

Comprehensive evaluation of the effectiveness and safety of balloon pulmonary angioplasty for inoperable chronic thromboembolic pulmonary hypertension - long-term effects and complications

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Background and aims: Chronic thromboembolic pulmonary hypertension (CTEPH) is characterized by persistent pulmonary arterial obstruction due to organized thrombus and fibrous tissue. Although balloon pulmonary angioplasty (BPA) improves hemodynamics and short-term prognosis in patients with inoperable CTEPH, the long-term effects of BPA and procedure-related complications remain to be fully elucidated.

Methods: From July 2009 to October 2016, we performed a total of 424 BPA sessions in 84 consecutive patients with inoperable CTEPH. We used 3D reconstructed computed tomography to determine target lesions of pulmonary arteries and optical computed tomography to select balloon size, if needed. Before we started BPA treatment, all patients had been treated with appropriate combination therapy with vasodilators and warfarin. In 77 patients (92%) who completed the BPA treatment (65 ± 14 [SD] y.o., male/female 14/63), we examined hemodynamics parameters, exercise capacity and serum levels of brain natriuretic peptide (BNP) and compared the data before first BPA session and those at 6 months after last BPA session. Moreover, in 53 patients (63%), we examined the same parameters in the chronic phase (at the time of >12 months after last BPA sessions).

Results: Although medical treatment improved hemodynamics and exercise capacity, the BPA treatment significantly and additionally improved mean pulmonary arterial pressure (38 ± 10 to 25 ± 6 mmHg), pulmonary vascular resistance (7.3 ± 3.2 to 3.8 ± 1.0 Wood units) and 6-min walk distance (380 ± 138 to 486 ± 112 meters) (all $P < 0.01$), and the improvements persisted throughout the follow-up period (43 ± 27 months) ($N=53$) (Figure). To examine the BPA procedure-related complications, all 424 sessions in 84 patients were reviewed. Pulmonary arterial dissection and hemoptysis were noted in 30 (7%) and 60 sessions (14%), respectively. Hemoptysis was noted in 45 sessions during BPA procedures and in 15 sessions after the procedure. None of the patients with PA dissection needed any additional trans-catheter or surgical procedures or non-invasive positive pressure ventilation (NPPV). NPPV was used in 33 sessions (8%); 29 for hemoptysis, and 4 for segmental pulmonary edema. NPPV was used for hemostasis except for 4 cases with segmental pulmonary edema. Only one patient with hemoptysis subsequently required oral intubation and mechanical ventilation due to aspiration pneumonia. In all the remaining patients, NPPV effectively controlled hemoptysis and improved pulmonary edema. Furthermore, 5-year survival was 98.4% without peri-procedural death (only one patient died of colon cancer).

Conclusions: These results indicate that BPA improves hemodynamics and exercise capacity in inoperable CTEPH patients with acceptable complication rate and that the beneficial hemodynamic effects of BPA persist for years with resultant good long-term prognosis.

A (mmHg) **mPAP** **B** (L/min/m²) **CI**

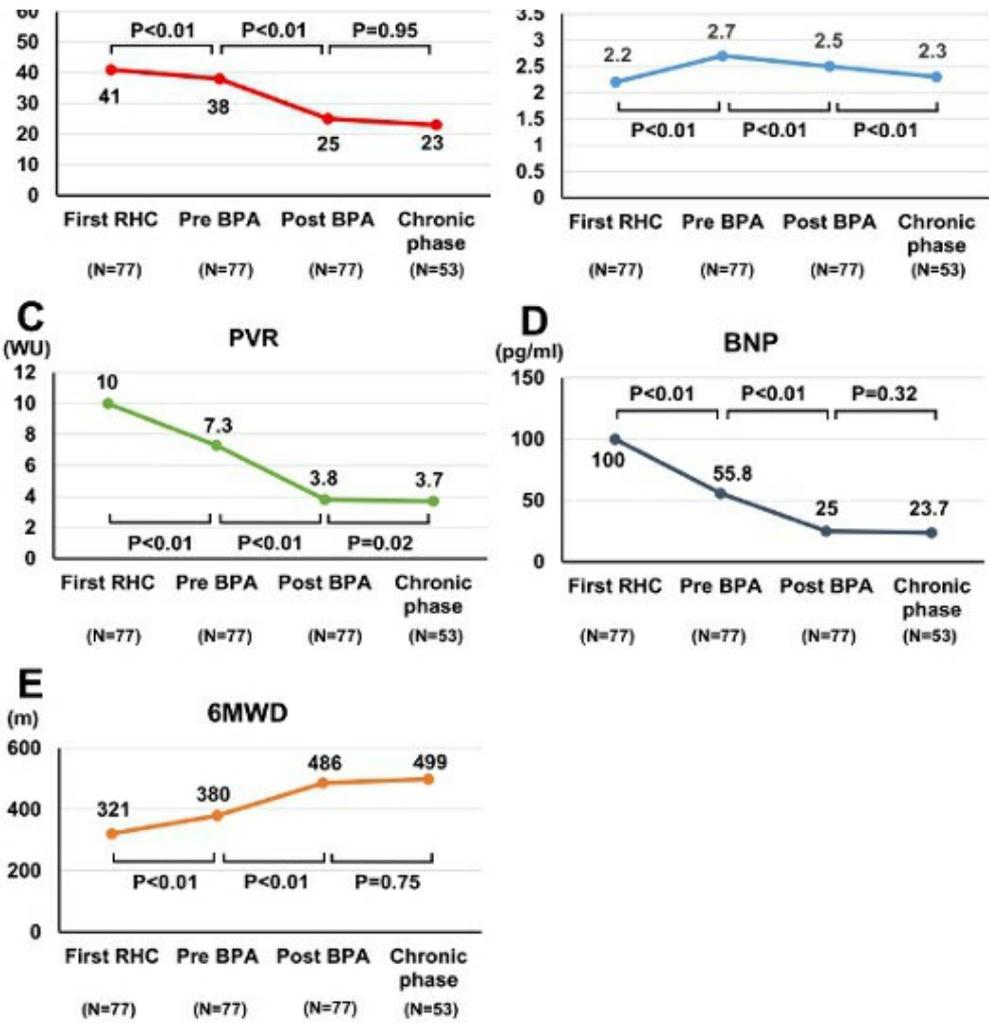


Figure 1