

## CASE REPORT

### CLINICAL CASE

# Hybrid Stenting of Pulmonary Venous Baffle Stenosis



## Subxiphoid Approach in Transposition of the Great Arteries

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### ABSTRACT

A 31-year-old woman with transposition of the great arteries status post-Senning operation presents with severe pulmonary venous baffle obstruction. Both standards of care (percutaneous stenting or open repair) were deemed suboptimal and/or high risk. A multidisciplinary, hybrid approach via subxiphoid incision, guided by 3-dimensional modeling, provided a lower risk and minimally invasive intervention. (J Am Coll Cardiol Case Rep 2024;29:102294)  
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### HISTORY OF PRESENTATION

We report on a 31-year-old woman with transposition of the great arteries (TGA) status post-Senning operation who was referred to our center after a 1-year history of progressive, severe dyspnea with light exertion, hemoptysis, and an unintentional 40-pound weight loss. On presentation, the patient's blood pressure was 93/64 mm Hg, pulse was 100 beats/min, respiratory rate was 23 breaths/min, and temperature

was normothermic. Her only notable finding on physical examination was her pale and lethargic appearance. Cardiac and thoracic examinations were normal.

### PAST MEDICAL HISTORY

In addition to TGA, the patient had a past medical history of fatigue, pulmonary hypertension, and pulmonary embolism.

### LEARNING OBJECTIVES

- To critically think about diverse therapeutic plans for cardiac patients with surgical complications who are not traditional candidates for standard of care therapy.
- To understand the importance of both cardiac interprofessional care as well as multi-modal imaging in adult congenital heart disease patients with complicated anatomy

### INVESTIGATIONS

Transesophageal echocardiography, cardiac magnetic resonance imaging, and diagnostic catheterization revealed severe pulmonary venous baffle obstruction with a gradient of 30 mm Hg, resulting in severe pulmonary hypertension and subpulmonary left ventricular (LV) dysfunction. On cardiac catheterization, she had suprasystemic LV pressure and pulmonary vascular resistance (PVR) of 27.2 WUs.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

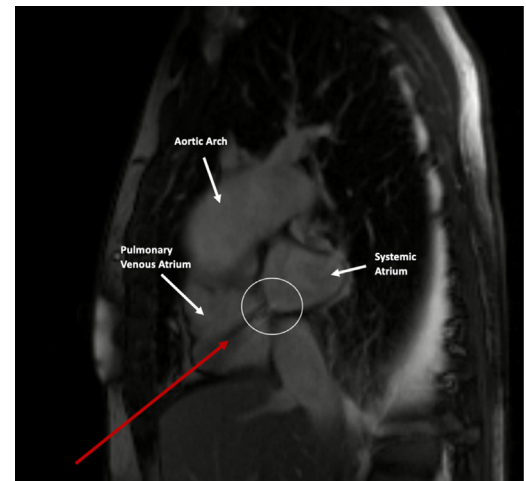
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**ABBREVIATIONS  
AND ACRONYMS****LV** = left ventricle/ventricular**PVR** = pulmonary vascular  
resistance**TGA** = transposition of the  
great arteries**MANAGEMENT**

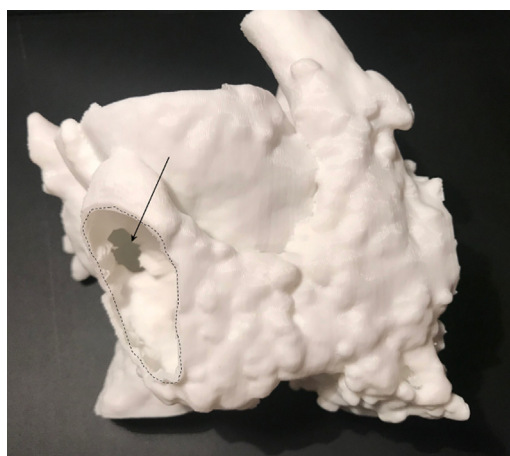
Intervention was performed with hybrid approach, using a 3-dimensional (3D) printed model as a guide (Figure 1), via subxiphoid incision with the sheath placed across the pulmonary venous baffle obstruction (Figure 2) by cardiothoracic surgery and the stent deployment by interventional cardiology. This resulted in complete relief of the obstruction. The surgical team conducted a partial lower sternotomy and gained visualization of the diaphragmatic surface of the heart and the pulmonary venous atrium. The interventional team placed a 12-F DrySeal sheath through a purse string suture. A Palmaz 3110 (Cordis) stent on a 20-mm BIB balloon was deployed across the stenosis under fluoroscopic and transesophageal echocardiography guidance. Postdilation and flaring of the stent ends was performed with a 25-mm Tyshak balloon. Postoperative imaging 2.5 years later showed continued freedom from obstruction (Figure 3).

**DISCUSSION**

To our knowledge, this is the first report of a subxiphoid approach, planned using multimodal imaging including 3D modeling, to relieve a baffle obstruction. TGA represents about 5% to 7% of all congenital heart disease diagnosed.<sup>1,2</sup> Atrial switch procedures, such as the Mustard and Senning operations, were utilized for palliation of patients with TGA before the advent

**FIGURE 2** Preoperative Cardiac Magnetic Resonance Image Demonstrating Surgical Approach

Labeled sagittal cardiac magnetic resonance image with white circle highlighting the site of the pulmonary venous baffle obstruction and red arrow simulating the course of sheath placement via subxiphoid approach. The abnormal pulmonary venous atrium and the systemic atrium are marked.

**FIGURE 1** 3-Dimensional Model of Baffle Obstruction

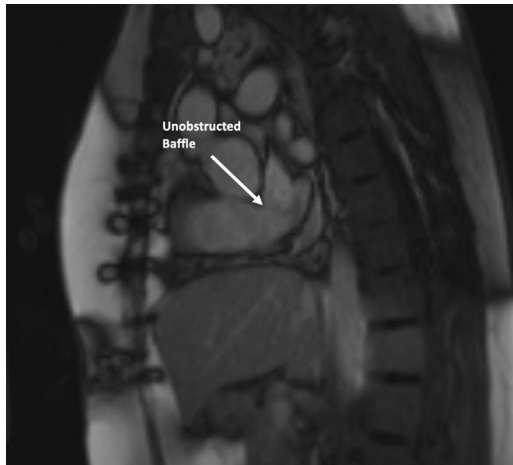
3-dimensional printed model with the anterior aspect of the right atrium cut away (dotted line) and arrow indicating pulmonary venous baffle obstruction.

of the arterial switch operation.<sup>3</sup> In these operations, the systemic venous blood is rerouted to the LV and the pulmonary venous blood is rerouted to the right ventricle. Patients who have undergone atrial switch procedures are prevalent in the adult congenital heart disease population, and complications of this management strategy are routinely seen.

Pulmonary venous baffle obstruction is a potential complication of the atrial switch.<sup>4,5</sup> Although not common, such a complication can greatly reduce functionality and quality of life while increasing rates of morbidity. Previous therapeutic options have included open surgical relief of the obstruction or catheter balloon dilation.<sup>6</sup> Additionally, there has been one previous report of a hybrid approach using surgical access for catheter placement, but the authors gained catheter access through a thoracotomy instead of by subxiphoid approach.<sup>7</sup> There has otherwise been no exploration of therapeutic options for patients in which neither a solely surgical or transcatheter approach is both safe and efficacious, nor on other hybrid approaches.

In this case, our team was faced with an operative dilemma. Given the challenging retrograde catheter pass necessary to access the pulmonary venous baffle, percutaneous stenting of the obstruction was suboptimal. Additionally, open repair with

**FIGURE 3** Cross-sectional Cardiac Magnetic Resonance Imaging, 2.5 Years Postoperative



Sagittal cardiac magnetic resonance image from 2.5 years following the operation, showing an unobstructed baffle.

cardiopulmonary bypass was deemed high risk because of severe pulmonary hypertension with subpulmonary LV dysfunction. Thus, a 3D-printed model ultimately guided a hybrid approach via sub-xiphoid incision. This allowed for lesser invasion, reduced sternal disruption, adequate visualization, and a theorized safer operation with reduced recovery time.

### FOLLOW-UP

Following the hybrid procedure, there was immediate improvement in hemodynamics after relief of the

obstruction: the subpulmonary ventricular pressure dropped to two-thirds systemic pressure and PVR decreased from 27.2 to 16.1 WU. The patient was discharged home the following day. At 6 months post-intervention, the patient underwent repeat catheterization, and PVR had normalized without pulmonary vasodilator therapy. At 18 months post-intervention, the patient has enjoyed sustained complete resolution of heart failure.

### CONCLUSIONS

We present the first case in the published reports that demonstrates the use of a hybrid approach through subxiphoid access to relieve pulmonary venous baffle obstruction. This case illustrates the benefit of a collaborative approach to a difficult complication in adult congenital heart disease. Careful anatomic assessment of the atrial baffles led to a proper diagnosis of the etiology of this patient's heart failure. The 3D modeling allowed for collaborative planning of a hybrid approach between interventional cardiology and cardiothoracic surgery. This therapeutic plan allowed for a lower-risk, minimally invasive intervention, which was technically successful, and resulted in incredible clinical improvement.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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**KEY WORDS** pediatric surgery, pulmonary hypertension, transposition of the great arteries, 3D modeling