Evaluation of a Patient with Bioprosthetic Valve Dysfunction Due To Leaflet Rupture

Clinical Case Portal

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Case Report

Patients with bioprosthetic heart valves have low rates of thrombosis and hemorrhagic complications, and most have excellent quality of life. However, bioprostheses have limited long-term durability due to structural deterioration. When a bioprosthetic valve fails, the consequences of repeated replacement can be challenging. We present a 74-year-old woman with a bioprosthetic mitral valve, who was admitted to the emergency service with resting dyspnea.

Patient history prior to current observation :

A 74-year-old woman was admitted to the emergency service with resting dyspnea, orthopnea, palpitation and hemoptysis of 3 days' duration. The patient had undergone close mitral commissurotomy in 1962 and open mitral commissurotomy in 1988 due to rheumatic mitral stenosis. Eight years prior to admission (at 66 years of age), she had undergone 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.

Clinical findings on admission, evolution and outcome :

Physical examination revealed blood pressure 110/70 mmHg, pulse rate 130/min, and body temperature 36ºC. Chest and cardiac examinations revealed crepitant rales bilaterally and a third-degree pansystolic murmur over the apex that radiated to the precordium but not a musical systolic murmur. Laboratory tests showed that the patient's white blood cell count, erythrocyte sedimentation rate, and C-reactive protein level were all in the normal range. 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 mitral regurgitation (MR) with valvular and paravalvular components. The mean gradient at the mitral valve as calculated with continuous-wave (CW) Doppler was increased, at 17.3 mmHg. CW Doppler did not demonstrate striated shuddering appearance of the regurgitant flow signals. Pulmonary artery pressure as estimated by tricuspid regurgitation jet velocity was also elevated (75-80 mmHg).

Transesophageal echocardiography (TEE) was performed to investigate the cause of the bioprosthesis dysfunction. This showed no evidence of vegetation, thrombus or valve dehiscence, but primary valve degeneration, leaflet rupture, and severe MR were detected (fig. 1 and fig. 2). The imaging also confirmed that the MR was valvular and eccentric, traveling along the lateral border of the left atrium. Coronary angiography revealed 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. 3).

Discussion

The results of valvular surgery depend on patient-related factors, the type of surgery performed, 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; mechanical valves require indefinite anticoagulation and bioprosthetic valves have limited long-term durability due to SVD. Structural valve deterioration is defined as any change in valve function that results from an intrinsic abnormality, and that leads to either stenosis or regurgitation.

Bioprostheses offer a number of advantages over mechanical valves. The benefits include 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). Occurrence of bioprosthesis SVD depends strongly on the site of implantation and the age of the patient at the time of the operation. Patients over 65 to 70 years of age have a lower rate of SVD after MVR than younger individuals (3).

When choosing a prosthetic heart valve for a patient, the physician must consider the documented long-term outcomes for different valve types, the particular patient's characteristics, and the expected survival time for that individual. Bioprostheses are a good choice for MVR in patients approximately 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. These situations are as follows: patient life expectancy less than 10-12 years; cases in which anticoagulation is contraindicated; cases in which the patient cannot or will not take anticoagulation therapy; patients who are at increased risk for

bleeding with anticoagulation, and cases in which it is difficult to control the patient's international normalized ratio (INR).

Two large randomized trials have compared patient outcomes with use of a mechanical valve versus a porcine valve for MVR and AVR. One of these, the Edinburgh heart-valve trial, investigated 541 patients with mean follow-up of 12 years (4). The results showed a trend toward better survival with the mechanical valve ($p = 0.08$). The groups' reoperation rates at 5 years were low and the difference was not significant, but at 12 years the porcine-valve group had a higher reoperation rate. Other researchers examined 20 years of follow-up for these same patients (5). The results revealed no difference in survival between the two groups after 20 years. In the patients who had undergone MVR the difference between the groups' reoperation rates became significant after 8-10 years.

The second large-scale study, the United States Veterans Affairs trial, compared outcomes for 575 men who had been randomly assigned to receive either a mechanical or a bioprosthetic heart valve, and who had been followed for an average of 15 years (6). In the patients who underwent MVR ($n = 181$), there was no significant difference between the mechanical valve and bioprosthetic valve groups with respect to survival at 15 years. A significantly larger proportion of the bioprosthesis group both for MVR and for AVR developed primary valve failure, 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 frequencies of reoperation in the two groups after MVR were not statistically different.

Fann et al reported their twenty year experience with porcine bioprostheses (7). For all patients, younger age, later year of operation, and valve site (mitral) were found to be predictors of SVD. Risk factors for SVD who underwent MVR were younger age, female sex, and later year operation. They also reported that patients at 61-70 years of age had $74\pm4\%$ freedom from SVD rate for MVR at 10 years. 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 bioprosthetic valve at her first operation was the right choice. As she had all demonstrated risk factors for early SVD, a mechanical valve could well be chosen in this case.

Spampinato and coworkers reported 380 patients who were reoperated for bioprosthetic valve failure (8). Of these, 130 patients received a new bioprosthesis. The perioperative mortality rate for this group was 13.8%, the actuarial estimate for survival rate at 10 years was $77.4 \pm 6.6\%$, and the actuarial estimated proportion that would be free of SVD at this stage was $81.8 \pm 6.3\%$. The authors concluded that the extended survival of patients with bioprostheses compares favorably with that observed in patients 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 TEE should also be done when appropriate. Patients may present with sudden onset symptoms as in this case, and echocardiography has a critical role in differential diagnosis of valve rupture due to SVD, endocarditis, or valve thrombosis. Striated shuddering appearance of the regurgitant jet on CW Doppler signal 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 bioprosthetic valves are reliable alternatives to mechanical valves (4-6,10-12) under certain conditions. American College of Cardiology/ American Heart Association recommends bioprostheses as class I indication for patients who cannot or will not take warfarin treatment and as class IIa indication for patients >70 years needing MVR who do not have risk factors for thromboembolism (13). They also mentioned the importance of decision making for individual patient.

Considering the current data, we chose to implant a bioprosthesis in our patient because of her advanced age and because her expected survival was compatible with the valve's estimated durability. Since the

patient carried increased risk for bleeding due to anticoagulant therapy because of advanced age, we preferred to keep her INR lower than the level that is necessary with a mechanical valve. Surgeon and patient preferences were also important factors in determining the type of prosthetic valve that was used in our case.

Conclusion

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-up can help ensure earlier and lower-risk reoperation when this becomes necessary (14).

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Fig. 1 :
Bioprosthetic Mitral Valve Dysfunction - TOE - 2D

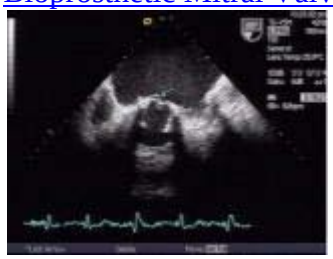

Fig. 2 :
Bioprosthetic Mitral Valve Dysfunction - TOE - 2D - Colour Flow

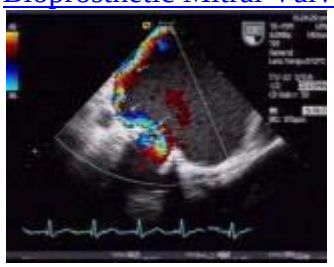

Fig. 3 :
Bioprosthetic Mitral Valve Dysfunction - Explanted Valve