

A Rare Etiology for Bioprosthetic Aortic Valve Regurgitation



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INTRODUCTION

Prosthetic valve regurgitation is challenging to evaluate and difficult to manage. Although a common mechanism is paravalvular regurgitation, valve perforation represents an infrequent etiology for prosthetic valve regurgitation. Important causes of valve perforation include infective endocarditis, surgical methods, and suture techniques. In this case report, we describe a rare case of prosthetic valve regurgitation due to valve perforation resulting from the use of an automated suture technique.

CASE PRESENTATION

A 78-year-old man who underwent bioprosthetic aortic valve replacement (AVR) with a 29-mm Edwards stented prosthetic valve (Edwards Lifesciences, Irvine, CA) in 2017, for severe aortic stenosis, presented to his cardiologist with shortness of breath on exertion and leg swelling. He denied any fever or chest pain. On examination, heart rate was 78 beats/min and blood pressure was 120/50 mm Hg. The patient was found to have elevated jugular venous pulse and 2+ pedal edema. On auscultation, an early diastolic murmur was heard in the left third intercostal space. Transthoracic echocardiography demonstrated prosthetic aortic valve regurgitation with eccentric jets; mild systolic dysfunction with an ejection fraction of 40% to 45%; moderate hypokinesis of anteroseptal, anterior, and anterolateral myocardium; and holodiastolic flow reversal in the descending thoracic aorta (velocity-time integral 22 cm; [Figures 1-3](#), [Video 1](#)).

Transesophageal echocardiography demonstrated multiple eccentric jets, making quantification difficult ([Figures 4](#) and [5](#)). Paravalvular regurgitation could not be ruled out. Holodiastolic flow reversal seen in the descending aorta along with eccentric nature of the jets confirmed severe aortic regurgitation ([Videos 2](#) and [3](#)). Intraoperatively, no evidence of paravalvular leak was found, but three punctate defects in the prosthetic valve were evident, corresponding to the level of COR-KNOT sutures (LSI Solutions, Victor, NY) placed at the time of initial valve replacement surgery ([Figures 6-8](#)).

These COR-KNOT sutures had been oriented medially toward the valve, resulting in valve impingement and trauma. Successful redo

VIDEO HIGHLIGHTS

Video 1: Parasternal long-axis view demonstrating eccentric regurgitation jet during diastole through prosthetic aortic valve toward anterior mitral leaflet.

Video 2: Transesophageal echocardiogram showing eccentric aortic regurgitation on midesophageal aortic valve long-axis view.

Video 3: Transgastric view during transesophageal echocardiography revealing multiple eccentric aortic regurgitation jets.

View the video content online at www.cvcasejournal.com.

AVR was performed with a 27-mm Edwards stented prosthetic valve with explantation of the in situ 29-mm Edwards prosthetic valve. The new prosthetic valve was secured with manual sutures during the reoperation.

DISCUSSION

The COR-KNOT device is an automatic knot fastener device that has been shown to produce stronger and more consistent suture knots than manual suturing ([Figure 9](#)).¹ Multiple studies have revealed significant benefits, such as reduced aortic cross-clamping time and cardiopulmonary bypass time, without significant differences in major adverse events such as 30-day mortality and stroke or transient ischemic attack, with use of the COR-KNOT compared with manual suturing during minimally invasive AVR and mitral valve surgery.²⁻⁵ However, statistically insignificant increases in the rates of pacemaker implantation of 1.3% and aortic regurgitation of 3.9% were found in one study.² In a study of 119 patients undergoing surgical AVR (75 using the COR-KNOT device and the remainder using manual suturing), multivariate analysis showed reduced postoperative aortic valve mean gradient and reduced incidence of postoperative aortic valve regurgitation with COR-KNOT use.⁶

Prosthetic valve leaflet perforation is one of the complications after manual suturing techniques. Repetitive trauma from suture tail is proposed to be the mechanism behind prosthetic leaflet perforation, and hence sutures must be cut close to the knots.⁷ Although valve perforation has been reported with manual suturing techniques, only a few cases have been reported in the literature with COR-KNOT device use. Balan *et al.*⁸ attributed leaflet perforation to recurrent trauma from the leaflets hitting the knots, produced by the automatic fastener device. The titanium clips from the COR-KNOT device make the knots stiffer and less pliable. The resulting suture tails are positioned higher compared with manual sutures, increasing the likelihood of leaflet trauma. Baciewicz⁹ reported moderate aortic insufficiency 7 months after AVR due to medially directed COR-KNOT sutures

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Conflicts of interest: The authors reported no actual or potential conflicts of interest relative to this document.

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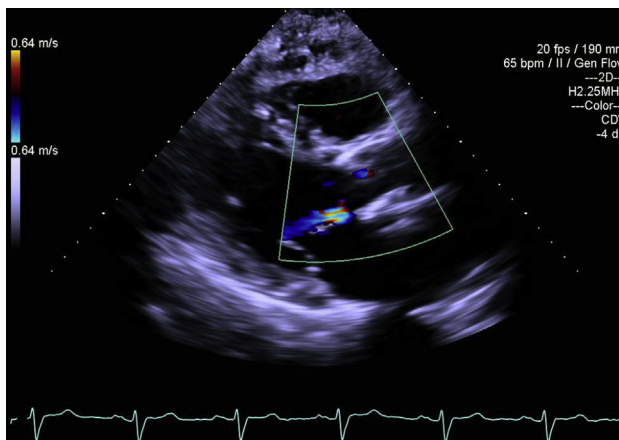


Figure 1 Parasternal long-axis view of transthoracic echocardiogram. Color Doppler image showing eccentric regurgitant jet impinging on anterior mitral valve leaflet.

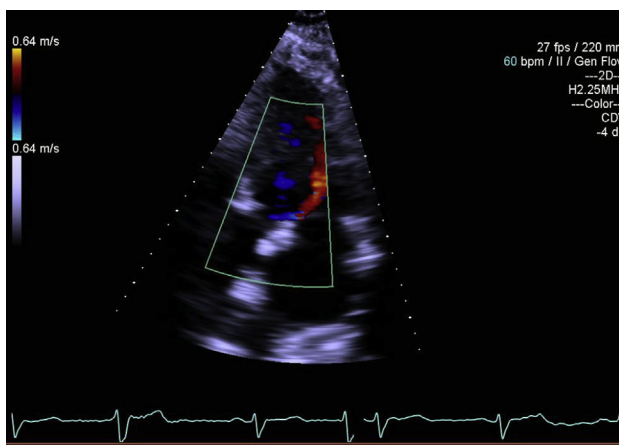


Figure 2 Apical four-chamber view. Color Doppler image revealing prosthetic aortic valve regurgitation depicted as red-colored flow along the mitral valve.

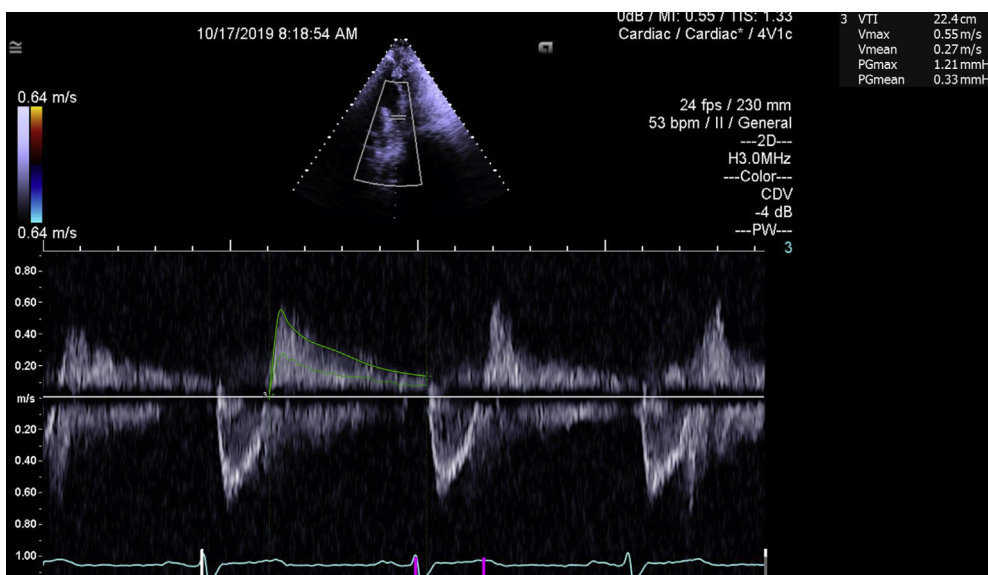


Figure 3 Pulsed-wave Doppler image of descending thoracic aorta. Supraclavicular view showing pulsed-wave Doppler image of aortic arch and proximal descending thoracic aorta demonstrating holodiastolic flow reversal with velocity-time integral of 22.4 cm, suggesting severe aortic regurgitation.

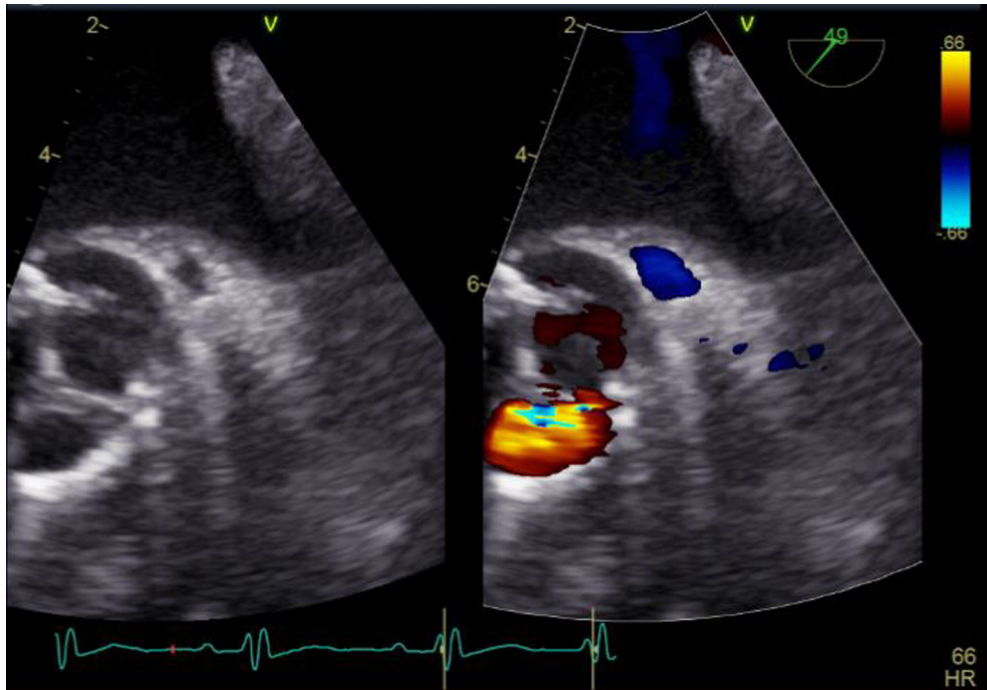


Figure 4 Transesophageal echocardiographic image of prosthetic aortic valve. Short-axis view depicting the aortic valve (*left*). Prosthetic valve regurgitation pertaining to particular valve seen on color Doppler (*right*).

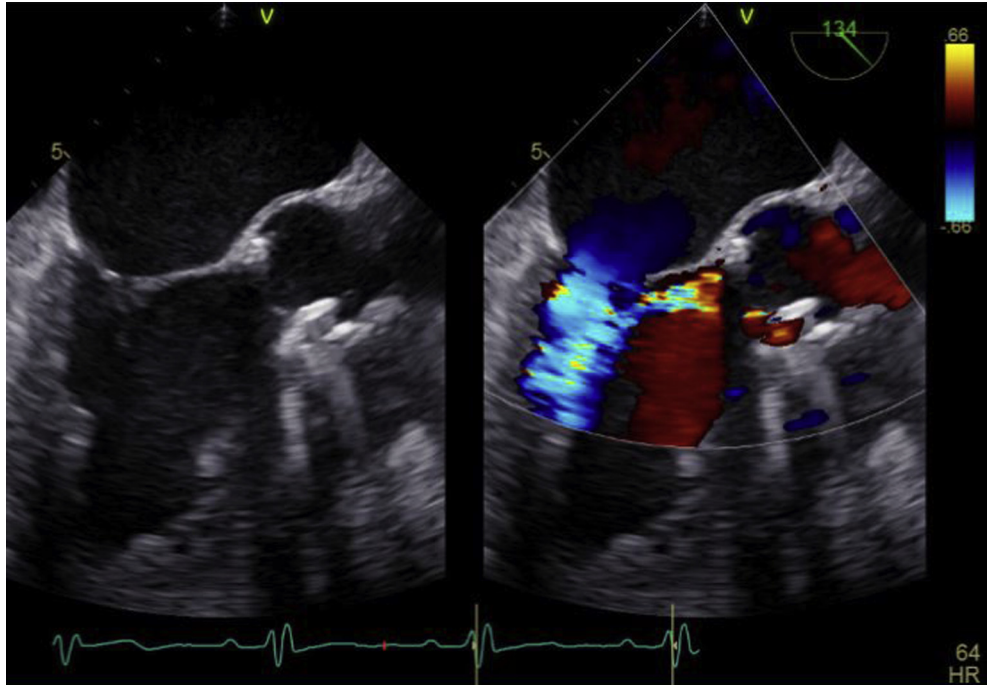


Figure 5 Midesophageal long-axis view of aortic valve and mitral valve. Diastolic eccentric regurgitant jet through left ventricular outflow tract preventing the opening of the anterior mitral valve leaflet.

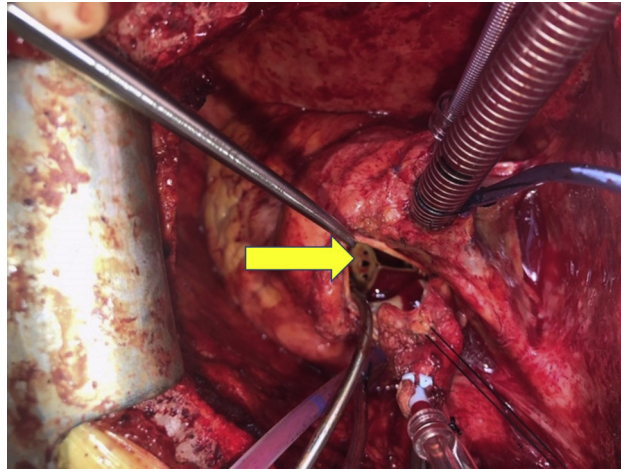


Figure 6 Intraoperative image of prosthetic aortic valve in situ. Three punctate defects (*solid yellow arrow*) seen in one of the prosthetic leaflets.

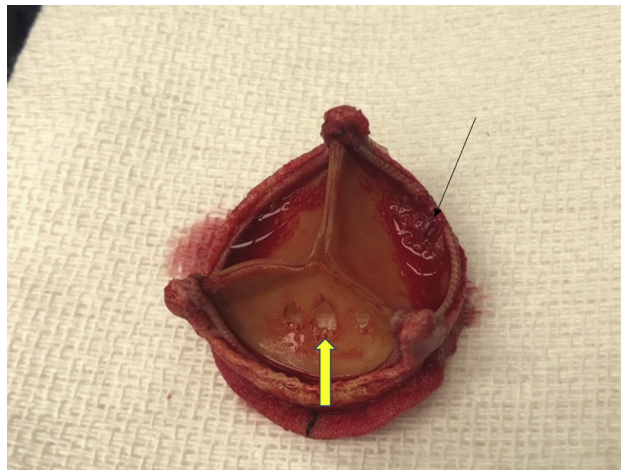


Figure 7 Explanted prosthetic aortic valve. Three perforations (*solid yellow arrow*) visualized on gross specimen of prosthetic aortic valve after surgical explantation. Traumatic damage seen in right upper leaflet (*black arrow*).

in a patient with a 21-mm St. Jude Trifecta prosthetic valve (St. Jude Medical, Minneapolis, MN). Brescia *et al.*¹⁰ reported on a 68-year-old man with aortic valve insufficiency due to initial orientation of the fasteners toward the center line of flow, which resulted in subsequent valve perforation. On the basis of our experience and other reports in the literature, medial orientation of the COR-KNOT sutures appears to be a significant risk factor for leaflet perforation and should be avoided. Brescia *et al.* also experienced a lower incidence of similar complications with a supra-annular rather than an intra-annular prosthesis during AVR.

COR-KNOT is also commonly used for minimally invasive mitral valve reconstruction. A retrospective analysis of 120 patients who underwent mitral valve repair revealed anterior leaflet perforation of the mitral valve in two patients after the use of COR-KNOT, resulting in moderate to severe mitral valve insufficiency requiring redo surgery. Angulation of the COR-KNOT suture and type of annuloplasty ring were identified as risk factors for perforation. In the two patients with mitral valve insufficiency after application of COR-KNOT, flexible tailor rings (St. Jude Medical, Little Canada, MN) were used.¹¹



Figure 8 Gross inspection of prosthetic aortic valve. Surgeon demonstrating three perforation defects in prosthetic aortic valve after surgical removal.

CONCLUSION

Automatic fastener devices have facilitated cardiac surgery by reducing aortic cross-clamp time and cardiopulmonary bypass time. Regardless, extreme caution and meticulous surgical techniques are essential to prevent complications such as valve perforation or damage and valve dysfunction and subsequent redo surgery. Medial orientation of COR-KNOT sutures must be avoided. Further studies are required to elucidate the safety of the COR-KNOT device during valve surgery.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.case.2020.06.008>.

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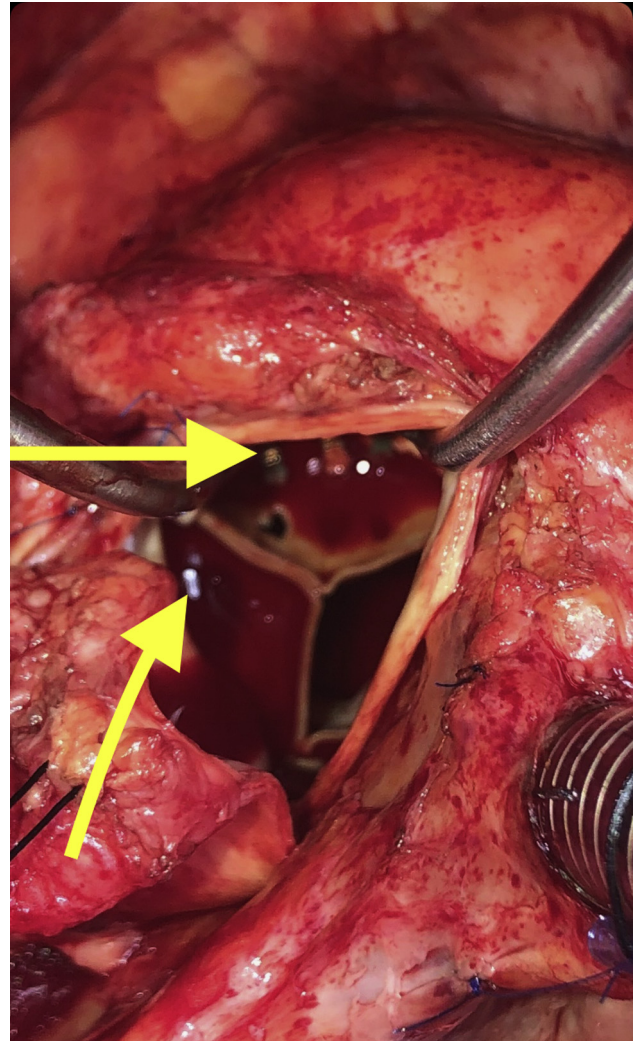


Figure 9 Intraoperative magnified image of prosthetic aortic valve with perforated defect and titanium clips (yellow arrow) placed using automated suture device, which damaged the prosthetic leaflet.

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