

Catheter-directed therapy for treatment of acute pulmonary embolism in a teenage patient: The role of close cooperation between the Pulmonary Embolism Response Team and pediatric physicians

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Acute pulmonary embolism (PE) occurs relatively rarely in adolescence. According to the 2018 American Society of Hematology guidelines, pulmonary arteries (PA) reperfusion treatment should be considered in children when hemodynamic compromise is present despite anticoagulation [1]. Catheter-directed therapies (CDT) have emerged as valuable reperfusion modalities [2, 3]; however, evidence of their utility in the pediatric population is scarce. Pulmonary Embolism Response Teams (PERT) have been created to support decision-making in severe and complex PE scenarios [4, 5].

We report a case of a 16-year-old girl referred to our PERT from a pediatric cardiology department due to intermediate-high-risk PE. She had a history of combined (etonogestrel and ethinylestradiol) oral contraceptives and antipsychotic use. Her symptoms occurred suddenly with syncope, dyspnea, and chest discomfort. Once computed angiography showed bilateral, proximal PA emboli, intravenous unfractionated heparin was started and continued at our tertiary pediatric cardiology and intensive care unit. Despite anticoagulation with activated partial thromboplastin time maintained between 46–70 s, symptoms and signs of cardiorespiratory compromise persisted over 24 hours. Her systolic blood pressure was 95 mm Hg, and her heart rate (HR) was 120/min. She required an oxygen supply of 4 l/min to maintain arterial

oxygen saturation (SatO₂) over 90%. Echocardiography revealed persistent dilation and impairment of the right ventricle (RV). No signs of chronic pulmonary hypertension were present. Troponin levels rose from 0.02 to 0.064 ng/ml (reference range <0.014 ng/ml) and the N-terminal pro-B-type natriuretic peptide from 2224 to 4480 pg/ml (reference range <206 pg/ml).

As no significant improvement could be observed, the PERT considered her condition potentially life-threatening and decided to pursue CDT in an off-label fashion for the pediatric population. After receiving her and her parents' informed consent, urgent percutaneous embolectomy with the Penumbra Lightning 12 system was performed, which evacuated a substantial thrombus and improved the mean PA pressure (mPAP) measured invasively from 34 to 32 mm Hg and the cardiac index (CI) from 1.48 to 1.58 l/min/m². To optimize the effect of embolectomy, we decided to supplement it with bilateral low-dose-local-thrombolysis with a cumulative alteplase dose of 20 mg delivered over 10 hours. The rationale for such an approach stemmed from reported significant distress experienced by the patient (chest discomfort) during manipulations with the embolectomy catheter, which precluded complete thrombus removal and achievement of intended clinical and hemodynamic efficacy. This strategy resulted in a further mPAP reduction to 21 mm Hg, CI increase to

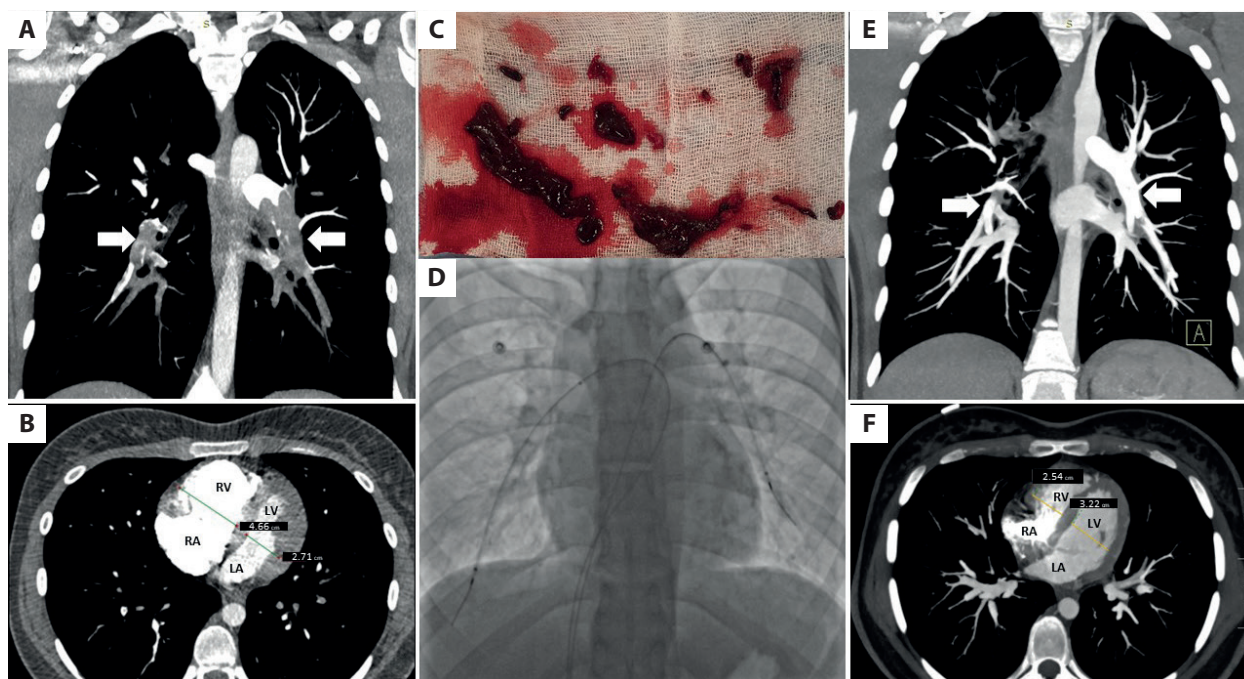


Figure 1. **A.** Angio CT of a 16-year-old girl with sudden syncope, dyspnea, and chest discomfort confirming the diagnosis of pulmonary embolism with massive proximal clots in both PAs (arrows). **B.** Angio CT showing dilation of the RV and the RV-to-LV ratio of 1.7; no thickening of the RV wall is present. **C.** Clots evacuated from PAs with the PENUMBRA Lightning 12 system during catheter-directed thrombolectomy procedure based on the Pulmonary Embolism Response Team's decision as no significant clinical improvement could be reached despite therapeutic anticoagulation, which led to a mPAP reduction from 34 to 32 mm Hg and CI improvement from 1.48 to 1.58 l/min/m² as assessed by right heart catheterization. **D.** Fluoroscopy showing infusion catheters placed within remaining clots in both PAs for low-dose catheter-directed thrombolysis, with a total dose of 20 mg delivered during 10 hours and resulting in a further mPAP reduction to 21 mm Hg and CI increase to 2.38 l/min/m². **E.** Angio CT presenting treatment results with a reduction of clot burden in both PAs (arrows) and improvement in the RV/LV ratio to 0.78 (**F**)

Abbreviations: Angio CT, computed angiotomography; CI, cardiac index; LA, left atrium; LV, left ventricle; mPAP, mean pulmonary artery pressure; PA, pulmonary artery; RA, right atrium; RV, right ventricle

2.38 l/min/m², improvement in symptoms and vital signs, and reduction in N-terminal pro-B-type natriuretic peptide levels to 1608 pg/ml.

The patient was ambulated the next day and transferred back to the pediatric cardiology clinic. Rivaroxaban was started on the 1st post-procedural day. Her subsequent hospital stay was uneventful, and she was discharged home without exercise limitation.

This case showed that CDT use in a teenage girl was safe and resulted in a rapid clinical improvement. It was, to the best of our knowledge, the first successful use of the PENUMBRA Lightning 12 system in a pediatric patient. Promoting partnerships between pediatric physicians and PERTs may bring benefit to PE management in this population.

Article information

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