Mitral Valve Chordal Rupture Caused by Prosthetic Valve Migration after Transcatheter Aortic Valve Implantation

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INTRODUCTION

Transcatheter aortic valve implantation (TAVI) has revolutionized interventional treatment of aortic stenosis in recent years, but there is limited evidence for TAVI as a treatment option for severe aortic regurgitation (AR).[1] Because of its minimal trauma and rapid recovery, there is global consensus that TAVI is a feasible and potential alternative treatment for older adults who cannot tolerate surgical aortic valve replacement.[2,3] However, because of the technical surgical challenges and unpredictable postoperative risks, TAVI is not recommended for isolated severe AR in international guidelines. We report the case of a patient at high surgical risk who underwent TAVI with subsequent prosthetic valve migration into the left ventricle, resulting in hemolysis and rupture of the mitral leaflet chordae tendineae.

CASE PRESENTATION

A 72-year-old man with a history of hypertension, gout, and chronic gastritis presented with chest tightness and dyspnea for 2 years. One month prior, the patient was found to have severe AR on physical examination at another hospital and was referred to our department for surgical treatment. Preoperative transthoracic echocardiography showed left coronary cusp prolapse, moderate to severe eccentric AR (Figure 1) with an AR vena contracta measuring 0.6 cm, left ventricular diastolic diameter of 5.3 cm, aortic sinus dilatation (4.2 cm), and a left ventricular ejection fraction of 58%. Because of the patient's advanced age and the high risk of thoracotomy, TAVI was planned after multidisciplinary discussion by the TAVI team.

A self-expanding TAVI valve was deployed under computed tomographic angiographic guidance. However, the prosthetic valve was displaced into the left ventricle during the self-expansion process. Transesophageal echocardiography showed that the distance between the lower edge of the valve stent and the aortic annulus was 3.1 cm, and moderate to severe AR was observed (Videos 1 and 2). Therefore, another self-expanding valve was implanted. Immediately after deployment, the overall shape of the second valve was normal, with no aortic valvular or paravalvular regurgitation observed. However, because of the deep-seated position of the first valve, the anterior mitral valve leaflet was slightly compressed. Mild mitral regurgitation (MR) was observed, but it did not affect the opening of the mitral valve.

Postoperative electrocardiography showed a new complete left bundle branch block (Figure 2).

On the third postoperative day, the patient developed hematuria, and liver function tests showed increased total and direct bilirubin levels, indicating hemolysis. Because the symptoms of hemolysis were mild, the patient was observed for 2 days, and hemolysis persisted even though it had declined. Transthoracic echocardiography was repeated, and no significant change was noted compared with postoperative transesophageal echocardiography (Figure 3, Videos 3 and 4).

VIDEO HIGHLIGHTS

Video 1: Intraoperative two-dimensional transesophageal echocardiography, apical long-axis (130°) view, shows the first valve, which was placed after precise positioning, displaced and dislodged into the left ventricular cavity.

Video 2: Intraoperative two-dimensional transesophageal echocardiography with color flow Doppler, apical long-axis (137°) view, shows that the first prosthetic valve lost its normal function because of displacement, along with moderate to severe AR.

Video 3: Two-dimensional transthoracic echocardiography, apical long-axis view, performed on the fifth postoperative day (because of hemolysis), demonstrates that the prosthetic valve stent had no significant change compared with intraoperative transesophageal echocardiography.

Video 4: Two-dimensional transthoracic echocardiography with color flow Doppler, parasternal long-axis view, performed on the fifth postoperative day (because of hemolysis), demonstrates mild MR as a result of slight compression of the mitral leaflet by the aortic prosthetic valve stent.

Video 5: Two-dimensional transthoracic echocardiography, apical five-chamber view, performed on the 11th postoperative day, demonstrates multiple mobile echo densities consistent with ruptured mitral chordae.

Video 6: Two-dimensional transthoracic echocardiography with color flow Doppler, apical five-chamber view, performed on the 11th postoperative day, demonstrates severe eccentric MR.

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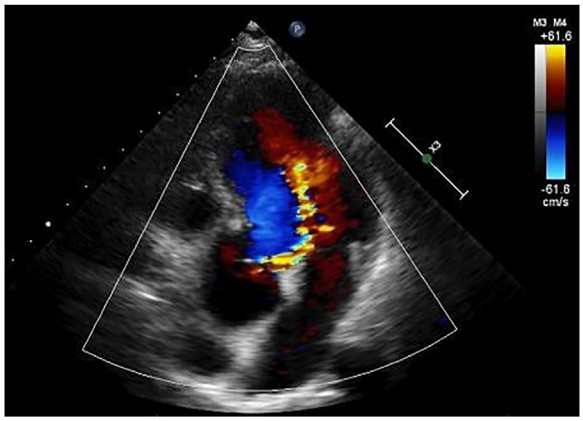

Figure 1 Preoperative two-dimensional transthoracic echocardiography, apical five-chamber view, with color flow Doppler demonstrates eccentric moderate to severe AR by visual assessment.

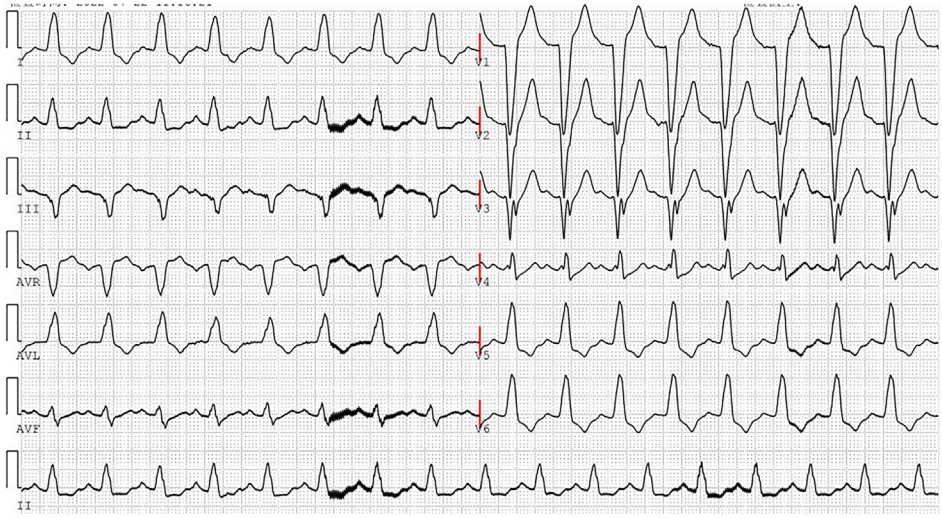

Figure 2 Postoperative electrocardiogram demonstrates complete left bundle branch block and sinus tachycardia.

As the symptoms of hemolysis diminished, no other treatment was administered, and hemolysis was significantly reduced 3 days later. On the eleventh postoperative day, the patient developed chest tightness and dyspnea. Transthoracic echocardiographic reexamination revealed rupture of the mitral leaflet chordae, severe eccentric MR during systole, and multiple miliary-like hyperechoic masses on the stump of the ruptured chordae (Figures 4 and 5, Videos 5 and 6). Blood test results showed an increase in white blood cell count (22.9×10^9/L), and the patient had a fever for 3 days, with a maximum temperature of 38.6 °C. Although blood culture results were negative; there was concern for infection.

With multiple ruptures of the mitral valve chordae tendineae, severe MR, and hemolysis, a decision was made to send the patient to surgery, which included prosthetic aortic valve extraction, mitral valve replacement, surgical aortic valve replacement, tricuspid valve repair, and pacemaker implantation. The surgery was successful, and the patient's hemodynamic status was stable postoperatively.

DISCUSSION

The absolute indications for TAVI, as outlined in the 2020 American College of Cardiology guidelines for the management of patients with valvular heart disease, include severe aortic stenosis, high surgical risk, short life expectancy after treatment, and anatomic suitability.[2] The Chinese expert consensus on TAVI shows that the J-Valve system (JC Medical) is effective for TAVI in patients with simple AR.[3] Currently, some Chinese surgical centers have been attempting TAVI using self-expanding valves for the treatment of isolated AR. TAVI with self-expanding valves and J-Valves has been successfully performed in >50 patients with isolated AR at our center, including >20 patients with self-expanding valves, with a success rate of 95%. Soong *et al.*[4] conducted a statistical study of TAVI for AR in Asians. The results indicated that TAVI has an acceptable safety and efficacy profile in native Asian patients with AR, with low mortality rates and generally good outcomes. However, the best approach of TAVI for isolated AR remains to be explored.

Prosthetic valve migration is a rare but serious complication of TAVI. For patients with aortic valve degeneration and calcification of the aortic annulus, correct placement of the prosthetic valve stent is easy, and displacement during TAVI does not occur, because of the large friction at the annulus. For patients with severe AR, the aortic annulus and leaflet are soft, and the prosthetic valve stent does not easily adhere in the normal position of the valve and shifts easily,[5] as in the case we describe here. To overcome these disadvantages,

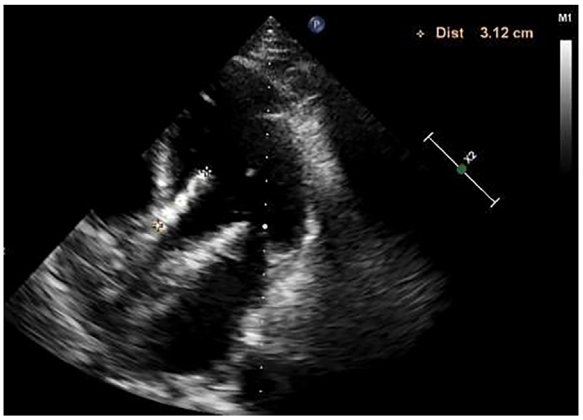

Figure 3 Two-dimensional transthoracic echocardiography, apical five-chamber view, on the third postoperative day demonstrates that the lower edge of the aortic valve stent is 3.1 cm from the aortic annulus, which was similar periprocedurally and immediately postprocedurally.

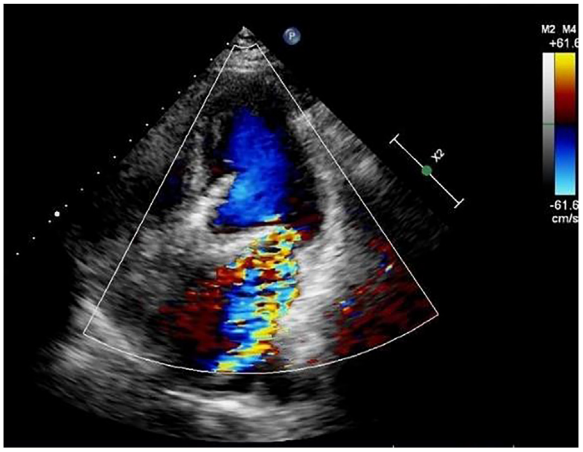

Figure 4 Two-dimensional transthoracic echocardiography, apical five-chamber view, with color flow Doppler on the 11th postoperative day demonstrates severe MR.

a slightly larger prosthesis should be used, and the release position of the self-expanding valve should be higher. Even if clinicians consider this before surgery, it is impossible to avoid all adverse outcomes. In cases such as these, the displaced prosthetic valve stent contacts the mitral chordae, resulting in rupture of the mitral chordae and potentially severe MR. The ruptured chordae tendineae, severe MR, and poor resistance due to anemia resulted in conditions for the occurrence of infection.

Left bundle branch block is the most common complication after TAVI[6] and is considered to be caused by mechanical compression from the artificial aortic valve.[7] Currently, pacemaker implantation is considered the most effective treatment.

Echocardiography plays a multifaceted role in the perioperative period of TAVI,[8] but the decision to perform TAVI is still based on computed tomographic evaluation.[9] However, evaluations during and immediately after TAVI rely mainly on transesophageal echocardiographic findings. Transesophageal echocardiography not only allows quick evaluation of the position, morphology, and function of

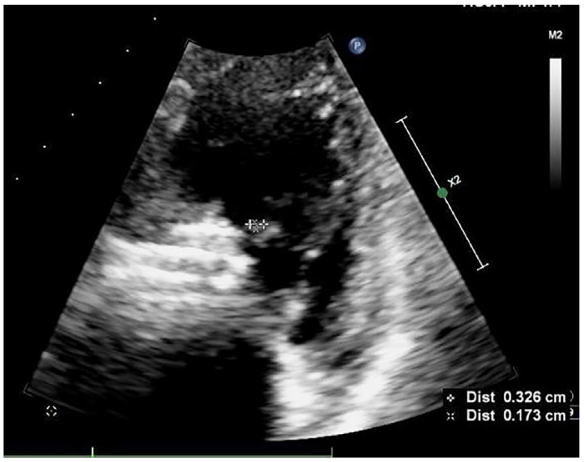

Figure 5 Two-dimensional TTE, zoomed apical five-chamber view, on postoperative day 11 demonstrates mitral valve chord and the flocculent hyperechoic density attached.

the prosthetic valve but also accurately evaluates prosthetic AR (from the valve orifice or perivalvular; x-ray fluoroscopy cannot distinguish between the two), recognizes complications, and quickly identifies the cause of hemodynamic instability. Echocardiography is indispensable in intraoperative and postoperative monitoring of TAVI.

CONCLUSION

Our case showed intraoperative prosthetic valve displacement and postoperative left bundle branch block as complications of TAVI. Chordae tendineae rupture combined with left bundle branch block caused by prosthetic valve displacement further reduced cardiac function. When the bioprosthetic valve is positioned too deeply within the LVOT and is found to affect the mitral valve apparatus and function, immediate surgical intervention should be considered.

ETHICS STATEMENT

The authors confirm that this study was conducted in compliance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans.

CONSENT STATEMENT

Consent was obtained from the patient or their appropriate parent, guardian, or power of attorney for publication of this report and any accompanying images.

FUNDING STATEMENT

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DISCLOSURE STATEMENT

The authors report no conflict of interest.

SUPPLEMENTARY DATA

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