

Usefulness of Optical Coherence Tomography Imaging in Chronic Thromboembolic Pulmonary Hypertension

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Background: Chronic thromboembolic pulmonary hypertension (CTEPH) is caused by unresolved thromboemboli in the pulmonary arteries. Although pulmonary thromboendarterectomy is an established treatment for central-type CTEPH, this surgical treatment is not feasible for distal-type CTEPH. We have previously demonstrated the usefulness of optical coherence tomography (OCT) to diagnose distal-type CTEPH, which is an interferometer-based imaging modality to produce a 2-D image of optical scattering from internal tissue microstructures with a high resolution of approximately 10-20 μm . In the present study, in order to develop an effective and safe treatment for distal-type CTEPH, we examined the effectiveness of percutaneous transluminal pulmonary angioplasty (PTPA) combined with OCT evaluation.

Methods: From July 2009 to December 2013, we prospectively enrolled 48 consecutive patients with distal-type CTEPH, including 2 patients of post-thromboendarterectomy with residual PH (41 ± 11 [SD] yrs, 38 females and 10 male, WHO-functional class (WHO-FC) II in 10, III in 26 and IV in 12). After stabilizing their condition using conventional pulmonary vasodilators, we then performed PTPA. We carefully performed PTPA in a step-wise manner at an interval of 4-8 weeks until mean pulmonary artery pressure (PAP) became less than 30 mmHg.

Results: We performed OCT examination in order to observe the unresolved PA thromboemboli, which clearly showed flaps and meshwork. 3D-OCT imaging more clearly showed flaps and meshwork, indicating the usefulness of 3D-OCT for the diagnosis of CTEPH. Combined with conventional pulmonary vasodilator therapy, we performed PTPA in a step-wise manner (4.7 ± 2.3 procedures for 9.8 ± 3.8 lesions), which

resulted in significant additional improvement of mean PAP (35.9 ± 8.7 to 26.9 ± 5.7 mmHg, $P<0.01$) and pulmonary vascular resistance (558 ± 232 to 299 ± 110 dyn*sec*cm⁻⁵, $P<0.01$). OCT examination revealed that PTPA destroyed the typical flaps and webs in PA and shifted them to the pulmonary artery walls. Pulmonary angiography also showed that PTPA enlarged the lumen diameter ($55\pm 77\%$ increase), although some severe occlusions by thrombus were resistant to PTPA. The complication of PTPA was mild to moderate hemoptysis in 16 out of the 48 patients, which was successfully managed with oxygen and non-invasive positive pressure ventilation without intubation. Importantly, epoprostenol therapy was successfully terminated in 14 out of the 48 patients and no patient died during the mean follow-up periods of 22 months, resulting in the significant improvement of prognosis compared with the historical controls ($n=38$) ($P<0.05$).

Conclusion: PTPA combined with conventional vasodilator treatment markedly ameliorates pulmonary hemodynamics and prognosis of patients with distal-type CTEPH, in which OCT imaging is useful.

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