A 61-year-old man was evaluated for hypotension and bradycardia after undergoing a left pleural pericardial pneumonectomy via a left thoracotomy for malignant mesothelioma. Past history was significant for coronary disease status after drug-eluting stent to the midleft anterior descending coronary artery 1 year before, hyperlipidemia, 25 pack-year smoking history, and malignant mesothelioma stage III. After the procedure, the patient was extubated without incident. He became hypotensive and tachycardic, requiring phenylephrine, vasopressin, and norepinephrine infusions in anesthesia recovery. Troponin T was trended at 0.17 ng/mL (normal, <0.01 ng/mL), to 0.93 ng/mL (at 3 hours), and peaked at 1.3 ng/mL (at 6 hours). On physical examination, the second heart sound was normal, and no right ventricular (RV) lifts, murmurs, rubs, or clicks were present. A chest tube was present in the left mediastinal space.

ECG demonstrated sinus tachycardia at a ventricular rate of 104 beats per minute, right axis deviation, and SIQIIITIII pattern (Figure 1), which were new findings compared with the previous ECG. Lower extremity ultrasound was negative for deep venous thrombosis. Transthoracic echocardiogram illustrated a left ventricular ejection fraction of 70%, septal flattening during systole and diastole, an estimated RV systolic pressure of 54 mmHg with severe tricuspid regurgitation secondary to severe annular dilatation, and severe RV enlargement with diminished RV systolic function. Repeat echocardiogram 12 hours later demonstrated further RV enlargement with worsening systolic function.

The patient experienced recurrent hypotension and became unresponsive. Because of concerns for postoperative pulmonary embolism, an emergent chest computed tomography was performed and demonstrated left-sided cardiac herniation posteriorly through the left pericardiectomy with a cephalad rim of pericardium causing extrinsic compression and supravalvular narrowing of the main pulmonary artery with a cross-sectional diameter of 5×8 mm and no filling defects (Figures 2 and 3 and Movie I in the online-only Data Supplement). The patient was taken to the operating room emergently, and redo thoracotomy revealed partial left cardiac herniation through the left-sided pericardiectomy with pericardial rim compressing the right pulmonary artery. The heart was repositioned within the mediastinum, and pericardial mesh placement closed the left-sided pericardiectomy to prevent subsequent malposition (Figures 4 through 6).

Cardiac herniation is a rare but potentially lethal complication of right or left pneumonectomy. The herniation occurs through a pericardial defect and occurs most commonly after right pneumonectomy but can also result after left-sided pneumonectomy, as in the current case. Approximately 60 or more cases have subsequently been reported since 1948. Because of the rarity of the complication, estimated incidence is unknown after pneumonectomy. However, the incidence after extrapleural pneumonectomy is 3%. Right-sided herniation results in cardiac rotation and compression of the superior and inferior vena cava. Diminished venous return and cardiac output result in hypotension and reflex tachycardia. Less commonly, left-sided herniation results in torsion of the great vessels with outflow tract obstruction and coronary artery impingement with ischemia and ventricular arrhythmias. Mortality rate is quoted at 50% but approaches 100% without early detection and surgical intervention. Clues of herniation include axis change on ECG, cardiac malrotation on echocardiogram, and hemodynamic collapse after pneumonectomy, but diagnosis requires a high degree of suspicion.

Although rare, cardiac herniation is a potentially life-threatening complication of pneumonectomy. In the present case, compression of the right pulmonary artery resulted in supravalvular obstruction, acute RV failure, and hemodynamic collapse mimicking a pulmonary embolism. The condition was not recognized on chest radiography or transthoracic
echocardiography. If not immediately fatal, the condition resolves with surgical revision and pericardial patch placement to prevent recurrent herniation.

**Disclosures**

None.

**References**


**Figure 1.** Twelve-lead ECG immediately postoperative demonstrating sinus tachycardia, new right axis deviation (QRS 107°), and new S_{VI}, Q_{VII}, T_{VI} pattern.

**Figure 2.** Chest computed tomography coronal view demonstrating left-sided cardiac herniation with proximal right pulmonary artery compression from a cephalad rim of pericardium. Ao indicates aortic arch; AoV, aortic valve; RPA, right pulmonary artery; and RV, right ventricle.
Figure 3. Chest computed tomography 3-dimensional reconstruction illustrating the focal narrowing of the proximal right pulmonary artery.

Figure 4. A, Chest computed tomography 3-dimensional reconstruction demonstrating focal narrowing of the right pulmonary artery with left-sided cardiac herniation. B, Chest computed tomography 3-dimensional reconstruction demonstrating resolution of the right pulmonary artery narrowing after cardiac repositioning and pericardial mesh placement. Ao indicates aortic arch; AoV, aortic valve; PV, pulmonary valve; RPA, right pulmonary artery; and RV, right ventricle.

Figure 5. Chest computed tomography axial views demonstrating (A) left-sided cardiac herniation with extrinsic compression of the right pulmonary artery and (B) resolution of the right pulmonary artery narrowing after cardiac repositioning and pericardial mesh placement on the left side. Ao indicates ascending aorta; AoV, aortic valve; DAO, descending thoracic aorta; PV, pulmonary valve; RPA, right pulmonary artery; RV, right ventricle; and SVC, superior vena cava.
Figure 6. Chest computed tomography illustrating (A) left-sided cardiac herniation into the left mediastinum and (B) resolution of the left-sided cardiac herniation after cardiac repositioning and pericardial mesh placement. DAO indicates descending thoracic aorta; LV, left ventricle; RA, right atrium; and RV, right ventricle.
Twist and Shout: Acute Right Ventricular Failure Secondary to Cardiac Herniation and Pulmonary Artery Compression

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**Movie Legend:**

**Movie 1.** Chest computed tomography video demonstrating left-sided cardiac herniation with proximal right pulmonary artery compression from a cephalad rim of pericardium. Best viewed with Windows Media Player.