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IMAGING

IMAGING VIGNETTE: CLINICAL VIGNETTE

Pulmonary Vein Stenosis After Single Lung Transplantation

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ABSTRACT

A 72-year-old man with interstitial lung disease underwent a planned single lung transplantation. His late postoperative course was notable for hemodynamic deterioration, after which severe right pulmonary vein anastomotic stenosis was identified via echocardiogram. The case highlights a rare complication of lung transplantation diagnosed by using transesophageal echocardiogram. (J Am Coll Cardiol Case Rep 2024;29:102275) © 2024 Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

A 72-year-old man with end-stage interstitial lung disease with autoimmune features underwent planned single right-lung transplantation, with single pulmonary vein (PV) common trunk anastomosis to the left atrium. The operation was supported by veno-arterial extracorporeal membranous oxygenation (ECMO) due to right ventricular (RV) dysfunction and mediastinal adhesions. PV anastomosis appeared normal on postoperative transesophageal echocardiogram (TEE) (**Figures 1A and 1B**).

ECMO decannulation and chest closure occurred on postoperative day 4, but hypercapnic and hypoxemic respiratory failure with worsening RV dysfunction followed. Veno-venous ECMO and a percutaneous RV assist device (ProtekDuo, LivaNova) were placed and later removed on postoperative day 14. However, the patient remained chronically critically ill with mild rejection, chronic respiratory failure, and recurrent aspiration pneumonia requiring tracheostomy, enteral nutrition, and renal replacement therapy.

After 5 months of gradual improvement, the patient's respiratory and hemodynamic status deteriorated, requiring epinephrine and high-dose norepinephrine; central venous pressure was 5 mm Hg. An echocardiogram showed normal left ventricular size and function, known RV dilatation and hypokinesis, and no valvular disease. A bedside right heart catheterization revealed right-sided pulmonary capillary wedge pressure (PCWP) of 40 mm Hg and a thermodilution cardiac index of 2.1 L/min/m^2. Unexpected PCWP elevation without left-sided heart disease raised suspicion for PV anastomotic stenosis.

TEE was performed on postoperative day 157. Right PV anastomosis appeared narrowed; PV color Doppler flow was turbulent with markedly increased velocity (3.5 m/s), and spectral Doppler waveform did not return to baseline (**Figures 1C and 1D**). Serial pulsed-wave Doppler showed an increase in PV velocity from 0.6 m/s at 15 mm from the PV-left atrium juncture, to 3.5 m/s at 8 mm. Left lung PV Doppler velocities were <0.5 m/s. These findings revealed severe PV stenosis.

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ABBREVIATIONS AND ACRONYMS

ECMO = extracorporeal membranous oxygenation

PCWP = pulmonary capillary wedge pressure

PV = pulmonary vein

RV = right ventricular

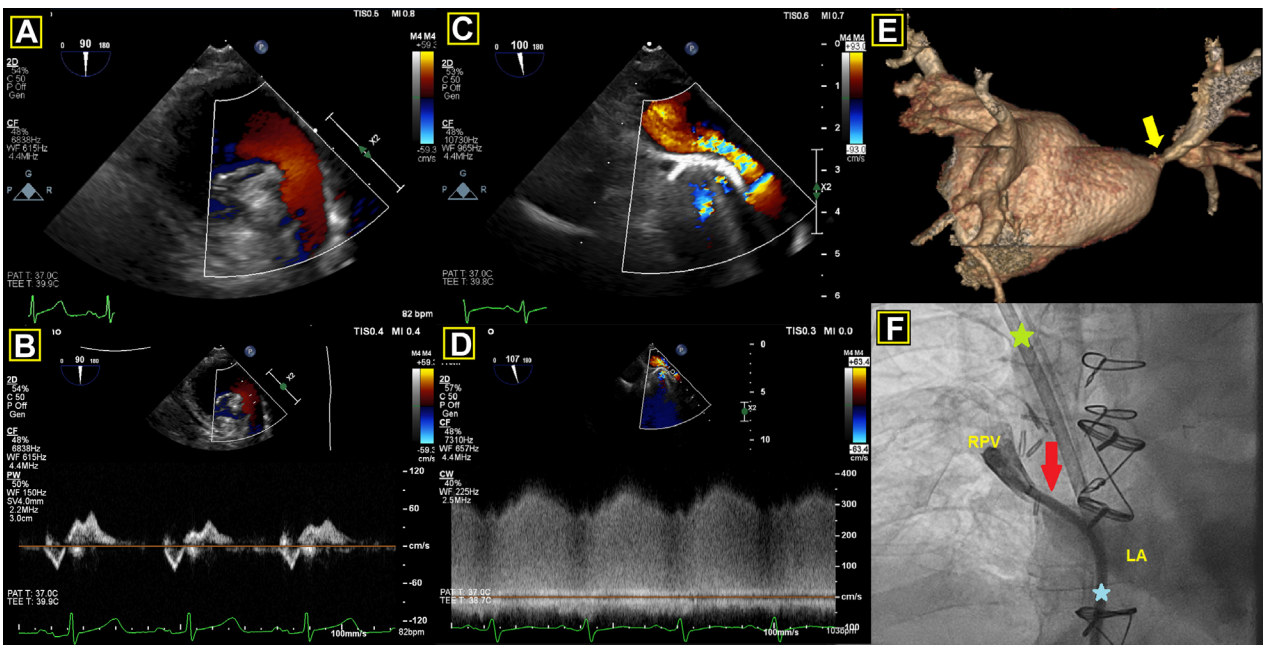
TEE = transesophageal echocardiogram

Gated computed tomography angiography performed for further anatomical delineation showed a 3 mm minimum diameter of PV anastomosis (Figure 1E).

PV catheterization via transeptal puncture revealed a gradient across the PV stenosis of 22 mm Hg (right PV pressure: 27 mm Hg; left atrial pressure: 5 mm Hg; Figure 1E), which was reduced to 4 mm Hg after implantation of a 10 × 29 mm Omnilink Elite bare metal stent (Abbott Vascular), with pre-balloon and post-balloon dilation (Armada balloon, Abbott Vascular). Inotropes were weaned poststenting day 1; vasopressors were weaned day 3.

PV stenosis remains a rare complication of lung transplantation, with current literature primarily built on case reports.[1] Late postoperative PV stenosis is often caused by anastomosis scar hyperplasia, which can be difficult to diagnose given the nonspecific signs that include pulmonary edema, respiratory failure, and hemodynamic instability.[2] Because PV stenosis raises lobar capillary pressures, this diagnosis should be strongly suspected if there are unexplained elevations in PCWP (as the catheter tip measures PV pressure). Echocardiographically, peak PV anastomosis Doppler flow velocity ≥1 m/s, with sustained elevations throughout the cardiac cycle, and turbulent color Doppler flow strongly suggest PV obstruction.[3] TEE is invaluable in evaluating posttransplant PV anastomosis and has been reported as the sole imaging tool for a number of post-transplant patients diagnosed with PV anastomosis dysfunction (either stenosis or thrombosis).[2] Our vignette reaffirms how TEE provides important functional information regarding PV stenosis after transplantation and may be particularly useful given the feasibility of bedside evaluation, especially for hemodynamically unstable patients.[1,2]

FIGURE 1 TEE and Computed Tomography Showing Severe Pulmonary Vein Stenosis After Single Right-Lung Transplantation



(A and B) Intraoperative transesophageal echocardiogram (TEE) findings immediately after lung transplantation. Color Doppler interrogation of the right pulmonary vein (RPV)-left atrium (LA) junction (A) show laminar flow through the vessel (inner diameter 9 mm), which reached a peak velocity, assessed by pulse wave Doppler, of velocity 0.5 m/s (B). (C and D) TEE images approximately 5 months after lung transplantation. Turbulent color Doppler flow through the RPV anastomosis indicates flow acceleration (C) was clearly observed on color Doppler evaluation; continuous wave Doppler examination revealed a significant increase in velocities across the RPV-LA junction (maximal velocity 3.5 m/s, peak gradient 50 mm Hg, and mean gradient 37 mm Hg across the cardiac cycle) and lack of return of the Doppler spectral signal to baseline (minimal velocity >2.5 m/s) (D). These findings suggest pulmonary venous obstruction. (E) Three-dimensional computed tomography reconstruction of the PV anatomy, viewed from the posterior aspect of the LA. A severe narrowing of the RPV anastomosis (yellow arrow) was anatomically confirmed. (F) Fluoroscopic imaging of the RPV-LA junction (8-F catheter: blue star). The red arrow shows a region of stenosis between the contrast-opacified areas of the RPV tree and the LA that does not appear wider than the 8-F outer diameter (2.7 mm); note for reference the 14-F dialysis catheter (green star), which would have an outer diameter of 4.7 mm.

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