Iatrogenic Left Circumflex Coronary Artery Fistula after Mitral Valve Replacement

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INTRODUCTION

The incidence of circumflex artery complications during mitral valve surgery is 0.5%–1.8%.1 We describe a unique presentation of circumflex artery injury after a mitral valve (MV) replacement resulting in a circumflex–to–left atrium fistula.

CASE PRESENTATION

A 67-year-old woman with a prior MV replacement, modified maze procedure, left atrial appendage ligation, and patent foramen ovale closure in 2007 was referred to the cardiology clinic for evaluation of a 1-year history of progressive dyspnea. Examination revealed a thin, chronically ill appearing woman with decreased breath sounds in the left base and mild expiratory wheezing bilaterally, elevated jugular venous pressure of 11 cm H2O, loud P2, and diastolic blowing murmur over the apex and no edema.

Electrocardiography showed sinus rhythm, extreme right-axis deviation, and incomplete right bundle branch block. Transthoracic echocardiography revealed normal left ventricular size and function, no regional wall motion abnormalities, and mild aortic insufficiency. There was severe thickening and calcification of a #29 Medtronic bioprosthetic MV, with a mean gradient of 13 mm Hg and pressure half-time of 139 msec (Figures 1 and 2, Video 1). The right ventricle was dilated, with moderately reduced systolic function, moderate tricuspid regurgitation, and right ventricular systolic pressure of 78 mm Hg (Figure 3, Video 2). Given the disproportionately short MV pressure half-time, transesophageal echocardiography was performed to evaluate for increased flow or occult mitral regurgitation. Transesophageal echocardiography revealed a left circumflex coronary artery–to–left atrium fistula and a severely stenotic bioprosthetic MV with a fistula located lateral to the prosthesis (Figures 4–6, Videos 3–5). The fistula was differentiated from a paravalvular leak by the presence of continuous flow on color and continuous-wave Doppler with a decrease in flow in late diastole (Figure 7). Left heart catheterization confirmed the LCx–to–left atrium fistula just distal to a subtotal occlusion of the mid-LCx (Figures 8 and 9, Videos 6 and 7). The patient’s circumflex coronary artery was reported to be normal by catheterization before her initial heart surgery.

The patient underwent redo MV replacement with #31 Biocor prosthesis, suture closure of the coronary artery fistula to the left atrium, and tricuspid valve repair. The fistula was localized by giving antegrade cardioplegia and oversewn, and closure was confirmed with repeat administration of antegrade cardioplegia. The patient was discharged home on postoperative day 8. She did develop postoperative atrial fibrillation, which spontaneously converted, and she continues to have less dyspnea and more energy, and she remains in sinus rhythm. Repeat transthoracic echocardiography was performed while in atrial fibrillation and revealed a left ventricular ejection fraction of 56% with no regional wall motion abnormalities, right ventricular systolic pressure of 45 mm Hg, and an averaged mean MV gradient of 6 mm Hg measured at a heart rate of 110 beats/min.

DISCUSSION

Coronary artery injury at the time of MV surgery occurs at a frequency of 0.5%–1.8%, although the actual frequency may be underreported or underacknowledged.1 Injury can occur secondary to alteration of the arterial course by internal compression from an annuloplasty ring or valve prosthesis or external compression (such as a hematoma), and the occlusion can be dynamic, partial, or complete.2-4 Alternatively, direct vessel injury can occur secondary to suture encircling, lacerating, or puncturing the vessel, resulting in partial or complete artery occlusion. Injury most frequently occurs in the proximal third of the circumflex coronary artery, corresponding to the anterolateral MV commissure (Figures 10–12).3 Injury typically occurs in a left-dominant coronary system (69%), related to the closer proximity of the MV annulus with the left-dominant circumflex coronary artery (as close as 1 mm) compared with a right-dominant system (≥5 mm).3,8 LCx injury has also been reported with anomalous origins from the right coronary sinus.6,10

Echocardiography is important in the assessment and diagnosis of coronary artery fistulas. Color Doppler can identify the anomalous flow and size of the fistula, while color and spectral Doppler can assess the directionality and timing of flow. Coronary artery fistulas typically have lower velocity flow, so the Nyquist limit may need to be decreased to 15–20 cm/sec to optimally detect the flow. Coronary artery blood flow occurs primarily during diastole. However, with a fistula, the timing of flow becomes dependent on gradients between the origin and recipient chamber.11 Therefore, a left atrial fistula will have continuous flow with an increase during systole, when the gradient between the aortic root and left atrium is greatest, and a decrease in late diastole following atrial contraction (Figure 7).12 A paravalvular leak can mimic a coronary artery fistula, but flow will be limited to systole when evaluated with color and spectral Doppler. Advances in three-
Figure 1 Transthoracic parasternal long-axis view showing severe thickening and calcification of the #29 Medtronic bioprosthetic valve (left) with color Doppler across the MV (right).

Figure 2 Transthoracic continuous-wave Doppler through the MV showing a mean MV gradient 13 mm Hg and a pressure half-time of 139 msec.

Figure 3 Transthoracic apical four-chamber view showing a dilated right ventricle.

Figure 4 Transesophageal midesophageal 30° view with X-plane showing LCx–to–left atrium fistula.

Figure 5 Transesophageal three-dimensional imaging of the MV prosthesis showing the location of LCx–to–left atrium fistula (red arrow). AV, Aortic valve.

Figure 6 Transesophageal color three-dimensional en face view of the anterolateral quadrant of the MV prosthesis showing the LCx–to–left atrium fistula. AV, Aortic valve.
Figure 7  Transesophageal midesophageal 68° view with continuous-wave spectral Doppler of the LCx–to–left atrium fistula showing continuous flow with a decrease in flow in late diastole.

Figure 8  Left heart catheterization (left anterior oblique 1, caudal 33) showing subtotal occlusion of the mid-LCx and associated coronary artery fistula (red arrow) to the left atrium and in close proximity to the MV prosthesis.

Figure 9  Left heart catheterization (right anterior oblique 26, caudal 26) showing subtotal occlusion of the mid-LCx and associated coronary artery fistula (red arrow) to the left atrium and in close proximity to the MV prosthesis.

Figure 10  Illustration demonstrating the location of the circumflex coronary artery relative to the anterolateral MV commissure.
dimensional imaging, including color Doppler, can also provide a better understanding of the location of fistula with en face views and allow offline reconstruction.

CONCLUSION

Acquired coronary artery fistulas are uncommon and can occur secondary to a variety of etiologies, which are typically traumatic and iatrogenic. Although rare, the LCx is particularly vulnerable to injury at the time of MV surgery related to the proximity of its epicardial course in the atrioventricular groove to the MV annulus. As highlighted in this case, echocardiography (transthoracic and transesophageal) plays a very important role in both the diagnosis and assessment of acquired coronary artery fistulas.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2018.04.004.

REFERENCES

1. Aybek T, Risteski P, Miskovic A, Simon A, Dogan S, Abdel-Rahman U, et al. Seven years’ experience with suture annuloplasty for mitral valve repair. J Thorac Cardiovasc Surg 2006;131:99-106.
2. Speziale G, Fattouch K, Ruvolo G, Fiorenza G, Papalia U, Marino B. Myocardial infarction caused by compression of anomalous circumflex coronary artery after mitral valve replacement. Minerva Cardiol 1998;46:455-6.
3. Vaishnava P, Pyo R, Filsoufi F, Sharma S. Compression of an anomalous left circumflex artery after aortic and mitral valve replacement. Ann Thorac Surg 2011;92:1887-9.
4. Vivas D, Alfonso F, Silva J. Anomalous circumflex coronary artery injury caused by mitral annuloplasty: role of 64 multislice computed tomography. J Invasive Cardiol 2009;21:E204.
5. Hiltrop N, Bennett J, Desmet W. Circumflex coronary artery injury after mitral valve surgery: a report of four cases and comprehensive review of the literature. Catheter Cardiovasc Interv 2017;89:78-92.
6. Kaklikkaya I, Yeginoglu G. Damage to coronary arteries during mitral valve surgery. Heart Surg Forum 2002;6:E138-42.
7. Cornu E, Lacroix P, Christides C, Laskar M. Coronary artery damage during mitral valve replacement. J Cardiovasc Surg 1995;36:261-4.
8. Pessa CJ, Gomes WJ, Catani R, Prates JC, Buffolo E. Anatomical relationship between the posterior mitral valve annulus and the coronary arteries: implications to operative treatment. Brazil J Cardiovasc Surg 2004;19:372-7.
9. Grande AM, Fiore A, Masotti M, Viganò M. Iatrogenic circumflex coronary lesion in mitral valve surgery: case report and review of the literature. Tex Heart Inst J 2008;35:179.
10. Morin D, Fischer A, Sohl B, Sadeghi H. Iatrogenic myocardial infarction. A possible complication of mitral valve surgery related to anatomical variation of the circumflex coronary artery. Thorac Cardiovasc Surg 1982;30:176-9.
11. Velvis H, Schmidt KG, Silverman NH, Turley K. Diagnosis of coronary artery fistula by two-dimensional echocardiography, pulsed Doppler ultrasound and color flow imaging. J Am Coll Cardiol 1989;14:968-76.
12. Renew JR, Ritter MJ. Coronary artery fistula to left atrium uncovered after mitral valve replacement. Anesth Analg 2017;124:30-2.