A Case of Isolated Peripheral Pulmonary Artery Branch Stenosis Associated with Multiple Pulmonary Artery Aneurysms

Hiroyuki Amano, Nobuhiro Tanabe, Seiichiro Sakao, Hideo Umekita, Toshihiko Sugiura, Satoru Kitazono, Miyako Kitazono, Fuminobu Kuroda, Yasunori Kasahara and Koichiro Tatsumi

Abstract

Selective right pulmonary arteriography and 3-dimensional computed tomography revealed multiple severe stenoses of the peripheral pulmonary artery associated with poststenotic aneurysms in a 65-year-old woman. She was referred to the hospital for evaluation of dry cough, gradually increasing dyspnea and multiple nodular shadows on a chest radiograph. Echocardiography and cardiac catheterization showed severe pulmonary hypertension, though other structural heart diseases or well-characterized congenital syndromes were ruled out. She was diagnosed as isolated peripheral pulmonary artery branch stenosis. Recent advances in CT technology enable a less-invasive assessment of pulmonary artery, and can be useful in the management of pulmonary arterial hypertension.

Key words: pulmonary artery stenosis, pulmonary hypertension, poststenotic aneurysm

(Inter Med 49: 1895-1899, 2010)  
(DOI: 10.2169/internalmedicine.49.3815)

Introduction

Peripheral pulmonary artery branch stenosis is defined as an obstruction of the pulmonary artery from the pulmonary trunk to the peripheral artery. The first case of peripheral pulmonary artery branch stenosis was reported by Oppenheimer in 1938 (1). The progressive development of right heart catheterization and selective angiography has increased the number of reported clinical cases. Although peripheral pulmonary stenosis in children has been well described as a part of systemic congenital disease (2), isolated peripheral pulmonary artery branch stenosis in adults is rare and may be frequently missed. Here, we present a case of isolated peripheral pulmonary artery branch stenosis associated with multiple pulmonary artery aneurysms, diagnosed using selective right pulmonary arteriography and 3-dimensional computed tomography (3DCT).

Case Report

A 65-year-old female complained of dry cough and gradually increasing dyspnea. Multiple nodular shadows were detected on a chest radiograph and she was referred to a hospital for evaluation. She had had an abnormal chest radiograph at routine examination over twenty years earlier, but that was only observed and left untreated at the time. Her vital signs were body temperature 36.2°C, blood pressure 122/64 mmHg and heart rate 84/min. A physical examination showed prominent pulmonary second heart sounds, a pulmonary vascular murmur that was loudest on the back and no edema. The laboratory findings showed elevated brain natriuretic peptide (BNP) of 66.7 pg/mL, D-dimer, protein C, protein S and anti-phospholipid antibody were negative. An electrocardiogram suggested right heart overload and right ventricle hypertrophy. Blood gas analysis...
Figure 1. Chest radiograph showed multiple nodular shadows in the right lung field.

in room air showed hypoxemia (PaO₂ 52.7 mmHg, PaCO₂ 37.9 mmHg). Her six-minute walk distance was 400 m.

A chest radiograph showed multiple nodular shadows in right lung field and cardiomegaly (Fig. 1). 3DCT showed multiple severe stenoses of the peripheral pulmonary artery associated with poststenotic aneurysms (Fig. 2). The perfusion scan showed a defect in the right upper lobe but no evidence of extrapulmonary trace uptake (Fig. 3). Right heart catheterization revealed a mean pulmonary artery pressure of 78 mmHg, a cardiac index of 2.86 L/min/m² and a pulmonary vascular resistance of 1,557 dyne·sec·cm⁻5. Selective right pulmonary arteriography revealed multiple severe stenoses of the peripheral pulmonary artery associated with poststenotic aneurysms. Selective left pulmonary arteriography revealed disruption in the upper lobe and a tortuous artery in the inferior lobe (Fig. 4). She was diagnosed as isolated multiple peripheral pulmonary artery branch stenosis, since congenital rubella syndrome, structural heart disease and systemic congenital disease were ruled out. She was treated with beraprost, warfarin and oxygen therapy, but beraprost was discontinued due to the side effects.

Five years later, she was admitted to the hospital for re-evaluation because of an elevated BNP level (164.9 pg/mL). Right heart catheterization revealed decreased cardiac output (3.75→3.16 L), pulmonary artery pressure (78→68 mmHg) and mixed venous oxygen tension (35.2→31.6 mmHg) and increased pulmonary vascular resistance (1,557→1,594 dyne·sec·cm⁻5) in comparison to the earlier examination, suggesting the development of right heart failure. 3DCT and pulmonary arteriography revealed slight enlargement of evident aneurysms in comparison to those in the earlier examination. Seven days after the oral administration of sildenafil, the estimated systolic pulmonary artery pressure was reduced (175 mmHg→145 mmHg) in echocardiography, although the six-minute walk distance remained unchanged.

**Discussion**

Peripheral pulmonary artery branch stenosis is defined as obstructions of the pulmonary artery from the pulmonary trunk to the peripheral artery. The etiology of pulmonary artery branch stenosis is undefined, but it is assumed to be congenital in origin because it often coincides with other embryological malformations (3). The pulmonary artery develops from four embryonal sacs, the bulbus cordis, truncus arteriosus, ventral portions of the sixth branchial arches and postbranchial pulmonary vascular plexus (branch pulmonary arteries). Most of the main or proximal segmental pulmonary artery branches are derived from the ventral portions of the sixth branchial arches. The peripheral type of pulmonary branch stenosis may be related to a developmental error of these lesions (4). In this case, 3DCT revealed the multiple peripheral stenosis involving many of the segmental pulmonary artery branches with no abnormality of the main pulmonary artery, indicating that this case could be classified as Class III by Gay et al (5). Congenital stenoses of the pulmonary artery and its branches are usually detected in early childhood and are often associated with other structural heart disease (teratology of Fallot, valvular pulmonary stenosis and various septal defects) or well characterized congenital syndromes (Williams syndrome, Alagille’s syndrome, Noonan’s syndrome, congenital rubella, Ehlers-Danlos syndrome), which usually account for the overall prognosis. McCue et al (6) reviewed 333 cases of pulmonary stenosis, including 224 (67%) with cardiac anomalies and 109 (33%) isolated types. In most cases, the main pulmonary arteries are involved (Class I or II by Gay) (5).
Figure 3. Perfusion scanning showed hypoperfusion in both lung fields and no evidence of extrapulmonary trace uptake.

Multiple peripheral stenosis of the segmental pulmonary artery branches alone (Class III as in the present case) or in conjunction with central stenosis (Class III) are rare (5). Moreover, the isolated type like our case in adult patients without a history of major cardiopulmonary symptoms is extremely rare. Only two comparable cases have been reported previously (7, 8). In contrast to our case, most congenital pulmonary artery stenoses are located in the main or proximal segmental pulmonary artery branches (2), and therefore may be treated successfully with surgery or balloon angioplasty (2, 5). Peripheral pulmonary artery branch stenosis, however, is usually not amenable to this therapeutic option.

The prevalence of isolated pulmonary artery branch stenosis is uncertain. Delaney et al (9) found only 4 cases among 3,250 right heart catheterization and described isolated pulmonary artery branch stenosis as a relatively rare disease. In general, patients are asymptomatic unless they have suprasystemic right ventricular pressure or associated cardiac disease, thus the prevalence of isolated pulmonary artery branch stenosis may be underestimated.

It was formerly thought that the definitive diagnosis of peripheral pulmonary artery branch stenosis could be attained only by adequate catheterization and angiographic studies (10). However, advances in CT technology enable a less-invasive assessment of the pulmonary artery. The obstructions of the pulmonary artery were clearly demonstrated by 3DCT in the current case, and this could be the first-line
diagnostic technique in patients with pulmonary artery stenosis. The multiple large post-stenotic aneurysms observed in the current case are also a rare radiographic finding.

Pulmonary angiography has been the mainstay of diagnosis in pulmonary arterial hypertension (PAH) for many years, but cross-sectional techniques, i.e., echocardiography and multislice computed tomography (CT), are rapidly taking over. For patients with PH but no evidence of cardiac disease, CT is the best step. CT distinguishes CTEPH from idiopathic PAH and evaluates underlying lung disease. Moreover, 3DCT that is suitable for serial examination more than CT may help identify rarer causes of PH like this disease. In comparison to pulmonary angiography, 3-DCT provides a vascular map with a three-dimensional view, showing luminal thrombi, organized mural thrombi, occlusions, webs, vascular wall abnormalities and stenosis (11). Moreover, it is noninvasive and a fraction of the price of conventional angiography. In addition to making a diagnosis of the disease, it provides monitoring of the multiple large post-stenotic aneurysms with more ease than conventional angiography.

In the diagnostic process of pulmonary artery stenosis, progressive dyspnea, pulmonary hypertension, and the finding of segmental lung perfusion defects with normal ventilation sometimes lead to the misdiagnosis of chronic thromboembolic disease (10). Therefore, careful examination of CT angiography, invasive pulmonary angiography and hemodynamic evaluation are essential, since some patients with chronic thromboembolic disease could be surgically treated. In the present case, although both CT and invasive angiography showed left upper pulmonary artery obstruction, thromboembolic findings were not observed and D-dimer was negative under no anti-coagulation therapy.

A pathologically narrowed pulmonary artery reveals various changes such as atheromata, fibrous intimal thickening and organized thrombi (3, 10). At the dilated portion showed variable loss of elastic fibers in the media either with or without proliferation of the intima.

Peripheral pulmonary artery branch stenosis has been a disease with limited treatment options. Stenoses distal to the hilum of the lung are difficult to reach surgically. Balloon dilatation is performed in several institutes as an alternative to surgical angioplasty (10-13). Rothman et al (13) reported 135 patients with peripheral pulmonary artery branch stenosis treated by balloon angioplasty procedures. They reported an overall success rate of 58% assessed by the following criteria: an increase $\geq$ 50% of the predilatation diameter, an increase $>20\%$ in flow to affected lung or a decrease $>20\%$ in the systolic right ventricular to aortic pressure. The complications of balloon angioplasty procedures are pulmonary artery perforation, pulmonary artery hemorrhage, pulmonary edema and pulmonary artery occlusion (10-13). Balloon angioplasty could not be performed in the current patient due to the risk of pulmonary artery rupture. No clinical treatment options have been proposed for peripheral pulmonary artery branch stenosis except for surgery and balloon angioplasty, and no standard medical therapy has been established. Sildenafil was administrated in this case because of the elevated BNP and decreased cardiac output. Two weeks of treatment decreased the estimated pulmonary artery pressure without side effects in this case. Sildenafil is a specific phosphodiesterase-5 inhibitor and has a demonstrated efficacy in idiopathic pulmonary artery hypertension (14). The efficacy of sildenafil has also been demonstrated for chronic thromboembolic pulmonary hypertension (15), although it is uncertain whether sildenafil could be an alternative treatment option for pulmonary hypertension with peripheral pulmonary artery branch stenosis. However, this requires further study.

Pulmonary artery stenosis should be included as differential diagnosis in cases with unexplained pulmonary hypertension. Peripheral pulmonary artery branch stenosis is still poorly understood and it requires further study for better therapeutic options to be developed. Moreover, recent advances in CT technology enable a less-invasive assessment.
of pulmonary artery, and could be useful in the management of pulmonary arterial hypertension.

References