INTRODUCTION

Mitral valve (MV) aneurysms are unusual saccular dilatations, usually located in the anterior leaflet of the MV. Pathophysiologic mechanisms may include subclinical endocarditis and local inflammation due to mechanical trauma derived from posteriorly directed aortic valve regurgitation jets, which directly affect the MV’s anterior leaflet, altering its normal architecture. We present two patients with MV aneurysms of infectious origin and a third patient whose etiology may have been related to a remote surgical procedure.

CASE PRESENTATIONS

Case 1
A 40-year-old man presented with a 4-week history of fever and chills. Outside hospital blood cultures were positive for *Streptococcus sanguinis*. Transesophageal echocardiography (TEE) showed a bicuspid aortic valve flail posterior leaflet with a 10-mm length vegetation attached to it, resulting in severe, eccentric, and posteriorly directed aortic regurgitation (Figure 1, Video 1). Likely secondary to the eccentric aortic valve jet directed to the anterior leaflet of the MV, a large aneurysm located in the A2 and A3 scallops was noticed, with a small perforation, resulting in a severe MV insufficiency jet (Figure 2, Video 2). Medical treatment was started with gentamicin and ampicillin.

The patient underwent aortic valve and MV replacement with biologic prostheses. Intraoperative findings included partial destruction of the posterior cusp of the bicuspid aortic valve with a large wartlike vegetation. Additionally, an abscess was noted in the MV at the A2 and A3 scallops, which together with the aforementioned blood culture results suggested an infectious etiology. No postoperative complications were seen, and the patient was discharged home 7 days postoperatively with a full 6-week course of antibiotics.

Case 2
A 22-year-old woman presented with 6-month history of shortness of breath and worsening functional class. Her medical history was significant for aortic coarctation and subaortic stenosis status post aortic angioplasty and Konno surgery, resulting in severe aortic regurgitation; she required valve replacement with a mechanical prosthesis 8 years previously and pacemaker implantation because of postoperative atroventricular block. On arrival, she was taking warfarin 5 mg/day, with a subtherapeutic international normalized ratio of 1.2.

Transthoracic echocardiography showed mild left ventricular dilation (indexed end-diastolic volume 79 mL/m²) with a normal left ventricular ejection fraction of 65%. Also, there was moderate posteriorly directed mitral regurgitation due to a perforated saccular aneurysm of the anterior leaflet (Figure 3, Video 3). TEE confirmed these findings and located the 10 × 6 mm aneurysm at the A2 and A3 scallops, in addition to a 0.2-cm² perforation at its tip (Figures 4 and 5, Videos 4 and 5). The aortic valve prosthesis showed a mean gradient of 33 mm Hg, a peak velocity of 4 m/sec, an acceleration time of 88 msec, and a dimensionless index of 0.4, with a continuous Doppler wave spectrum of triangular shape and normal excursion of the leaflets (Figure 6, Video 6). These values analyzed together were interpreted as indicating possible prosthesis-patient mismatch. Alternatively, increased pressure gradients across the aortic valve could be partially explained by a high-flow state due to the mitral regurgitation; the mean gradient across the MV was 6 mm Hg.

The patient was started on intravenous unfractionated heparin because of her low international normalized ratio and intermediate thrombosis valve risk. Later, she was bridged to warfarin, resulting in an international normalized ratio of 3.0. Also, diuretics and β-blockers were added, with an improvement of her functional class, and we decided to follow up clinically. Repeat transtracheal echocardiography is pending to reassess hemodynamics of the aortic valve prosthesis and determine the need for further surgical treatment.

Case 3
A 77-year-old man was admitted with a 2-month history of fever and progressive dyspnea. Medical history included hypertension, type 2 diabetes, chronic obstructive pulmonary disease, and end-stage kidney disease on hemodialysis. He had two prior admissions...
about 0.02% to 0.29%.³ They were initially described in MV aneurysms are infrequent, with a reported incidence of 1729 by Morand⁴ and consist of a thin-walled saccular formation protruding into the atrium in systole that collapses during diastole.⁵

After reviewing our database of 34,482 echocardiograms obtained in 2017 and 2018, only three cases of MV aneurysm were found, corresponding to 0.008% of all studies.

Current literature on the etiology of MV aneurysm suggests an infectious process as the leading cause, in particular aortic valve endocarditis followed by MV coinfection.⁶,⁷ In patients with aortic valve endocarditis, MV aneurysms occur secondary to the close relationship between the aortic valve and the anterior mitral leaflet. There are three proposed mechanisms for the anterior MV leaflet structural damage: (1) “seeding” by the regurgitant jet of the infected aortic valve, (2) direct contact between aortic vegetation that protrudes in the ventricular cavity and “kisses” the anterior mitral leaflet, and (3) dissemination of the infection by contiguity.⁷ After the anterior mitral leaflet is compromised by the mechanical stress, an inflammatory process is perpetuated, which thins and destroys the mitral leaflet fibers, leading to the aneurysmal formation.⁵ The previously proposed mechanisms are described in two of the largest MV aneurysm series,⁵,⁶ which included 23 lesions, 21 located at the anterior leaflet (19 with aortic valvular endocarditis and two with primary infection of the anterior mitral leaflet) and the remaining two located at the posterior mitral leaflet.

In our series, we included both the typical spectrum of the disease and less common presentations; findings on TEE clearly elucidate the associated pathologic mechanism previously described.

Patients in whom endocarditis is not identified (even subclinical) but who have MV aneurysms are uncommon. It is postulated that they may correspond to degenerative myxomatous processes and collagen diseases. Some argue that in cases of noninfectious aortic insufficiency, mechanical trauma to the anterior MV leaflet of the regurgitant jet may be another cause of the development of the aneurysmal lesion.³ In our second patient, the possible valvular trauma generated during the surgical intervention is proposed as a likely cause of the MV aneurysm.

Posterior leaflet MV aneurysm is much less frequent. Direct infection processes have been described, as occurred with the third case in our cohort. However, it is worth mentioning that in this type of presentation, the degenerative compromise of the valve may be more frequent, just as some clinical case records have reported.⁸,¹⁰

We present the varying spectrum of MV aneurysm, with the infectious component as the main associated finding while giving light to other less frequent forms of presentation.

**CONCLUSION**

MV aneurysms are rare lesions, commonly associated with aortic valve endocarditis, which may result from continuous extension due to anatomic proximity or seeding of the anterior leaflet. In patients with aortic valve endocarditis with severe regurgitation, a very rigorous examination of the MV is also needed during TEE to avoid misdiagnosis. Concomitant aortic valve endocarditis and MV aneurysm may be associated with higher morbidity and mortality.

**DISCUSSION**

MV aneurysms are infrequent, with a reported incidence of about 0.02% to 0.29%.³ They were initially described in

**VIDEO HIGHLIGHTS**

Video 1: TEE showing bicuspid aortic valve with posterior thickening due to vegetations and severe aortic regurgitation hitting the anterior mitral leaflet.

Video 2: TEE, four-chamber view, showing a large aneurysm of the mitral anterior leaflet with perforation and subsequent eccentric regurgitation jet heading toward the left atrial appendage.

Video 3: Transthoracic echocardiography, parasternal long-axis view with zoom on the MV, showing a perforated aneurysm in the anterior mitral leaflet. Note the systolic bulge and diastolic collapse of the lesion.

Video 4: TEE, four-chamber view, depicting an aneurysm of the anterior mitral leaflet and a regurgitant jet passing a perforation of the lesion.

Video 5: Three-dimensional TEE, en face view, of the MV with aneurysmal formation between A2 and A3 scallops. Note the small 0.2-cm perforation on its tip.

Video 6: TEE, aortic valve short-axis view; a mechanical aortic valve with normal functioning is present. On the left, an image suggestive of patent foramen ovale (PFO) is appreciated, but no flow was detected. On the right, in a left ventricular outflow tract view, an MV aneurysm is appreciated in the anterior mitral leaflet, and a normal disk excursion of the mechanic aortic valve is showing.

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for pneumonia, with multiple antibiotic regimens. On physical examination, a 4/6 holosystolic murmur was heard at the apex, radiating to the axilla. Antibiotic therapy with vancomycin and meropenem was started after three sets of blood cultures were obtained. TEE showed a cavitated saccular image on the P1 and P2 scallops, leading to severe mitral regurgitation consistent with an MV aneurysm (Figure 7). The clinical and imaging findings were consistent with subacute infective endocarditis, likely due to an intravascular device (hemodialysis catheter). Therefore, the hemodialysis catheter was explanted, and broad-spectrum antibiotics were continued. However, the patient deteriorated and needed transfer to a critical care unit because of septic shock. Emergent MV replacement with a biologic prosthesis plus reconstruction of the posterior aspect of the mitral ring with bovine pericardium and Dacron patches was performed. The surgical specimen showed a friable hemorrhagic MV aneurysm, with significant destruction of the posterior leaflet scallops (Figure 8). Unfortunately, the patient died because of severe multisystem organ failure 15 days after surgery.
Figure 1  TEE. (A, B) Aortic valve short-axis view: bicuspid aortic valve with posterior thickening (noncoronary cusp; arrow) due to the vegetations, which can also be seen in (C; white arrowhead). (C) Aortic valve long-axis view. (D) Severe aortic regurgitation jet hitting the anterior mitral leaflet. See Video 1.

Figure 2  (A) TEE, four-chamber view, showing a large aneurysm of the mitral anterior leaflet with systolic bulging (asterisk). (B) TEE, two-chamber view, showing perforation of the MV aneurysm with an eccentric regurgitation jet heading toward the left atrial appendage (yellow arrow). (C) TEE, three-dimensional reconstruction of the MV (from left atrial view) in which the aneurysm can be seen affecting the A2 and A3 scallops (dotted arrow). (D) The defect, which bulges in systole, hides the posterior MV (blue arrowhead). See Video 2.
Figure 3 (A) Transthoracic echocardiography, parasternal long-axis view, with zoom on the MV showing a saccular image (white arrowhead) seen in the anterior mitral leaflet during systole. (B) The aneurysm collapses in diastole (yellow arrowhead), common with this type of MV lesion. See Video 3.

Figure 4 (A) TEE, four-chamber view, with aneurysm of the anterior leaflet of the MV (white arrow), which shows in (B) the regurgitant jet with color Doppler examination, which passes through the perforated aneurysm. See Video 4.

Figure 5 (A, B) Three-dimensional TEE, en face view of the MV with aneurysmal formation between the A2 and A3 scallops, with a small 0.2-cm² perforation (dotted circle). See Video 5.
Figure 6 (A) Aortic prosthesis continuous-wave Doppler and (B) left ventricular outflow tract pulsed-wave Doppler. Hemodynamic analysis of the mechanical prosthesis shows an abnormally high peak jet velocity (4 m/sec), increased mean gradient (33 mm Hg), normal acceleration time (88 msec), normal dimensionless index of 0.4, and reduced indexed effective orifice area (EOAi) of 0.68 cm²/m²; assessed together, these findings were interpreted as indicating possible aortic prosthesis-patient mismatch. See Video 6.

Figure 7 (A) TEE, mitral commissural view, with evidence of systolic saccular dilatation of the posterior leaflet MV (blue arrowhead). (B) Three-dimensional reconstruction of the same aneurysmal lesion with central perforation (red dotted circle).

Figure 8 Resected MV with aneurysmal dilatation of the posterior leaflet. It had a hemorrhagic and friable aspect (black arrow).
SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2019.07.004.

REFERENCES

1. Stechert MM, Pletcher JR, Tseng EE, London MJ. Aneurysm of the anterior mitral valve. Anesth Analg 2012;114:86-8.
2. Vilacosta I, Roma AS, Sarria C, Aragoncillo P, Stoermann W. Clinical, anatomic, and echocardiographic characteristics of aneurysms of the mitral valve. Am J Cardiol 1999;84:5-8.
3. Silveira J, Sousa MJ, Oliveira F, Pereira L, Alves V, Cabral S, et al. Mitral valve aneurysm: a serious complication of aortic valve endocarditis. Rev Port Cardiol 2016;35:621.e1-5.
4. Meier JH, Seward JB, Miller FA, Oh JK, Enriquez-Sarano M. Aneurysms in the left ventricular outflow tract: clinical presentation, causes, and echocardiographic features. J Am Soc Echocardiogr 1998;11:729-45.
5. Pena JLB, Bomfim TO, Simão-Filho C, de Souza Andrade-Filho J. Mitral valve aneurysms: clinical characteristics, echocardiographic abnormalities, and possible mechanisms of formation. Echocardiography 2017;34:986-91.
6. Reid CL, Chandraratna AN, Harrison E, Kawanishi DT, Chandrasoma P, Nimalasuriya A, et al. Mitral valve aneurysm: clinical features, echocardiographic pathologic correlations. J Am Coll Cardiol 1983;2:460-4.
7. Silbiger J. Review: mitral valve aneurysms in infective endocarditis: mechanisms, clinical recognition, and treatment. J Heart Valve Dis 2009;18:476-80.
8. Janardhanan R, Kamal MU, Riaz I, Smith MC. Anterior mitral valve aneurysm: a rare sequelae of aortic valve endocarditis. Echo Res Pract 2016;3:K7-13.
9. Kim D J, Cho K-I, Jun H-J, Kim Y-J, Song Y-J, Jhi J-H, et al. Perforated mitral valve aneurysm in the posterior leaflet without infective endocarditis. J Cardiovasc Ultrasound 2012;20:100-2.
10. Konishi T, Funayama N, Yamamoto T, Hotta D, Kikuchi K, Ohori K, et al. Severe mitral regurgitation due to mitral leaflet aneurysm diagnosed by three-dimensional transesophageal echocardiography: a case report. BMC Cardiovasc Disord 2016;16:234.