

Bioprosthetic valve dysfunction due to leaflet rupture: a case report

Kapak yırtılmasına bağlı biyoprotez işlev bozukluğu: Olgu sunumu

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Patients with bioprosthetic heart valves have low rates of thrombosis and hemorrhagic complications. However, bioprostheses have limited long-term durability due to structural deterioration. A 74-year-old woman was admitted with resting dyspnea, orthopnea, palpitation, and hemoptysis of three days' duration. She had undergone closed and open mitral commissurotomies due to rheumatic mitral stenosis in 1962 and 1988, respectively, and mitral valve replacement (MVR) with a bioprosthetic valve at the age of 66 years. Electrocardiography revealed atrial fibrillation. Transthoracic echocardiography demonstrated a massively enlarged left atrium and severe eccentric mitral regurgitation (MR) with valvular and paravalvular components. Transesophageal echocardiography showed primary valve degeneration, leaflet rupture, and severe MR. Coronary angiography showed normal coronary arteries and third-degree MR. The patient was reoperated and a 29-mm porcine bioprosthesis was implanted. The operative material confirmed rupture of one leaflet.

Key words: Bioprosthesis/adverse effects; heart valve diseases; heart valve prosthesis; mitral valve/surgery; reoperation.

Treatment of native valvular disease has resulted in an increase in the number of patients with mechanical and biological prosthetic valves. The main properties of an ideal prosthetic heart valve are long-term durability, good hemodynamic profile, and low thrombogenicity. Two major clinical problems with mechanical valves include thromboembolism and the need for anticoagulation therapy of indefinite duration. The most frequent problems with bioprostheses are structural valve deterioration (SVD) and reoperation-related challenges. We pre-

sent a case of bioprosthetic valve dysfunction due to SVD and leaflet rupture.

Biyoprotez kalp kapakları kullanımıyla ilgili tromboz ve kanama riski düşük olmakla birlikte, zaman içinde meydana gelen yapısal bozulma nedeniyle bu kapaklarda uzun dönemli dayanıklılık sınırlıdır. Yetmiş dört yaşında bir kadın hasta, üç gündür süren istirahat dispnesi, ortopne, çarpıntı ve hemoptizi nedeniyle hastanemize yatırıldı. Hasta yıllar önce, romatizmal mitral darlık nedeniyle kapalı (1962) ve açık (1988) mitral komisürotomi geçirmiş, 66 yaşında da mitral kapağı biyoprotezik kapak ile değiştirilmişti. Elektrokardiyografide atriyum fibrilasyonu; transtorasik ekokardiyografide aşırı derecede büyümüş sol atriyum ve valvular ve paravalvular komponentli ciddi, eksantrik mitral regürjitasyon (MR); transözofajiyal ekokardiyografide primer kapak dejenerasyonu, yaprakçık yırtığı ve ciddi MR saptandı. Koroner anjiyografide koroner arterler normal bulunurken üçüncü derece MR gözlemlendi. Yeniden ameliyat edilen hastaya 29 mm'lik *porcine* biyoprotez takıldı. Çıkarılan materyalde bir yaprakçığın yırtıldığı görüldü.

Anahtar sözcükler: Biyoprotez/yan etki; kalp kapak hastalıkları; kalp kapak protezi; mitral kapak/cerrahi; yeniden ameliyat.

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CASE REPORT

A 74-year-old woman was admitted to the emergency service with resting dyspnea, orthopnea, palpitation, and hemoptysis of three days' duration. The patient had undergone closed and open mitral commissurotomies due to rheumatic mitral stenosis in 1962 and 1988, respectively. Eight years prior to admission (at 66 years of age), she had undergone

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mitral valve replacement (MVR) with a bioprosthetic valve. Her medical history included hypertension, chronic atrial fibrillation, and anemia. She was not on anticoagulant therapy at the time of admission for unknown reasons. On physical examination, blood pressure was 110/70 mmHg, pulse rate was 130/min, and body temperature was 36 °C. Chest and cardiac examinations revealed bilateral crepitant rales and a third-degree pansystolic murmur over the apex, radiating to the precordium, not musical in character. Laboratory tests for white blood cell count, erythrocyte sedimentation rate, and C-reactive protein level showed normal values. Chest radiography showed an increased cardiothoracic ratio, pulmonary congestion, and pleural effusion on the right side. Electrocardiography revealed atrial fibrillation.

Transthoracic echocardiography demonstrated a massively enlarged left atrium and severe eccentric

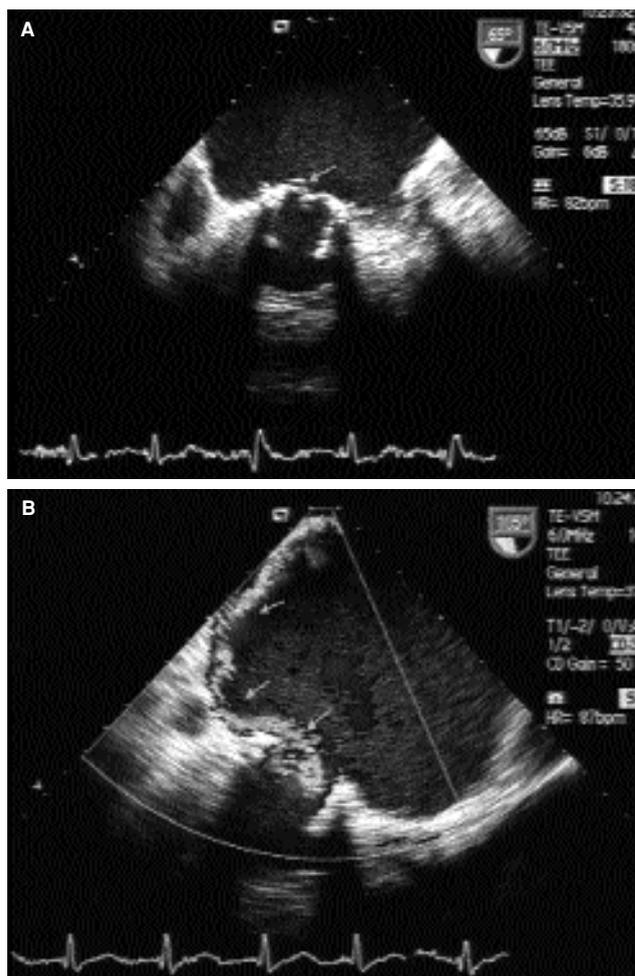


Fig. 1. (A) Transesophageal echocardiography showing the degenerated bioprosthetic valve. Arrow indicates the site of the leaflet rupture. **(B)** Color Doppler transesophageal echocardiography showed eccentric mitral regurgitation (arrows).

mitral regurgitation (MR) with valvular and paravalvular components. The mean mitral valve gradient calculated with continuous-wave Doppler was increased (17.3 mmHg). There was no evidence for a striated shuddering appearance of the regurgitant flow signals. Pulmonary artery pressure estimated by the velocity of the tricuspid regurgitant jet was also elevated (75-80 mmHg).

Transesophageal echocardiography performed to investigate the cause of the bioprosthetic dysfunction showed no evidence for vegetation, thrombus, or valve dehiscence, but primary valve degeneration, leaflet rupture, and severe MR (Fig. 1a, b). It also confirmed that MR was valvular and eccentric, travelling along the lateral border of the left atrium. Coronary angiography showed normal coronary arteries and third-degree MR.

The patient was reoperated and a 29-mm porcine bioprosthesis was implanted. The operative material confirmed rupture of one leaflet (Fig. 2).

DISCUSSION

The results of valvular surgery depend on patient-related factors, the type of surgery performed, the type and site of prosthesis implanted, and factors related to quality of health care.^[1] Although techniques and success with cardiac valve surgery have improved, prosthetic valves still result in suboptimal hemodynamics, with mechanical valves requiring indefinite anticoagulation and bioprosthetic valves having limited long-term durability due to SVD. Structural valve deterioration is defined as any change in valve function resulting from an

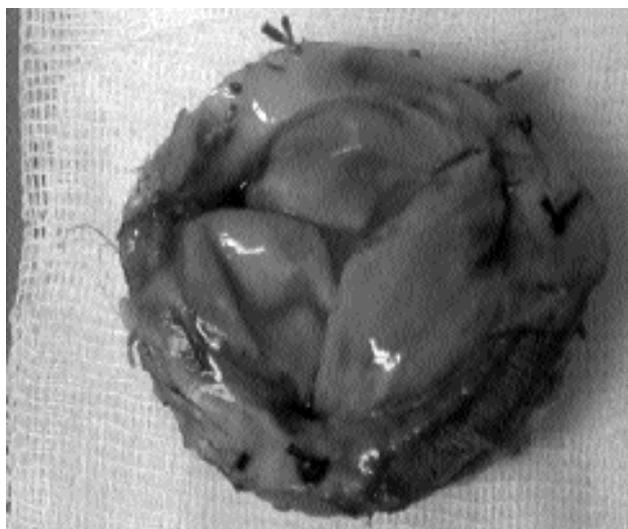


Fig. 2. The atrial side of the explanted valve. Note the ruptured leaflet on the right.

intrinsic abnormality and leading to either stenosis or regurgitation.

Bioprostheses offer a number of advantages over mechanical valves, including a low incidence of thrombosis, no hemorrhagic complications, no noise, and better quality of life for the patient. The most common clinical problem with bioprosthetic valves is SVD. The factors associated with SVD include changes intrinsic to the valve such as wear, calcification, leaflet tear or rupture, and shifting of the stent.^[2] The occurrence of bioprosthesis-associated SVD depends strongly on the site of implantation and the age of the patient at the time of the operation. Compared to younger individuals, patients over 65 to 70 years of age have a lower rate of SVD after MVR.^[3]

When choosing a prosthetic heart valve for a patient, the physician must consider long-term outcomes for different valve types, patient's characteristics, and expected survival for that individual. Bioprostheses are a good choice for MVR in patients 65 to 70 years old, who exhibit sinus rhythm. There are certain circumstances in which it might be preferable to insert a bioprosthetic valve even if the patient has atrial fibrillation, such as an expected survival of less than 10-12 years; anticoagulation being either contraindicated, unfeasible, or of increased risk for bleeding, and difficulty in controlling the patient's international normalized ratio (INR).

Two large randomized trials compared patient outcomes following the use of a mechanical *versus* porcine valve prosthesis for mitral and aortic valve replacement. The Edinburgh Heart-Valve Trial investigated 541 patients with a mean follow-up of 12 years.^[4] The results showed a trend toward better survival with the mechanical valve ($p=0.08$). Reoperation rates at five years were low without a significant difference, but at 12 years, the porcine-valve group had a higher reoperation rate. The same patient groups were compared after 20 years of follow-up.^[5] There were no differences in terms of survival between the two groups after 20 years; however, a significantly improved survival became apparent with the intact original mechanical valve prosthesis after 8-10 years in patients undergoing MVR.

The second large-scale randomized study, the United States Veterans Affairs trial, compared outcomes for 575 men after an average of 15 years following implantation of either a mechanical or bioprosthetic heart valve.^[6] In the patients who underwent MVR ($n=181$), there was no significant difference between the mechanical and bioprosthetic valve

groups with respect to survival at 15 years. However, a significantly larger proportion of patients in the bioprosthesis group developed primary valve failure following mitral or aortic valve replacement, but virtually all of these failures occurred in patients younger than 65 years of age. At 15 years, the rate of primary bioprosthetic valve failure after MVR was $20\pm 18\%$. The two groups did not differ significantly with respect to the reoperation rate following MVR.

Fann et al.^[7] reported their 20-year experience with porcine bioprostheses. For all the patients, younger age, later year of operation, and valve site (mitral) were found to be predictors of SVD. Significant risk factors for SVD following MVR were younger age, female sex, and later year of operation. It was also found that, at 10 years following MVR, freedom from SVD was $74\pm 4\%$ for patients at 61-70 years of age.

Our patient underwent MVR with a bioprosthesis at a relatively young age. Based on the echocardiographic finding of massively enlarged left atrium, one can consider that she had the operation late in the course of primary illness. This raises the question whether a bioprosthetic valve was the right choice for the initial operation. As she had demonstrated all the risk factors for an early SVD, a mechanical valve could have been chosen.

Spampinato et al.^[8] reported 380 patients who were reoperated for bioprosthetic valve failure. Of these, 130 patients received a new bioprosthesis for reasons including contraindication to anticoagulation, tricuspid replacement, and specific patient requests. The perioperative mortality for this group was 13.8%, the actuarial estimate for survival at 10 years was $77.4\pm 6.6\%$, and freedom from SVD was $81.8\pm 6.3\%$. The authors concluded that the extended survival of patients with bioprostheses compared favorably with that seen with mechanical valves.

Echocardiography provides detailed information about valve function and hemodynamics, and thus, allows early detection of SVD.^[9] Patients with bioprosthetic valves must be periodically evaluated with transthoracic echocardiography, and transesophageal echocardiography should also be performed when appropriate. Patients may present with sudden onset symptoms as in our case, where echocardiography has a critical role in the differential diagnosis of valve rupture due to SVD, endocarditis, or valve thrombosis. The striated shuddering appearance of the regurgitant jet on continuous-wave Doppler signals, which is an indicator of a torn or flail cusp, may

not be observed in patients with cusp tears adjacent to the valve ring.

Research has shown that, under certain conditions, bioprosthetic valves are reliable alternatives to mechanical valves.^[4-6,10-12] According to the recommendations of the American College of Cardiology/American Heart Association, valve replacement with bioprostheses is classified as a class I indication for patients who cannot or will not take warfarin treatment, and as a class IIa indication for patients above 70 years of age, who need MVR and do not have risk factors for thromboembolism.^[13] The importance of decision making is also emphasized for individual patients.

Considering the current data and because of the patient's advanced age, she was reoperated using a bioprosthesis, whose estimated durability was compatible with expected survival of the patient. Moreover, since there was an increased risk for bleeding due to anticoagulant therapy and advanced age, we preferred to keep her INR lower than that required with a mechanical valve. Preferences on the part of the surgeon and the patient were also in favor of a bioprosthetic implantation.

In conclusion, choosing the optimal heart valve to be implanted and early detection of SVD after valve replacement are essential aspects of patient management. Periodic echocardiographic monitoring should be performed in all patients with bioprosthetic valves. Regular follow-ups can help determine and perform earlier and lower-risk reoperations.^[14]

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