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CASE REPORT

CLINICAL CASE

# Hybrid Transcatheter Approach to an Iatrogenic Left Ventricle–Coronary Sinus Fistula

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## ABSTRACT

This clinical case describes a subacute presentation of decompensated heart failure secondary to an iatrogenic left ventricle–to–coronary sinus fistula after sequential mitral valve surgical procedures. Computed tomography was used to select an unconventional hybrid transapical access approach and facilitate successful closure using a vascular plug.


## HISTORY OF PRESENTATION

A 70-year-old woman was admitted to the hospital after a few days of generalized lethargy and weakness. She described a dry cough and NYHA functional class III symptoms, including reduced exercise tolerance, orthopnea, and paroxysmal nocturnal dyspnea.

## LEARNING OBJECTIVES

- To understand the risks and clinical presentation associated with the rarely described iatrogenic LV-CS fistula.
- To evaluate surgical and nonsurgical options before selecting transcatheter closure.
- To improve outcomes by integrating widely accessible cardiac imaging into the periprocedural planning of transcatheter closure.

## PAST MEDICAL HISTORY

The patient's history was significant for recent elective mitral valve replacement (MVR) for severe rheumatic mixed mitral valve disease with evolving pulmonary hypertension. A presurgical work-up showed preserved biventricular function, mildly elevated pulmonary pressures, and no significant coronary artery disease. The mitral valve was replaced with a 27-mm Epic bioprosthesis. This was complicated by moderate to severe paravalvular regurgitation. The patient underwent redo surgery with the same size and make of valve 2 weeks later. Intraoperative transesophageal echocardiography (TEE) during the second procedure confirmed no further paravalvular leak.

## DIFFERENTIAL DIAGNOSIS

The differential diagnoses for this subacute presentation of congestive heart failure must include those

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**ABBREVIATIONS AND ACRONYMS**

**CT** = computed tomography

**CS** = coronary sinus

**LV** = left ventricle

**MVR** = mitral valve replacement

**PA** = pulmonary artery

**TEE** = transesophageal echocardiography

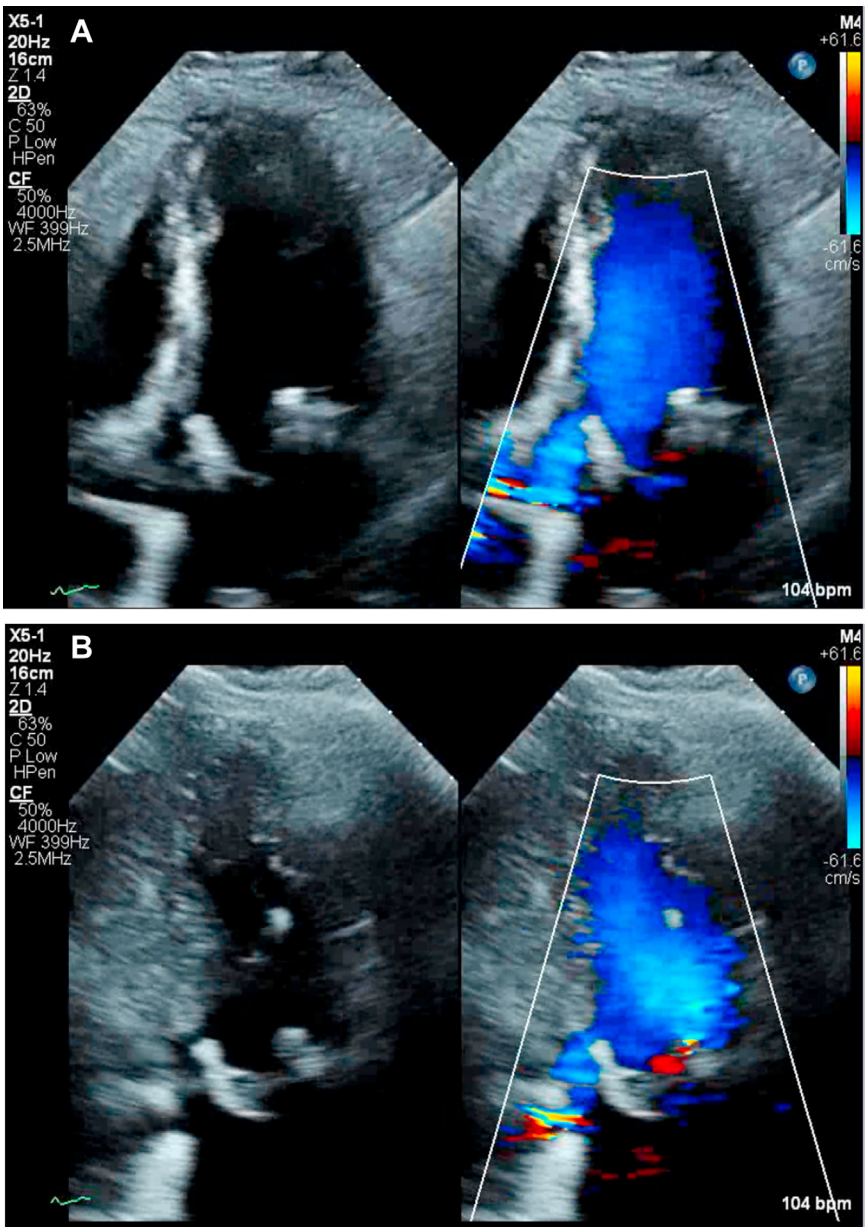
**TTE** = transthoracic echocardiography

conditions related to the patient's recent surgery. These include periprosthetic leak, bioprosthetic dysfunction (including patient prosthesis mismatch), arrhythmias, pericardial effusion, and intracardiac shunts.

## INVESTIGATIONS

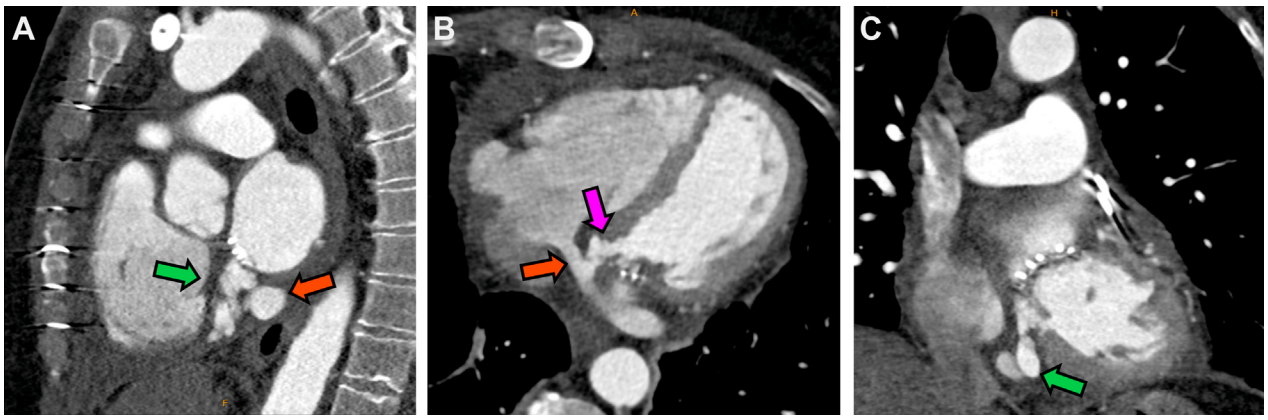
During this admission, transthoracic echocardiography (TTE) showed a dilated, severely dysfunctional right ventricle, elevated pulmonary artery (PA) systolic pressure of 60 mm Hg, and a nondilated, moderately impaired left ventricle (LV). There was a paravalvular jet that seemed to fistulize into the myocardium medially and posteriorly into the coronary sinus (CS) (**Figures 1A and 1B**, Videos 1A and 1B). Gated cardiac computed tomography (CT) showed an LV-to-CS fistula (**Figures 2A to 2C**).

**FIGURE 1 Preprocedure Transthoracic Echocardiography**




Apical (A) 4-chamber and (B) 2-chamber views demonstrating an echolucent space at the medial sewing ring of the bioprosthetic aortic valve. The associated paravalvular jet appears to fistulize into the myocardium medially and posteriorly into the coronary sinus.

**FIGURE 2** **Preprocedure Computed Tomography**




(A) Sagittal views showing the blind-ended dehiscence (green arrows in A and C). (B) Transverse views demonstrating the fistula tract (pink arrow in B) between the paravalvular apparatus and the coronary sinus (orange arrows in A and B). Septal shift toward the left ventricle suggests right-sided heart strain. (C) Coronal views demonstrating extension into the inferior atrioventricular groove.

## MANAGEMENT (MEDICAL/INTERVENTIONS)

This patient had an LV-to-CS fistula post-cardiac surgery with significant left-to-right shunting, leading to right ventricular dilatation and dysfunction with PA hypertension. The likely underlying pathology was ventricular dehiscence of the atrioventricular groove after multiple surgical procedures.

CT analysis demonstrated a 15-mm fistula with a wide 14-mm orifice at the LV end and a small, 3-mm orifice at the CS end. There was further blind-ended dehiscence from the midsegment of the fistula.

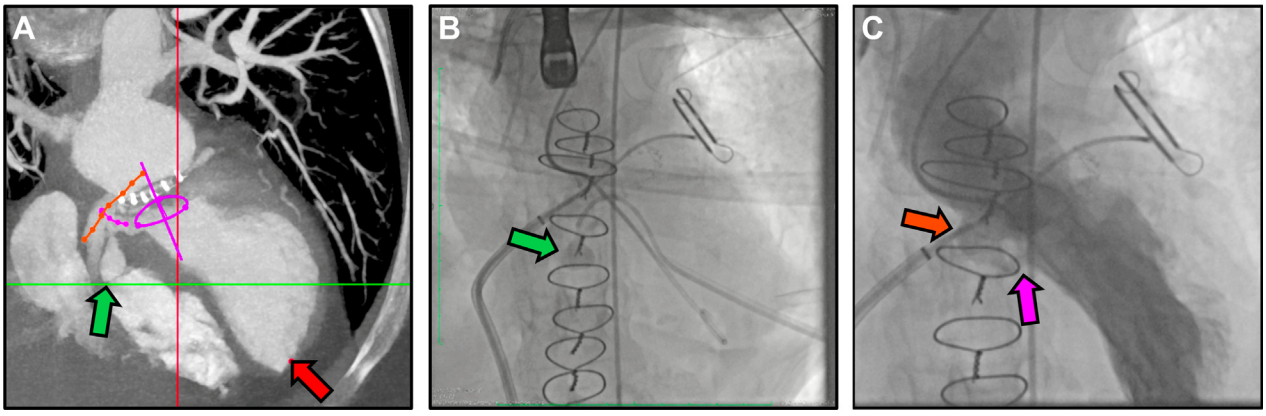
A multidisciplinary discussion involving the cardiology and cardiothoracic departments generated various ideas on interventional and noninterventional management strategies. The patient was deemed at prohibitive risk for a second redo surgery. Transcatheter options included fistula closure with a coil or vascular plug or covered stent deployment in the CS. A covered stent in the CS could potentially divert left ventricular pressure to the fistulous tract, including the blind-ended pouch, thus leading to further dehiscence. Fistula closure requires coaxial access to minimize the risk of the delivery system enlarging the tract given recent surgery. The most straightforward path was believed to be through apical access (**Figures 3A to 3C**). The decision was made to perform transcatheter closure through surgical apical access, as a hybrid procedure.

With the patient under general anesthesia, the procedure was performed with fluoroscopy and TEE guidance. A multiple purpose catheter was placed in the CS to mark the respective structure and to perform venography (Video 2). Similarly, a left ventricular catheter was placed with ventriculography assisting in confirming the fistula tract (Video 3). Transapical access was performed through a submammary small, non-rib-spreading thoracotomy; a 9-F sheath was inserted to the left ventricular apex with Seldinger cannulation. After characterizing the blind-ended dehiscence (Video 4A), the fistula was crossed with an angled glide wire through a 5-F multipurpose catheter (Video 4B). This procedure was performed using predetermined, CT-derived fluoroscopic views of the best orthogonal projection of the tract (**Figure 3C**). After wiring into the CS, the catheter was changed to a 6-F destination sheath (Video 5A), and a 12-mm Amplatzer Vascular Plug II (St Jude, Abbott) was deployed (Video 5B). Immediate left ventriculography confirmed a minor residual leak, with final views confirming complete occlusion (Videos 6A and 6B).

## DISCUSSION: ASSOCIATION WITH CURRENT GUIDELINES/POSITION PAPERS/CURRENT PRACTICE

Acquired LV-CS fistula is a rare complication of intracardiac procedures, with documented occurrences after MVR, myocardial infarction, and catheter ablation.[1-4] The risk of fistula formation after mitral valve surgery increases with the number of interventions, damage to the posterior ventricular wall, and excessive debridement of the mitral valve

**FIGURE 3 Computed Tomography Correlation With Fluoroscopy**




(A) Computed tomography reformat and (B and C) corresponding left ventriculograms characterizing the coronary sinus (orange line and arrows), mitral valve struts (purple lines), pseudoaneurysm (green arrow) and demonstrating the apical approach (red line) and orientation (right anterior oblique, 10°; cranial, 40°) to traverse the fistula (pink line and arrow).

annulus.[5] That last factor is particularly relevant in this patient with rheumatic valvular disease because intraoperatively, the degree of pannus and tissue friability around the annulus required significant debridement to allow adequate seating of the prostheses. Historically, reported acquired cases have been medically managed unless a patient was deemed fit enough for surgery.[5] Unfortunately, our patient was considered to be at high risk for surgical intervention because of the development of systolic biventricular failure along with elevated pulmonary pressures.

Percutaneous intervention has relatively recently become an option, with the first case published in 2015. It has been described only 3 times in the available literature, twice using a vascular plug, once with ventricular septal defect occluders, and all using access through the CS.[1-3] To our knowledge, this is the first case of an LV-CS fistula treated percutaneously through a hybrid transapical approach.

The case continues to add evidence to the feasibility of percutaneous closure of iatrogenic LV-CS fistulas and highlights the importance of cardiac CT, a widely available imaging modality. The anatomical dimensions and direction of the fistula characterized by CT were essential in offering the best chance of a successful outcome, by selecting the safest alternative access, sizing of the occluder device, and guiding the procedure by using predetermined fluoroscopy angles.

## FOLLOW-UP

TTE performed approximately 2 months post-procedurally showed complete resolution of left ventricular dilatation and systolic dysfunction. Right ventricular dysfunction was markedly improved, as were the PA pressures.

## CONCLUSIONS

LV-CS fistula is a rare but important complication of repeated mitral valvular surgical procedures. Percutaneous closure is a viable option in nonsurgical candidates; cardiac CT is essential in preprocedural planning and achieving successful outcomes.

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**KEY WORDS** acquired, imaging, percutaneous, plug, shunt, structural

**APPENDIX** For supplemental videos, please see the online version of this paper.