

Changes of the pressure-volume loop after pulmonary embolism catheter intervention: a pressure-conductance catheterization study

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Background: Acute pulmonary embolism (PE) causes an abrupt increase in right ventricular (RV) afterload, potentially leading to RV dysfunction and hemodynamic instability. Although catheter-directed interventions can rapidly reduce thrombotic burden, their immediate effects on RV pressure–volume (PV) relationships remain poorly characterized. We aimed to assess acute changes in RV mechanics using invasive pressure–conductance catheter measurements before and after catheter-directed treatment of PE.

Methods: Five patients (age: 59±13 years, 80% male) with acute PE underwent invasive RV pressure-conductance catheterization before and after catheter-directed intervention. Four patients underwent mechanical thrombectomy and one received catheter-directed selective thrombolysis. Changes in RV pressures, volumes, arterial elastance (Ea), end-systolic elastance (Ees), and ventriculoarterial coupling (VAC) were assessed using paired comparisons. Individual PV loops were reconstructed and aligned using end-diastolic and end-systolic reference points to generate averaged pre- and postprocedural PV loops.

Results: Following intervention, RV end-systolic pressure (ESP) decreased from 47.3 to 39.0 mmHg ($p=0.09$), while end-diastolic pressure (EDP) decreased from 16.8 to 13.8 mmHg ($p=0.44$). Neither Ea (0.784 ± 0.345 vs. 0.73 ± 0.45 mmHg/mL, $p=0.49$) nor Ees changed significantly (0.448 ± 0.148 vs. 0.59 ± 0.28 mmHg/mL, $p=0.16$), while VAC showed significant improvement (0.61 ± 0.16 vs. 0.85 ± 0.25 , $p=0.007$). RV volumes decreased significantly, along with a marked reduction in RV stroke work (2776 ± 732 vs. 1231 ± 274 mLmmHg, $p \leq 0.001$). Averaged PV loops demonstrated a pronounced change in morphology, characterized by a leftward and downward shift and a marked reduction of the isovolumetric contraction phase (Figure 1).

Conclusions: Catheter-directed treatment of acute PE was associated with immediate changes in RV loading conditions, chamber volumes, and PV-loop morphology. Improved VAC despite unchanged individual elastance parameters suggests an acute improvement in RV–pulmonary arterial interaction. These preliminary findings highlight the potential of invasive PV-loop analysis for characterizing immediate RV responses to catheter-directed PE treatment.

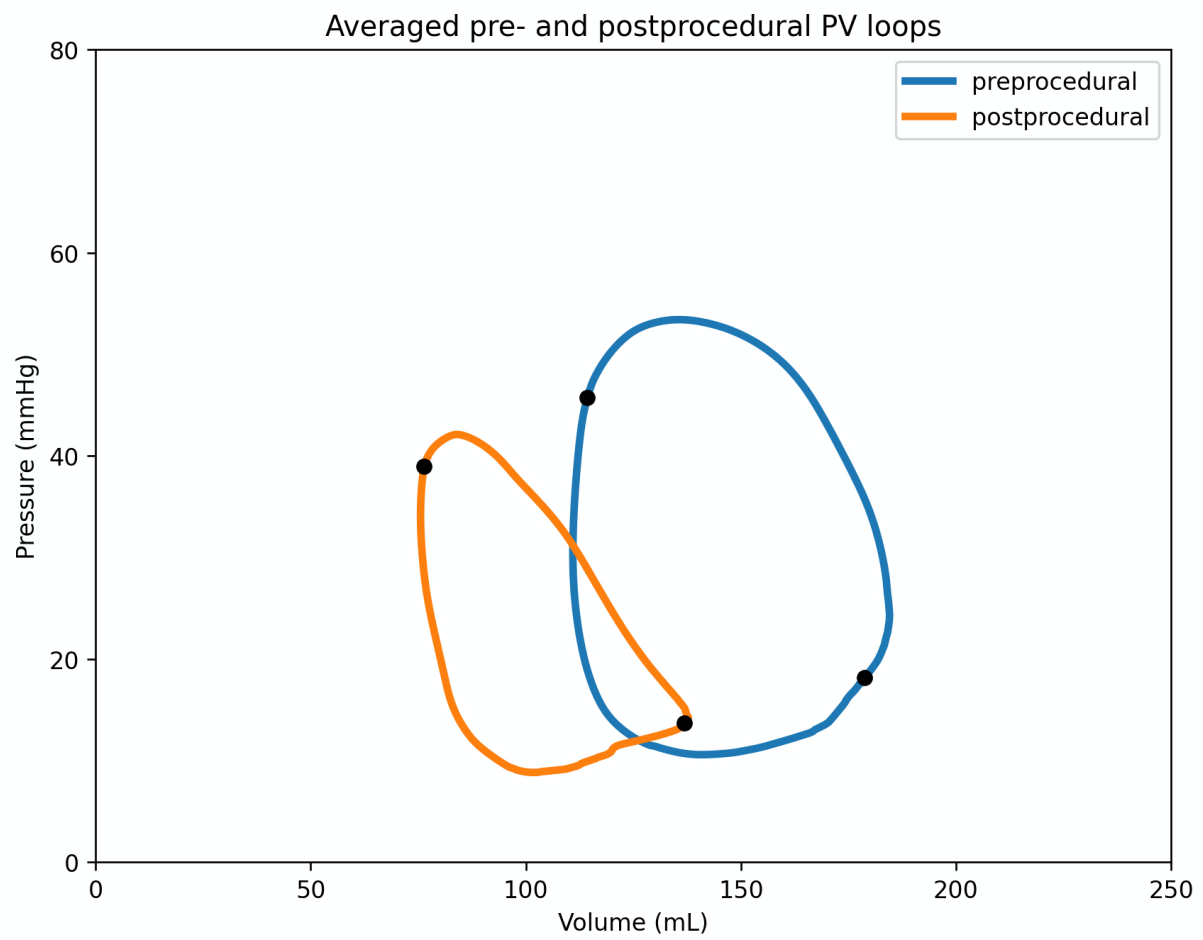


Figure 1. Illustration of averaged changes in the right ventricular pressure-volume loop with following intervention in the represented patients