cases the false aneurysms arose from the anterior and anteroapical regions. One case involved the inferior wall. In the present case the aneurysmal complex arose from the posterobasilar wall. The clinical presentations varied from asymptomatic or incidental findings to progressive heart failure to frank cardiac tamponade.

Diagnosis of the pseudoaneurysms may be made by angiography, computed tomography, magnetic resonance imaging, or two-dimensional echocardiography [7]. In our case the left ventriculography and transthoracic echocardiography did not show any evidence of pseudoaneurysm. However, transesophageal echocardiography clearly demonstrated the presence of a pseudoaneurysm arising from a true left ventricular aneurysm. The appearance of a new systolic ejection murmur at the apex in the absence of a ventricular septal defect or significant mitral regurgitation is an interesting finding. The systolic murmur arising from the blood flow through the neck of a left ventricular pseudoaneurysm has been well described. However, without left ventriculography or transesophageal echocardiography it would probably be impossible to be certain that a systolic murmur in a patient with a ventricular aneurysm was not caused by mitral regurgitation associated with the ventricular dilatation that occurs in the presence of a large true aneurysm [4].

Occasionally these two types of ventricular aneurysms may coexist and pose diagnostic difficulties. Because of the propensity for pseudoaneurysmal rupture, an accurate diagnosis is paramount. Therefore, awareness and vigilance are important for successful surgical resection and repair.

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References

Postpneumonectomy Interatrial Right-to-Left Shunt: Successful Percutaneous Treatment
François Godart, MD, Henri L. Porte, MD, Christian Rey, MD, Jean-Marc Lablanche, MD, and Alain Wurtz, MD
Hôpital Cardiologique and Clinique Chirurgicale, Hôpital Calmette. Centre Hospitalier Régional Universitaire de Lille, Lille, France

This report describes the case of a 67-year-old man in whom atrial right-to-left shunt developed after a right pneumonectomy, leading to dyspnea with severe arterial desaturation. Transcatheter occlusion of the patent foramen ovale was successfully performed using a buttoned device. Review of literature and mechanisms of these atrial right-to-left shunts are discussed.


Shortness of breath with severe hypoxemia after pneumonectomy is a common finding with multiple causes. The current report presents this complication after a right pneumonectomy due to a right-to-left shunt through a patent foramen ovale (PFO) successfully treated by transcatheter occlusion.

A 67-year-old man was referred to our hospital for a squamous cell carcinoma (classified T4 N0 M0) of the right main bronchus involving the trachea. After neoadjuvant chemotherapy, he underwent a right sleeve pneumonectomy and was immediately extubated.

Two days after the operation, acute dyspnea developed with variable hypoxemia requiring oxygen support with no postural changes. Physical examination revealed a pulse rate of 90 beats/min, a blood pressure of 130/80 mm Hg, and respiration rate of 25 per minute. The thorax examination revealed dullness over the right hemithorax and normal breath sounds. The heart sounds and the electrocardiogram were normal. Chest radiography showed a mediastinal shift to the right and a clear

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Address reprint requests to Dr Godart, Service des Maladies Cardiovasculaires Infantiles et Congénitales, Hôpital Cardiologique, Centre Hospitalier Régional et Universitaire de Lille, 59037 Lille cedex, France.
left-lung field. Severe hypoxemia was noticed on 8 L/min of oxygen delivered by nasal canula (oxygen partial pressure of 53 mm Hg, saturation 87%). Arterial blood gas determination on inspired oxygen concentration of 100% showed a mild increase (oxygen partial pressure of 85 mm Hg, saturation 96%). Spiral computed tomographic angiography of the pulmonary artery revealed an early aortic opacification but no evidence of left-pulmonary embolism. Thus, interatrial shunting was suspected and confirmed by transoesophageal echocardiography.

Cardiac catheterization was performed under local anesthesia on the ninth postoperative day with the patient receiving 6 L/min of oxygen. Contrast material injection in the inferior vena cava showed right atrial opacification with shunting of contrast material into the left atrium through a PFO 10 mm in diameter. The atrial septum was displaced horizontally (the angle with the horizontal axis was 23 degrees) (Fig 1). The pressures were as follows: right atrium, had a pressure of 6/3 (mean, 4 mm Hg); left atrium, 8/0 (mean, 4 mm Hg); and right ventricle, 28/0 mm Hg. The oxygen saturation was decreased in the left atrium (89%) whereas a normal value was noticed in the left-upper pulmonary vein (saturation of 97.4%). Transcatheter occlusion of the PFO was performed with a modified buttoned device initially fashioned to occlude secundum atrial septal defect [1]. This modification included two occluding devices. The first occluder is a squared foam of polyurethane supported by an X-shaped wire skeleton deployed in the left atrium, and a second similar occluder is deployed in the right atrium to prevent right-to-left shunt. Both occluding devices are then buttoned together (Fig 2). After deployment of the first occluder, the arterial oxygen saturation rose to 94% and then to 99% after deployment of the second occluder. Fifteen minutes later on room air, the arterial saturation was 94%. The patient was discharged from the hospital while receiving oral anticoagulant treatment. Six months later, he remains asymptomatic with normal oxygen saturation (arterial saturation of 93% on room air) and contrast echocardiography reveals no interatrial residual shunt.

Comment

In 1956, Schnabel and associates [2] reported the first case of atrial right-to-left shunt after a right-sided pneumonectomy. This complication has sometimes been reported as platypnea-orthodeoxia syndrome, which is a relative uncommon diagnosis. This syndrome is characterized by dyspnea and arterial oxygen desaturation in the upright position that improve during recumbency. The Medline database up to October 1996 revealed 36 patients suffering from this complication after pulmonary resection [3, 4]. Such atrial right-to-left shunt is more frequent after a right-sided pneumonectomy (n = 23; 64%) than a left-sided one (n = 8; 22%) or a lobectomy (n = 5; 14%). There is usually a free period between operation and occurrence of dyspnea (mean 4 months), but in a few cases, immediate postoperative dyspnea was observed. The symptoms are classically posture dependent, ie, platypnea, but in our patient and a few other reports, no postural change was noticed. Thirty-one pa-
tients had a PFO and 5 had an atrial septal defect. Most of these patients (n = 27; 75%) underwent surgical closure of the PFO or atrial septal defect. Another patient was operated on but underwent heart replacement by peri-cardial reconstruction without PFO occlusion. Two patients died after operation: 1 of cerebral infarction and the second of septic shock. The 8 remaining patients were not operated on. One of them died of complications related to the interatrial right-to-left shunt. Three others were medically treated. In the 4 remaining patients, transcatheter occlusion of the PFO was performed using the clamshell occluder [5, 6].

The possible explanation for atrial right-to-left shunt is interatrial pressure gradient favoring right-to-left shunt either through a PFO or a small atrial septal defect. Due to increased right ventricle afterload after pulmonary resection, reversal of the normal mean interatrial pressure has been advocated. Such a gradient can be accentuated by inspiration, cough, and Valsalva maneuver. Nevertheless, reversal gradient is not always observed, but some reports show a mean right atrial pressure equal to or lower than the mean left atrial pressure, as observed in our patient. We believe that the modifications of anatomic relations between inferior vena cava and atrial septum are the determinant factor. The atrial septum was completely displaced toward the diaphragm. These modifications allow a complete streaming of the inferior vena caval blood flow through the PFO leading to cyanosis. This flow phenomenon seems essential in our experience and is clearly the consequence of lung resection with heart displacement.

Due to the prevalence of PFO in the general population (up to 25% to 27%), the interatrial right-to-left shunt may be underestimated in patients with dyspnea or hypoxemia after pneumonectomy. When it occurs, the first diagnosis to eliminate is pulmonary embolism. Then contrast two-dimensional echocardiography or transesophageal echocardiography is the most helpful procedure to detect PFO or atrial septal defect.

Most patients suffering from postpneumonectomy atrial right-to-left shunt are referred for surgical correction of the PFO. Transcatheter closure of the PFO or atrial septal defect appears as a good alternative to operation. It is an effective and safe method with a low procedural morbidity, especially in patients who recently underwent a pulmonary resection. Several devices are available for transcatheter occlusion of atrial septal defect. In our report, the buttoned device was employed successfully.

This case report illustrates that transcatheter therapy is the first-choice procedure in patients with dyspnea or hypoxemia due to interatrial right-to-left shunt after pneumonectomy.

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Anomalous Origin of Left Coronary From Right Pulmonary Artery in Hypoplastic Left Heart Syndrome

George E. Sarris, MD, Jonathan J. Drummond-Webb, MD, Makram R. Ebeid, MD, Larry A. Latson, MD, and Roger B. B. Mee, FRACS

Center for Pediatric and Congenital Heart Surgery, The Cleveland Clinic Foundation, Cleveland, Ohio

An infant with hypoplastic left heart syndrome presented for surgical repair at 9 months of age, the ductus having remained open in the presence of a restrictive atrial septal defect. In addition, an anomalous left coronary artery originating from the right pulmonary artery was found. After preliminary blade/balloon atrial septotomy, a successful modified Norwood procedure with concomitant reimplantation of the anomalous coronary artery was performed.

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Address reprint requests to Dr Sarris, Department of Pediatric and Congenital Heart Surgery, The Cleveland Clinic Foundation, 9500 Euclid Ave, Cleveland, OH 44195.