

IMAGES IN INTERVENTION

3-Dimensional SPECT/CT Fusion Imaging-Guided Balloon Pulmonary Angioplasty for Chronic Thromboembolic Pulmonary Hypertension



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A 45-year-old woman with chronic thromboembolic pulmonary hypertension was referred to our hospital for balloon pulmonary angioplasty (BPA). After a total of 4 sessions of BPA, the mean pulmonary arterial pressure decreased from 50 to 24 mm Hg. However, pulmonary vascular resistance remained high (4.0 Wood units) and the patient still had moderate dyspnea with exercise. Technetium-99m macroaggregated albumin lung perfusion single-photon emission computed tomography (SPECT) showed residual perfusion defects in parts of the right upper (A2), middle (A4), and lower (A9) lobar areas (Figure 1A, upper panel, red [A2], yellow [A4], and blue [A9] arrowheads). These culprit vessels had not been identified with conventional pulmonary angiography (Figure 1A, lower panel).

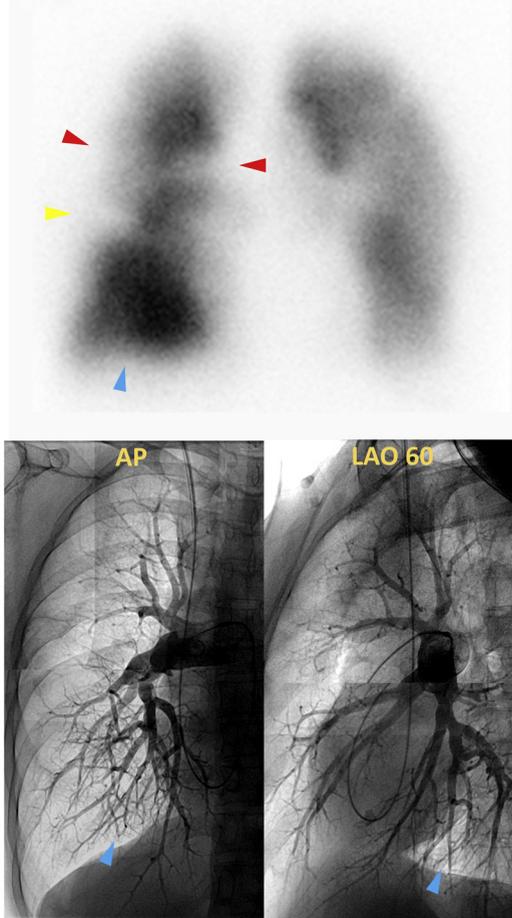
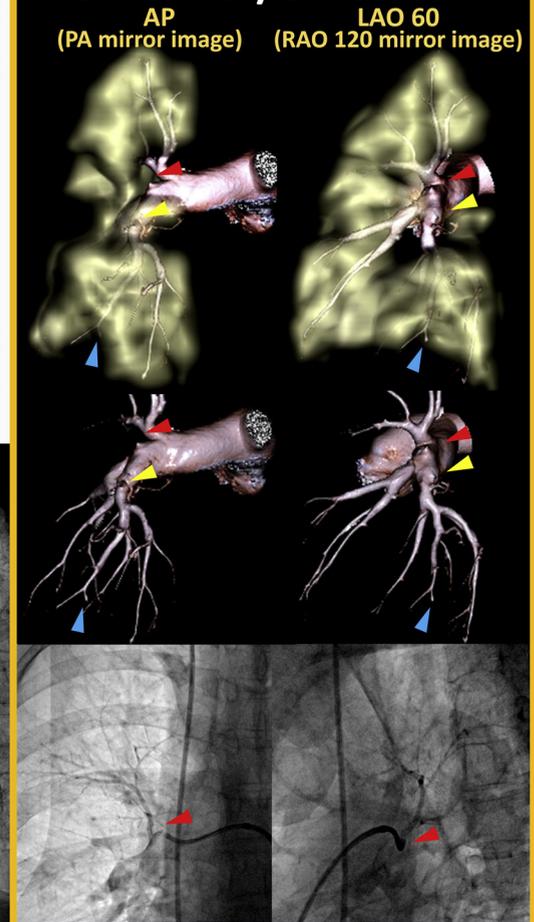
We performed a 3-dimensional (3D) reconstruction by conjoining lung perfusion SPECT and computed tomography (CT) angiography (Figure 1B, upper panel). The 3D SPECT/CT fusion imaging clearly revealed the 2 orifices of A2 and A4 to be nearly occluded, corresponding to perfusion defects (Figure 1B, upper panel, red [A2], yellow [A4], and blue [A9] arrowheads, Online Video 1). Following the 3D CT imaging, we successfully directed the guide catheter to the A2 orifice, and dilated the vessel with a 2.0 mm balloon (Figure 1B, lower panel, red arrowheads). An immediate reduction of pulmonary vascular resistance to 3.7 Wood units was noted at the end of the BPA. One month after the BPA, 6-min walk distance increased from 420 to 455 m without

dyspnea. BPA, an emerging treatment, has been widely adopted as a promising treatment for inoperable chronic thromboembolic pulmonary hypertension (1). No standardized imaging modality has been established in the preoperative setting. Lung perfusion SPECT, enhanced CT, and pulmonary angiography are usually all conducted. As the anatomy of the pulmonary arterial tree varies significantly in patients, pulmonary angiography is still considered essential. However, 3D CT angiography is frequently more helpful to find the ostium of totally occluded vessels because 3D CT angiography visualizes those lesions in any angle. Furthermore, superimposing the lung perfusion SPECT on the 3D CT angiography may clarify not only obstructive lesions but also hemodynamically significant web lesions that are often angiographically undetectable (peripheral A9 of this case, blue arrowheads). Although the use of several novel modalities such as cone beam CT (2) and 360° rotational pulmonary angiography (3) have been reported, these require special equipment and setup. 3D SPECT/CT fusion imaging requires no further imaging other than the usual data from the lung perfusion SPECT and the enhanced CT. Even if SPECT and CT angiography are conducted on different days, the data can be merged.

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FIGURE 1 Conventional Imaging Versus 3D SPECT/CT Fusion Imaging**A Conventional****B 3D-SPECT/CT fusion**

(A) Lung perfusion planar image (**upper panel**) and conventional pulmonary angiography (**lower panel**). **(B)** **Upper panel** demonstrates 3-dimensional (3D) fusion image described from lung perfusion single-photon emission computed tomography (SPECT) and computed tomography (CT) angiogram ([Online Video 1](#)). **Lower panel** shows selective angiography of right A2 vessel just after balloon dilatation. Three colors of **red, yellow, and blue arrowheads** indicate the culprit vessels of A2, A4, and A9 and the corresponding perfusion defects, respectively. AP = anteroposterior; LAO = left anterior oblique; PA = posteroanterior; RAO = right anterior oblique.

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KEY WORDS balloon pulmonary angioplasty, chronic thromboembolic pulmonary hypertension, computed tomography, fusion, lung perfusion

APPENDIX For a supplemental video and its legend, please see the online version of this article.