The Value of Lung Perfused Blood Volume Computed Tomography in Selecting the Target Lesions for the Effective Treatment of Chronic Thromboembolic Pulmonary Hypertension

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Pulmonary endarterectomy is a conventional definitive therapeutic strategy for the treatment of chronic thromboembolic pulmonary hypertension. Several reports recently demonstrated that balloon pulmonary angioplasty (BPA) improves clinical status and hemodynamics in patients with chronic thromboembolic pulmonary hypertension. Because the success of reperfusion of occluded pulmonary vessels is considered to depend on the patency of the distal vessels via the systemic collateral circulation, the assessment of regional pulmonary perfusion is important for the selection of the candidates when performing either BPA or pulmonary endarterectomy. Lung perfusion scintigraphy cannot provide information regarding lung perfusion via the systemic collateral circulation. Lung perfused blood volume computed tomography (PBV-CT) is useful for the assessment of lung perfusion in occluded areas during the pulmonary arterial phase and the systemic arterial phase.

A 73-year-old man was referred to our hospital with progressive exertional dyspnea. He had declined pulmonary endarterectomy because his hemodynamics were not critically impaired. On echocardiography, right ventricular end-diastolic volume was 41 mL, and right ventricular ejection fraction was 65%. He had been treated with warfarin since the diagnosis of chronic thromboembolic pulmonary hypertension. Pulmonary angiography revealed complete obstruction in the middle lobe of the right lung (Figure, A and B). Right coronary angiography demonstrated collateral circulation to the right middle lobe via the conus branch (Figure, C and Movie I in the online-only Data Supplement). The balloon was inflated at the ostial lesion in the right middle lobe based on the findings of lung PBV-CT, as described below. Reperfusion was successful, including to the distal area, as expected (Figure, D and E in the online-only Data Supplement). This alleviated symptoms and improved exercise capacity. In addition, systolic pulmonary artery pressure decreased from 43 to 39 mmHg after BPA. The patient continued to take warfarin to keep his prothrombin time international normalized ratio between 2.0 and 3.0.

Before BPA, lung perfusion scintigraphy showed a wedge-shaped perfusion defect in the right middle lobe (Figure, F). Lung PBV-CT in the pulmonary arterial phase also revealed wedge-shaped areas of low attenuation in the right middle lobe (Figure, G). However, in the systemic arterial phase (Figure, H), the areas of low attenuation could not be visualized because of systemic collateral blood supply. After BPA, the perfusion defect on lung perfusion scintigraphy (Figure, I) recovered partially, and low-attenuation areas on lung PBV-CT (Figure, J) disappeared relative to those before BPA, with a slight resolution of low-attenuation areas in the systemic arterial phase (Figure, K).

Lung PBV-CT provides useful information regarding regional lung perfusion in the occluded area, including collateral circulation, and it enables easy and effective selection of the optimal lesion when performing BPA.

Disclosures
None.

References
Figure. A, Pulmonary angiography, frontal view, shows an avascular area in the right middle lobe (arrow). B, Pulmonary angiography in the left anterior oblique view shows complete obstruction of the pulmonary vessel in the right middle lobe (arrow). C, Right coronary angiography demonstrates collateral circulation to the right middle lobe via the conus branch. This collateral vessel disappears after balloon pulmonary angioplasty (BPA; arrow). D, Pulmonary angiography, frontal view, in the right middle lobe shows reperfusion after BPA. E, Pulmonary angiography in the left anterior oblique view after BPA. F, Lung perfusion scintigraphy, frontal view, shows a wedge-shaped perfusion defect in the right middle lobe (arrow). G, Lung perfused blood volume computed tomography (PBV-CT) image in the pulmonary arterial phase shows wedge-shaped areas of low attenuation in the right middle lobe (arrow). H, Lung PBV-CT in the systemic arterial phase shows smaller areas of low attenuation in contrast to the pulmonary arterial phases (arrow). I, A wedge-shaped perfusion defect on lung perfusion scintigraphy is seen to partially recover after BPA (arrow). J, Lung PBV-CT on pulmonary arterial phase shows reperfusion in the right middle lobe after BPA (arrow). K, Lung PBV-CT in the systemic arterial phase shows resolution of low-attenuation areas after BPA (arrow).
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