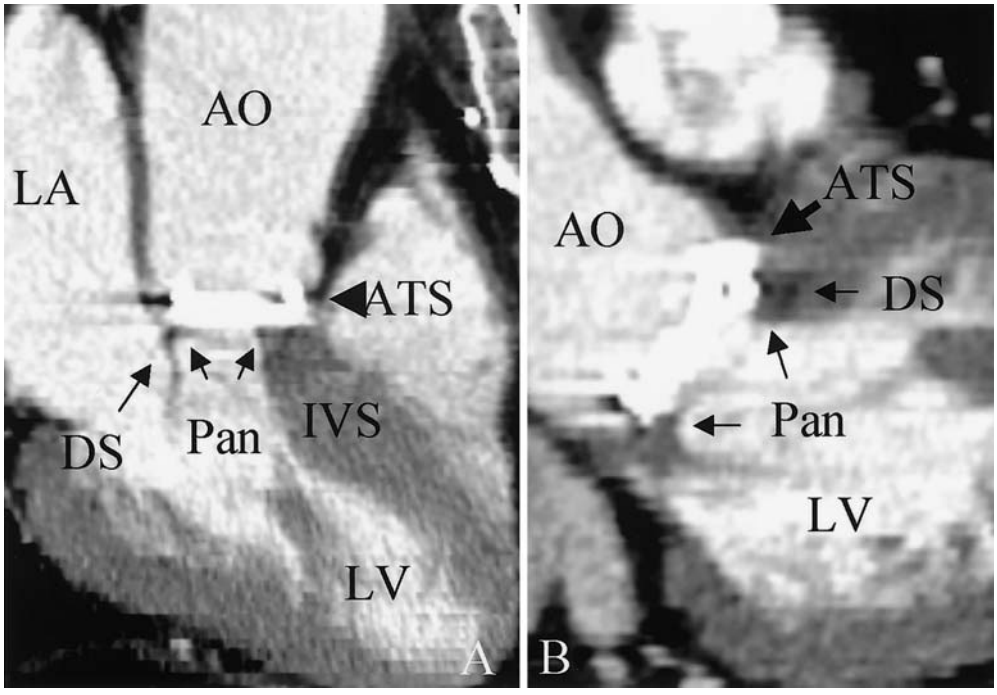

Fig. 2. **A** Multidetector-row computed tomography demonstrated concentric pannus (*small black arrows*), detected in the long-axis tomographic section view by the two-dimensional technique of multiplanar reformation. **B** Pannus was also detected in the coronal section view. *AO*, aorta; *LA*, left atrium; *LV*, left ventricle; *IVS*, interventricular septum; *Pan*, pannus; *ATS*, ATS valve; *DS*, dark spot of attenuation in the periannular region

pannus, on the inflow aspect of the ATS valve (Fig. 2), and also showed dark spots of attenuation in the periannular region, which were suspected to be either degenerated sewing cuffs or pledgets used for fixation of the ATS valve. Based on these findings, the final diagnosis of PVD resulting from pannus overgrowth was made and replacement of the ATS valve was scheduled.

During surgery, excessive growth of pannus over the valve-housing ring of the inflow side of the ATS valve was confirmed, and the overgrown pannus had caused subvalvular stenosis of the ATS valve as a result of narrowing of the actual orifice area (Fig. 3). The ATS valve was excised and replaced with a 19-mm Carpentier-Edwards pericardial bioprosthesis. The patient recovered uneventfully.

Discussion

This case report describes the first example of PVD of an ATS valve in the aortic position caused by pannus overgrowth. To our knowledge, one pediatric case of PVD caused by pannus formation in a mitral ATS valve has been reported,[5] but there have been no reports of PVD of an aortic ATS valve caused by pannus formation until now. Furthermore, the presence of subvalvular pannus in our patient proved that MDCT is, in addition to echocardiography and cineradiography, a useful diagnostic technique for PVD. We previously demonstrated that MDCT can clearly delineate subvalvular pannus overgrowth in the St. Jude Medical valve.[6] The pannus in the

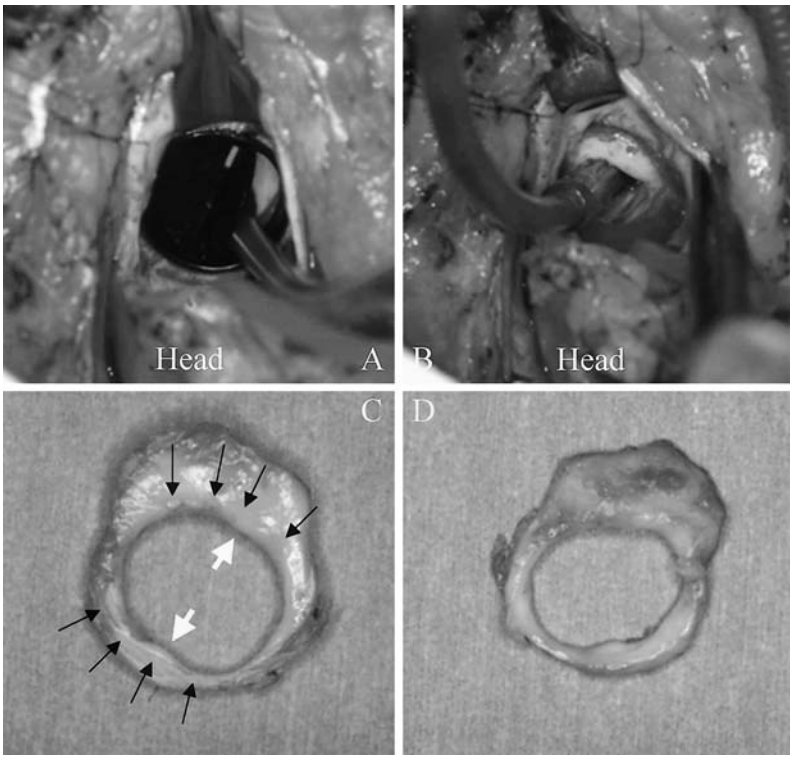

Fig. 3. **A** Concentric pannus without thrombus was observed beyond the ATS valve. **B** With the pannus removed, the ATS valve was visible. **C** The pannus had only circular traces that contacted the housing (*black arrows*). Traces of the straight edge of the leaflets were not observed (*white arrows*). **D** The pannus observed looking from the left ventricle to the aorta. *Head*, head side

ATS valve, unlike that in the pivot guard system of SJM valves, was detected as an image of subvalvular tissue extending from the interventricular septum at the valve-housing ring on the inflow side of the ATS valve.

Excellent intermediate-term results of valve replacement with ATS valves have been described in some reports.[7–9] The low rate of thromboembolism in aortic ATS valve implants has permitted maintenance of decreased INR values.[8,9] PT-INR levels are maintained at a slightly lower level in Japan than in North American and European countries.[10] However, despite the lower PT-INR values in Japanese patients, the rate of thromboembolism in Japanese patients with AVR has been just as good as those found in studies performed outside Japan.[8–10] Whether a causal relationship exists between pannus overgrowth and lower PT-INR levels is controversial. Our previous study demonstrated that pannus formation appears to originate in the periannular neointima, not associated with thrombus, and seems to be related to a process of periannular tissue healing.[2] In addition, Renzulli and his colleagues have indicated that pannus cannot be an organized thrombus but more likely is a fibroblastic proliferation.[11] Therefore, we suspect that PVD caused by pannus formation developed in the ATS valve in spite of adequate anticoagulation therapy.

The opening angle diagnosed by cineradiography was 62°. During repeat operation, however, pannus was found not to be directly in contact with the leaflets of the ATS valve. Our previous studies reported that in vivo, some normally functioning ATS valves did not open completely,[4,12] and also described that the ATS leaflet movement behavior was affected by its outflow configuration.[12] Therefore, this restricted leaflet movement in the ATS valve might have been associated with the narrowed inflow configuration resulting from pannus overgrowth.

In conclusion, we report here the case of a 64-year-old woman who underwent replacement of an aortic ATS valve because of PVD resulting from pannus formation. This is the first reported case of PVD resulting from pannus formation in a patient with an ATS valve in the aortic position.

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