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## **Recurrent pulmonary embolism in patient after COVID-19 treated with percutaneous and surgical approach**

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## **Recurrent pulmonary embolism in patient after COVID-19 treated with percutaneous and surgical approach**

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**Short title:** Catheter directed therapy in acute pulmonary embolism after COVID-19

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Evidence show increased prevalence of venous thromboembolism (VTE) after coronavirus disease 2019 (COVID-19) [1]. Pulmonary embolism (PE) with acute pressure overload may lead to death. An early diagnosis and therapy is crucial [2].

Catheter directed therapy (CDT) is an promising alternative to systemic thrombolysis (ST) pathway (class C/IIa recommendation by the European Society of Cardiology guidelines), but still needs research [3, 4].

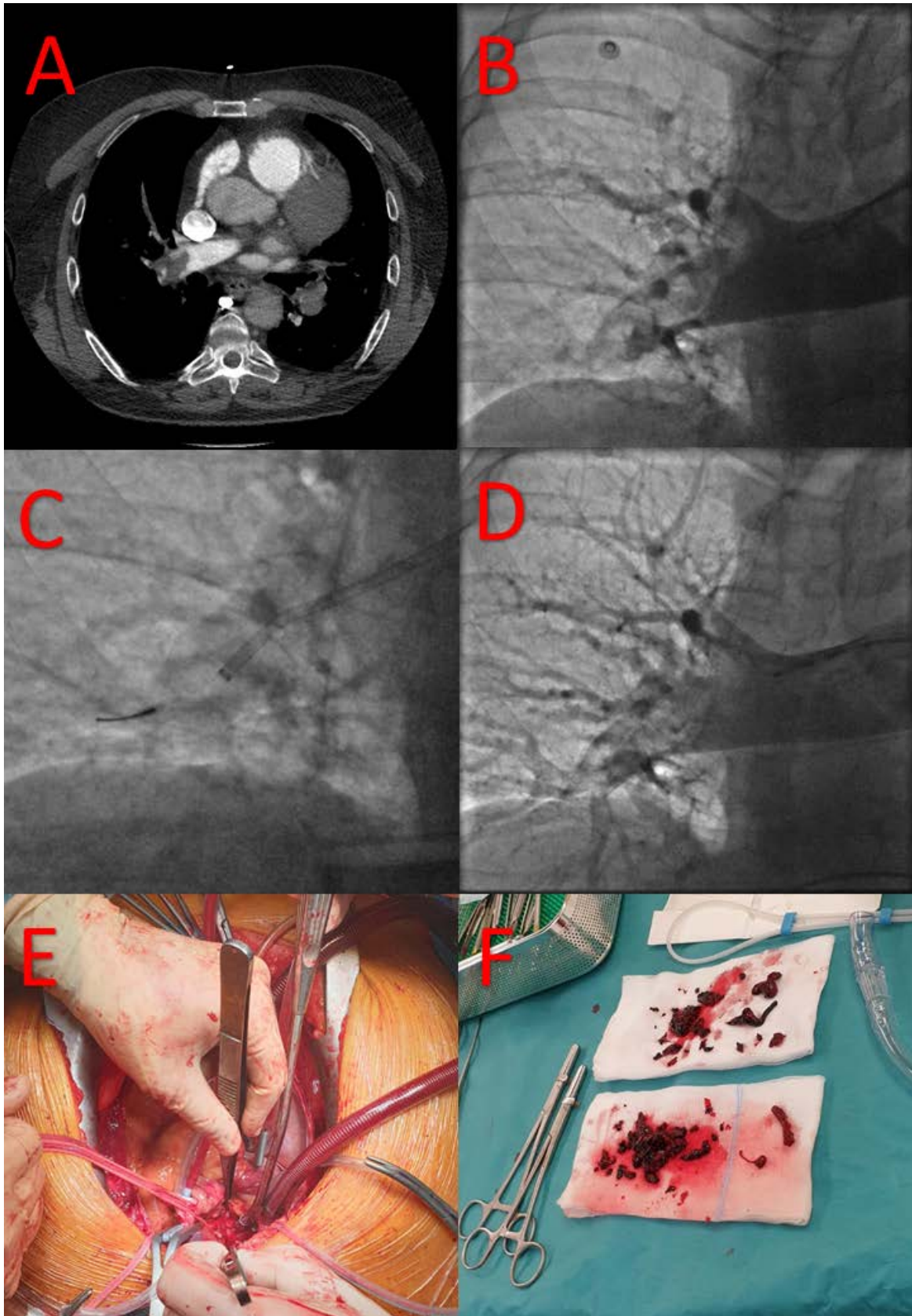
A 48-year-old man with a history of arterial hypertension and COVID-19 infection was admitted due to dyspnea and syncopal episodes. He had no history of deep vein thrombosis (DVT), but one day prior to admission he was driving long distance. Laboratory tests revealed elevated concentrations of D-dimer, cardiac troponin I (cTnI) and N-terminal B-type natriuretic peptide (NT-proBNP). Computed tomography (CT) angiography revealed massive PE. Echocardiography showed right ventricular (RV) enlargement, shortening of pulmonary acceleration time, flattening of the interventricular septum and the McConnell's sign. Ultrasonography confirmed right popliteal vein thrombosis. Initial treatment with low

molecular weight heparin (LMWH) was administered. However, 24 hours later, due to symptoms worsening, progressing RV failure and increasing cTnI and NT-proBNP levels, still without cardiogenic shock, decision to start CDT (as preferred over ST) was made by the multidisciplinary pulmonary embolism response team (PERT). The PERT in our centre includes interventional cardiologists, cardiac surgeons, cardiac intensive care cardiologists and anesthesiologists. CDT was an unanimous decision. The procedure was performed under local anesthesia, via left femoral vein access. Several passages with Indigo Aspiration System (Penumbra, Inc., USA) were done. The system utilizes aspiration catheter connected to engine generating negative pressure and retractable separator device to clear the thrombus from the catheter tip. 5000 international units of unfractionated heparin were administered, activated clotting time was above 250 s. CDT resulted in partial evacuation of thrombi, but was complicated by wire perforation of a subsegmental branch of the left PA, resulting in haemoptysis. Protamine sulfate was administered and no bleeding site was revealed by angiography. After the procedure, LMWH was initially reduced but reintroduced in full therapeutic dose over the next 24 hours since no signs of active bleeding occurred. The patient's condition and RV function were improving. However, four days later, the patient developed symptoms of cardiogenic shock with tachycardia, hypotension and hypoxemia, with a need for inotropic and vasopressor support, and echocardiographic signs of PE recurrence. The PERT decided on surgical embolectomy and subsequently inferior vena cava (IVC) filter implantation, and excluded ST due to bleeding risk. Periprocedural course was uncomplicated. Therapeutic dose of LMWH was maintained. Laboratory, genetic and imaging testing ruled out cancer, thrombophilia, antiphospholipid syndrome, autoimmune diseases, but confirmed methylenetetrahydrofolate reductase mutation, which in addition to COVID-19 might provoke DVT. Echocardiography showed improving RV function. 6-months follow-up was free of VTE events.

In our opinion PERT-guided approach improves communication between specialists who provide complex care and facilitates difficult decisions making, including risk stratification, and therefore rapid redirection of therapeutic strategies. In patients with bleeding due to CDT and subsequent anticoagulation stopping, IVC filter implantation may be considered to avoid recurrence of PE.

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**Figure 1.** **A.** Computed tomographic pulmonary angiography. **B.** Pulmonary angiography prior to thrombectomy. **C.** Pulmonary thrombectomy — Indigo Aspiration System. **D.** Pulmonary angiography after thrombectomy. **E–F.** Surgical embolectomy