

# One-day experience of pulmonary embolism response team (PERT) during the COVID-19 pandemic: three urgent percutaneous pulmonary embolectomies in acute pulmonary embolism

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## Introduction

Percutaneous pulmonary embolectomy (PPE) is a rapidly evolving therapy in selected acute pulmonary embolism (APE) patients [1–5]. Novel percutaneous procedures tend not to be common, even in reference centers.

## Aim

We present an unusual series of three consecutive cases of intermediate–high risk APE patients, who underwent urgent PPE performed by our pulmonary embolism response team (PERT) during one duty.

## Case reports

The first patient was a 41-year-old man, with hemorrhagic transformation of acute ischemic stroke, treated with thrombolysis 1 day before. He presented with systemic blood pressure (BP) 156/96 mm Hg, heart rate (HR) 105/min and with saturation (SAT) of 88% on oxygen supplementation 5 l/min. Troponin T concentration (hsTnT) was elevated to 0.105 ng/ml ( $N = 0.014$ ). Echocardiography confirmed right ventricular dysfunction (RVD) and on Doppler ultrasound deep vein thrombosis (DVT) was found. Due to elevated risk of deterioration according to the BOVA Score (4 points) and contraindication to systemic thrombolysis, he underwent PPE of both pulmonary arteries with the AngioJet System (Boston Scientific), without local thrombolysis [6]. Total thrombectomy activation time was 72 s. BP and HR were stable and SAT increased to 98%. PPE was completed with implantation of a retrievable inferior vena cava filter (IVCF) (Figures 1 A–D). After 2 days of low-molecular weight heparin

(LMWH) treatment, the patient was transferred for neurological rehabilitation.

The second patient was a 64-year-old woman, transferred from a remote hospital after severe bleeding from suspected cervical cancer. On admission her BP was 122/73 mm Hg and HR 115/min, respiratory rate (RR) 40/min, SAT was 93% on room air, hsTnT was 0.097 ng/ml, RVD and DVT were also present. BOVA Score was 5 points. Another successful PPE with the AngioJet System (no thrombolysis, activation time 70 s, left and right pulmonary artery) was performed. After the procedure HR was 97/min, SAT was 100% and BP was stable. The patient was anticoagulated with unfractionated heparin (UFH) and LMWH. IVCF was also implanted and the patient was referred for oncological therapy.

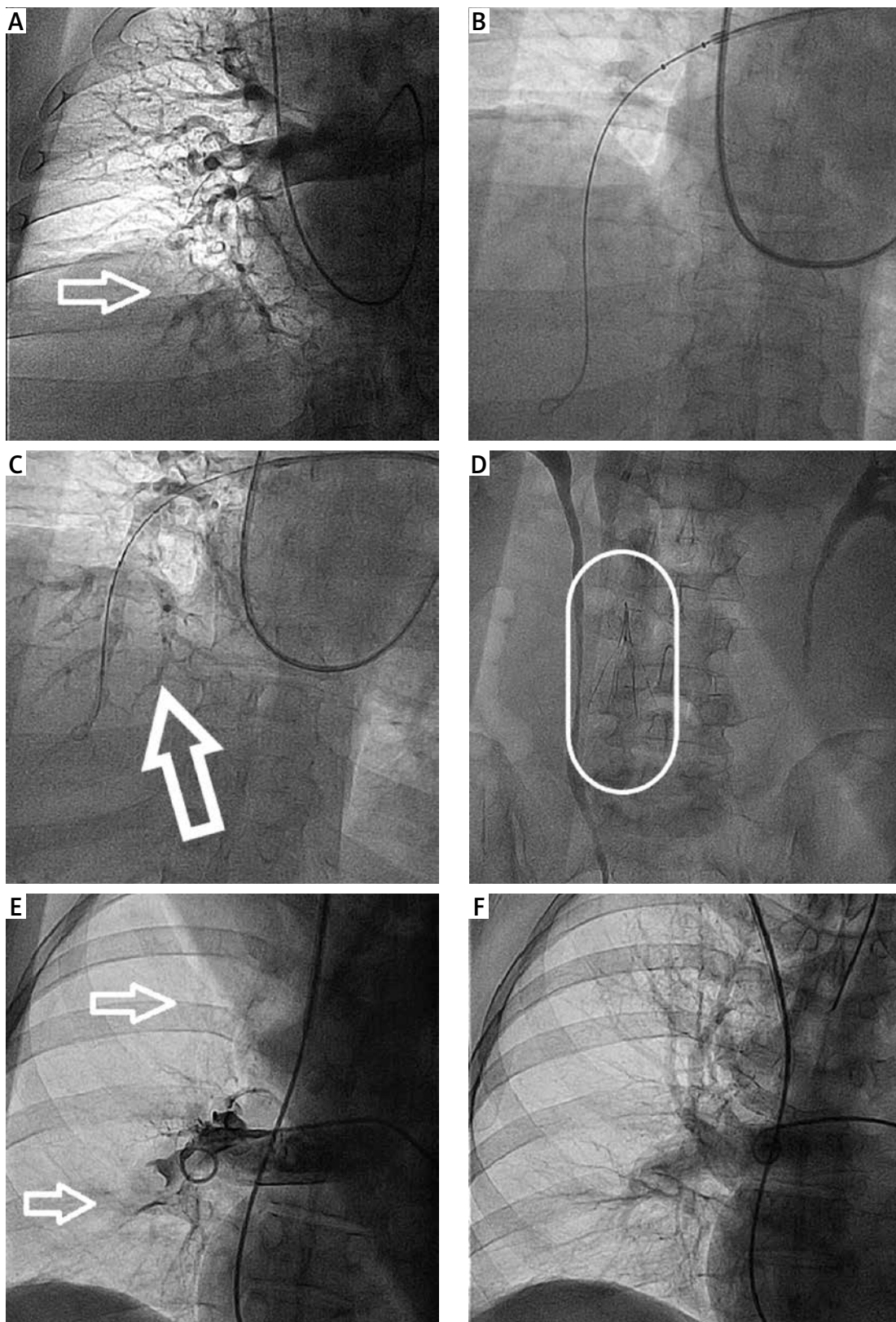
The third patient was a 59-year-old woman with APE confirmed after syncope and significant head trauma. She presented with systolic BP 106 mm Hg, SAT 84%, HR 130/min and with RVD and elevated hsTnT (0.156 ng/ml). BOVA Score was 7 points. Ultrasound at bedside showed DVT and a large abdominal tumor. PPE was performed (activation time 10 s, right upper lobe artery) without local thrombolysis, no IVCF was implanted. The immediate clinical result was impressive – SAT increased to 100%, HR decreased to 105/min. UFH was continued (Figures 1 E–F). After 24 h from the initial procedure, she developed cardiogenic shock due to APE recurrence. Bail-out PPE with local administration of tissue plasminogen activator (tPA) (15 mg for each pulmonary artery) was performed, with a good final clinical and angiographic result. She improved gradually and 1 week later she was referred for surgery.

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**Figure 1.** A – Initial right pulmonary angiography of first patient, with thrombus occlusion of lower lobe artery. B – Percutaneous pulmonary thrombectomy with AngioJet System. C – Restored blood flow to right lower lobe. D – Implanted inferior vena cava filter. E – Angiography of third patient after acute pulmonary embolism recurrence, with total occlusion of right pulmonary artery. F – Impressive angiographic result of third patient after percutaneous pulmonary embolectomy with local tissue plasminogen activator

## Discussion

All presented cases of APE with contraindications for systemic thrombolysis showed high risk of deterioration despite anticoagulation. They were successfully treated with PPE during one medical duty in the catheterization laboratory, among eight other coronary interventions. We have confirmed that all 3 patients were alive at 30 days from PPE. We are convinced that PPE not only allowed for hemodynamic improvement in treated patients but also improved their long-term prognosis. All of them shortly after PPE were qualified for therapy of preexisting comorbidities.

All cases of APE in our department are evaluated according to the ESC Guidelines. We use mainly the BOVA Scale (30-day risk of PE related complications in hemodynamically stable patients) to qualify referred patients for PPE. Despite the fact that this scale does not include saturation, it is quick and useful in decision-making. Usually, at more than 4 points (or exactly 4 but with low saturation), we strongly consider PPE. Contraindications to effective anticoagulation are also taken into account. To perform PPE we use the AngioJet System (Boston Scientific) or the Penumbra Indigo System. Most of our experience is with the AngioJet System, but knowing advantages and disadvantages of a particular device is the key to a safe and swift procedure. The AngioJet System allows local administration of a drug (thrombolytic) directly into the thrombus, with an amount of pressure. This allows one to inject the drug in the largest thrombus formation and make it easier to aspirate (Power Pulse). In patients with absolute contraindications to thrombolysis, we use this option but with saline. A series of short (less than 10 s) aspirations allows one to avoid severe bradycardia. Distribution of thrombi (assessed in computed tomography or initial angiography) and estimated age of emboli (from clinical data) also help to choose appropriate device. The Penumbra System is preferred in patients after unsuccessful thrombolysis and if the thrombus burden is localized in smaller vessels (less than 6 mm diameter). Periprocedural anticoagulation depends on the last one used and on intention to administer low dose tPA (i.e. via Power Pulse option available in the AngioJet System). Most of the performed procedures are on UFH. The access site is usually the right internal jugular vein. Pulmonary angiography precedes every PPE. Retrievable IVCF are implanted in patients with proximal DVT and with suspected gaps in anticoagulation (bleeding, surgery).

The goal of PPE is rapid hemodynamic stabilization of the patient. In contrast to coronary interventions, the angiographical result may be suboptimal in this case. Clinical presentation, with a trend to reduction of RVD in echocardiography, indicates a successful procedure.

Successful APE management and clinical follow-up is determined by a well-organized PERT [7]. Every team member provides knowledge, experience, skill and data

to treat a particular PE patient. An interventional cardiologist, cardiologist, intensivist, technician and radiologist are on site during duty, and a cardiac surgeon is on call. Having experienced staff and PPE-dedicated devices allows proper treatment for APE patients, even in hostile times. All described cases were challenging, especially because of unknown COVID status. This fact could cause catastrophic delay in specific treatment. Although they all were found to be SARS-CoV-2 negative, all PPE were done with special safety measures. Immediate availability of PPE in experienced centers ameliorates management of APE, especially when intensive care and cardiac surgery are limited due to the COVID-19 pandemic. With adjustments made in our facility, PPE in selected APE patients is possible despite their COVID status.

## Conflict of interest

The authors declare no conflict of interest.

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