

VASCULAR DISEASE

CASE REPORT: CLINICAL CASE

Dynamic Pulmonary Vein Stenosis After Left Pneumonectomy



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ABSTRACT

Pulmonary vein stenosis might be caused by mediastinal migration into the vacated pleural space after pneumonectomy. In a patient complaining of worsening dyspnea in the left lateral decubitus position after left pneumonectomy, transthoracic echocardiography during different postures revealed pulmonary vein stenosis that worsened in the left lateral position. (J Am Coll Cardiol Case Rep 2024;29:102284) © 2024 The Authors. 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 59-year-old woman was referred to our outpatient cardiology clinic because of experiencing dyspnea on exertion for 6 months. Dyspnea worsened in the left lateral decubitus position but not in other positions. The patient had gained 4 kg in the previous 6 months. Physical examination revealed the following: height, 160 cm; weight, 47 kg; body mass index, 18.4 kg/m²; blood pressure, 102/60 mm Hg; pulse, 68 beats/min and regular; and oxygen saturation, 98% on room air. Breath sounds were decreased in the left lung field. A

holosystolic Levine II/VI murmur was heard in the left anterior chest. There was no lower extremity edema.

MEDICAL HISTORY

At the age of 15 years, the patient had tuberculosis but was completely cured with medication. She underwent left pneumonectomy for left upper and lower lobe lung cancer 2.5 years before this presentation. The TNM stage was pT4N0M0. Transthoracic echocardiography (TTE) performed before pneumonectomy showed normal cardiac function. Chest computed tomography (CT) 1.5 years after pneumonectomy revealed compression of the right mainstem bronchus against the vertebral body, which was considered postpneumonectomy syndrome.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included congestive heart failure, postpneumonectomy syndrome, tricuspid regurgitation, and pulmonary vein stenosis (PVS).

LEARNING OBJECTIVES

- To understand that mediastinal deviation after total pulmonary resection can lead to intracardiac structural changes such as pulmonary vein stenosis and tricuspid regurgitation.
- To understand that transthoracic echocardiography performed in the position in which the patient describes experiencing symptoms may be useful.

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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****PVS** = pulmonary vein stenosis**TR** = tricuspid regurgitation**TTE** = transthoracic
echocardiography**INVESTIGATIONS**

Chest radiography showed mediastinal deviation to the left and right lung distension (Figure 1). Chest CT revealed a mediastinal shift toward the left vacated pleural space and compression of the right bronchus against the vertebral body (Figure 2). In the left lateral decubitus position during TTE, flow in the right upper pulmonary vein was accelerated, reaching 1.8 m/s (Figure 3A, Video 1). The velocity decreased to 1.1 m/s in the right lateral decubitus position (Figure 3B). Severe tricuspid regurgitation (TR) was also observed, which might have been caused by the annular dilatation and leaflet displacement associated with excessive displacement of the heart into the left pleural space (Video 2). Her left ventricular systolic function was normal. In both lateral decubitus positions, TR severity was the same (Figures 4A and 4B), and peak TR velocity was 2.9 m/s (Figures 4C and 4D).

Although there were no significant decreases in peripheral capillary oxygen saturation, she described experiencing dyspnea only in the left lateral decubitus position.

MANAGEMENT

According to a systematic review, mediastinal repositioning using prostheses or tissue expanders is a viable treatment option for patients with PVS after pneumonectomy. Short-term follow-up showed that 75.3% of patients had no complications.¹ Percutaneous pulmonary vein stenting may be another treatment option; it has often been performed in patients with PVS caused by pulmonary vein isolation for atrial fibrillation.² However, to the best of our research, there have been no reports of percutaneous intervention for PVS after pneumonectomy. In this case, the transeptal puncture required for percutaneous intervention was expected to be particularly difficult because of the curvature of the inferior vena cava into the right atrium. Given that this patient did not have severe symptoms and an additional tumor was found in the right lung, chemotherapy was administered without PVS intervention.

DISCUSSION

Postpneumonectomy syndrome is a rare complication that can result in compression of the mainstem bronchi caused by excessive mediastinal shift.¹ However, in this case, the patient's symptoms may not have been entirely due to bronchial compression, inasmuch as bronchial stenosis was observed on CT at least 1 year before the onset of her symptoms. In addition, the left lateral decubitus position is unlikely to exacerbate mainstem bronchial compression. Some studies have reported that PVS caused by compression against vertebral bodies or the aorta after pneumonectomy may also cause symptoms.^{3,4} CT or magnetic resonance imaging with calculation of the luminal diameter is commonly used to diagnose PVS.⁵ Although there is no standard definition of PVS based on echocardiography, peak flow velocity ≥ 1.1 m/s is considered a significant value based on the published data.⁶ In addition to narrowing of both right pulmonary veins observed on CT with a peak velocity of ≥ 1.1 m/s, the velocity increased to 1.8 m/s when this patient came into the left lateral decubitus position. Therefore, it is natural that the patient's symptoms seemed to be related to PVS. PVS can be estimated with TTE in some cases. Furthermore, Partington et al⁷ found that PVS worsened in the standing and the left lateral decubitus positions on TTE in a patient who

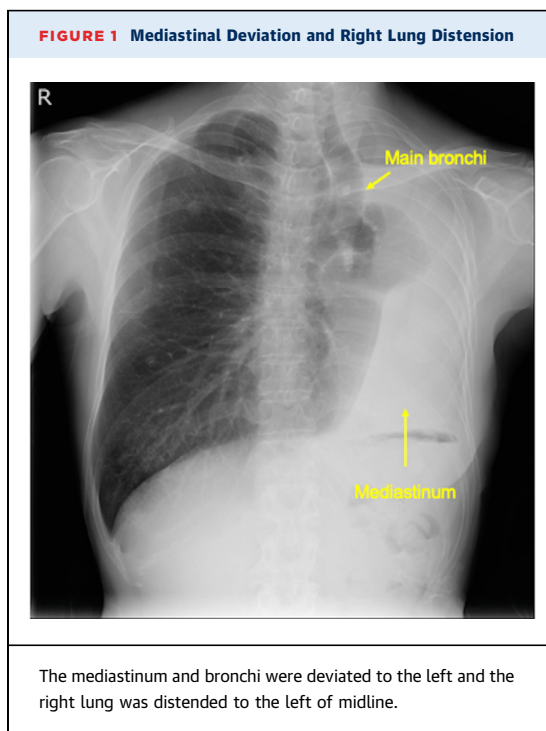
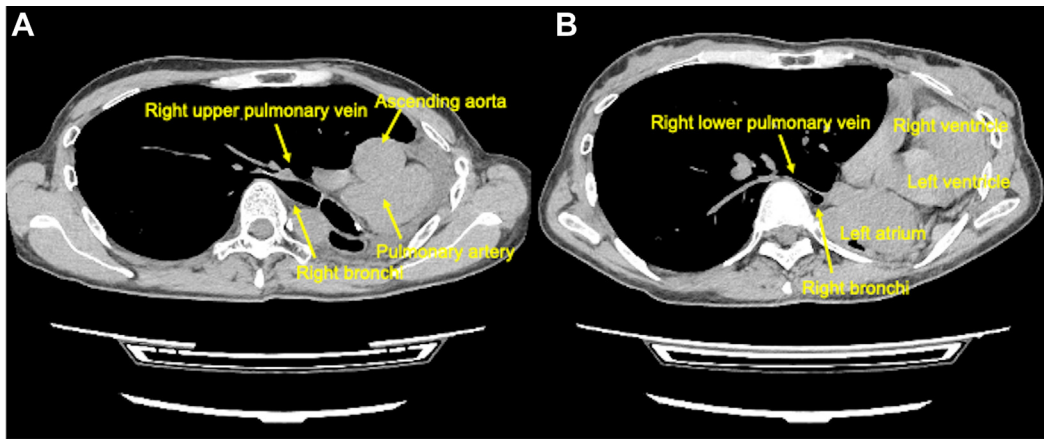


FIGURE 2 Compression of the Right Mainstem Bronchi



The mediastinum was shifted posteriorly to the left. The right bronchial trunk and the right upper (A) and lower (B) pulmonary veins were compressed and narrowed by a vertebral body.

underwent left pneumonectomy. In our case, PVS after pneumonectomy appeared to be the cause of symptoms because they worsened in the left lateral decubitus position. Although TTE showed severe TR, which might have been due to annular dilatation after pneumonectomy,⁸ TR did not worsen in the left lateral decubitus position. Therefore, PVS is considered to be a major cause of postural dyspnea after pneumonectomy. TTE with postural changes may be useful for the diagnosis of postural dyspnea after pneumonectomy.

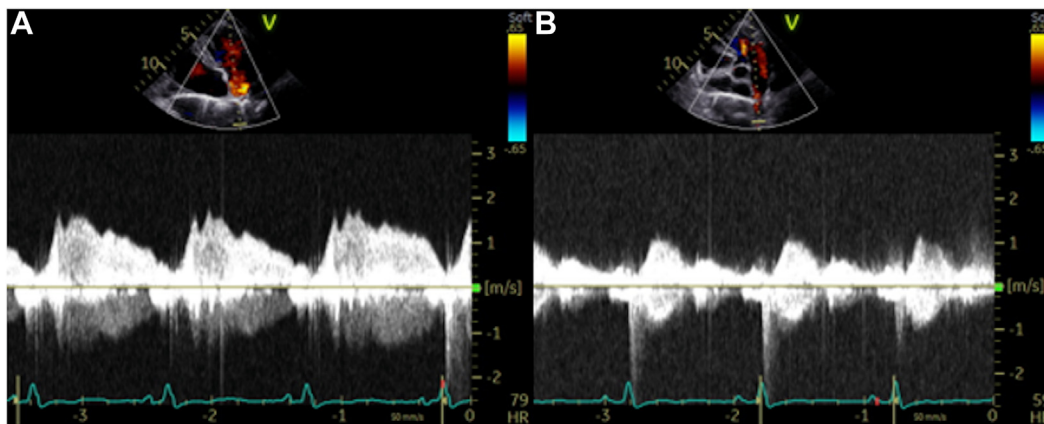
FOLLOW-UP

There has been no worsening of symptoms. Echocardiography has shown no significant changes.

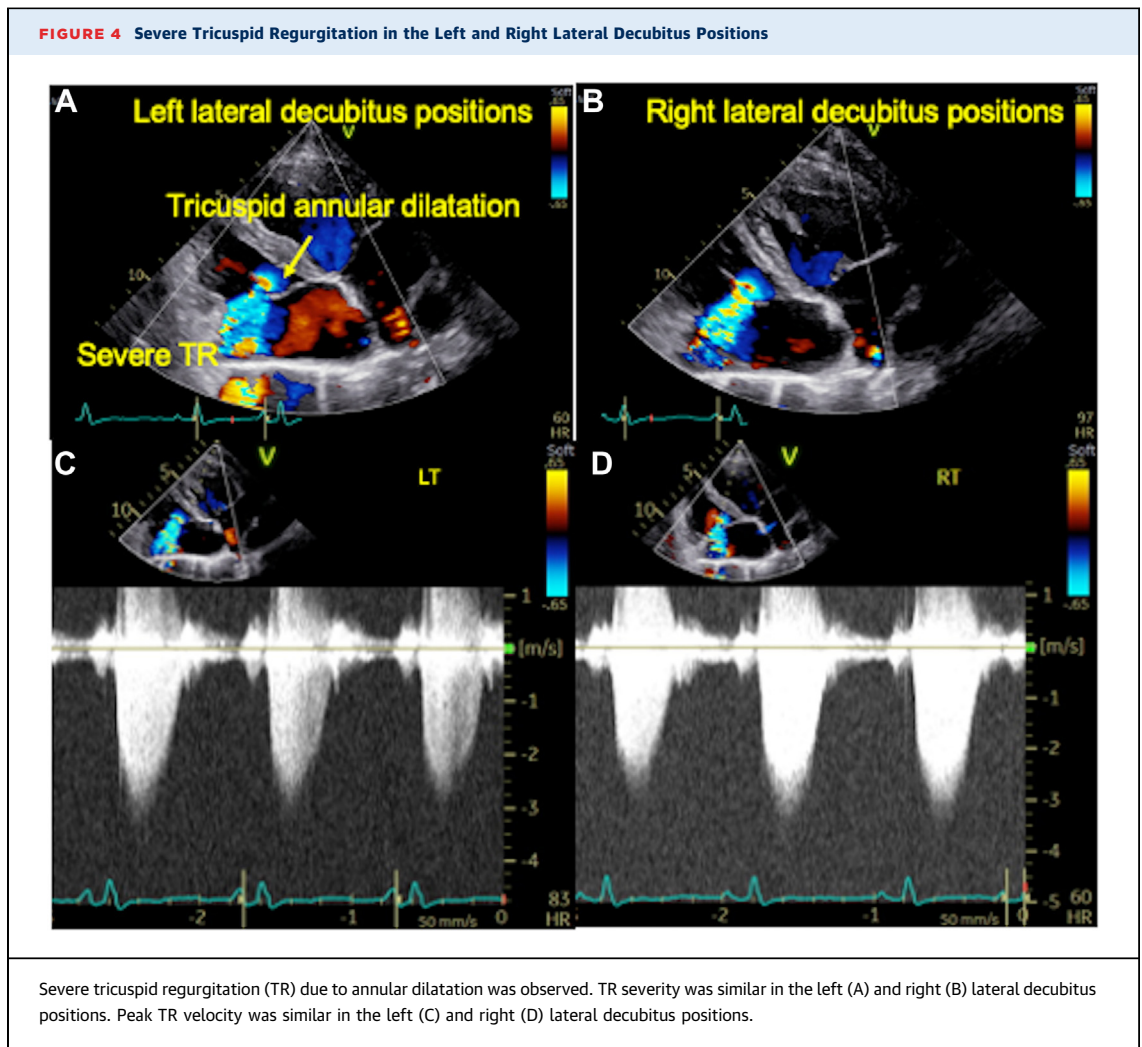
CONCLUSIONS

PVS can be identified as a potential symptom of postpneumonectomy syndrome. TTE with postural changes can be helpful in the diagnosis of post-pneumonectomy PVS.

FIGURE 3 Pulmonary Vein Stenosis Worsened in Left Lateral Decubitus Position



The peak velocity in the right pulmonary vein was 1.8 m/s in the left lateral decubitus position (A) and 1.1 m/s in the right lateral position (B).



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KEY WORDS acquired pulmonary vein stenosis, postpneumonectomy syndrome, tricuspid regurgitation

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