

## Off-Pump Pulmonary Embolectomy

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### ABSTRACT

Pulmonary embolism is a common clinical condition associated with high mortality. Surgical pulmonary embolectomy (SPE), despite having been in existence for over 100 years, is generally regarded as an option of last resort with high mortality rates. Prompt recognition of predictors of mortality, such as right ventricular stress on echocardiography, helps decision-making for immediate surgical pulmonary embolectomy prior to development of significant circulatory collapse, with promising results.

We present a 71-year-old male, with recent intracranial bleed and acute massive bilateral pulmonary embolism. The patient underwent successful off-pump surgical pulmonary embolectomy.

### BACKGROUND

Pulmonary embolism (PE) is a common clinical condition associated with significant morbidity and mortality. Massive PE is a serious fatal condition with an estimated incidence of 4.5%, when characterized by hemodynamic instability and occlusion of more than 50% of pulmonary vasculature [Dauphine 2005; Goldhaber 1999]. Various therapeutic options are available including anticoagulation, thrombolysis, catheter embolectomy, and surgery. Surgical pulmonary embolectomy has traditionally been reserved for the most severely compromised patients not amenable to medical therapy. Recent studies have demonstrated impressive outcomes of surgical embolectomy through careful patient selection.

We report a patient with a recent hemorrhagic stroke with bilateral PE, successfully treated with off-pump surgical pulmonary embolectomy.

### CASE PRESENTATION

A 71-year-old male with hemorrhagic stroke and left hemiplegia 9 days prior presented with a massive pulmonary embolism. His condition started to deteriorate over 6 hours. Upon arrival at our hospital, blood pressure (BP) was 70/50 mmHg. Heart rate was 120 beats per minute (bpm). Respiratory rate was 22 breaths/min and he had an oxygen saturation of 80% at room air. Electrocardiography showed sinus tachycardia.

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Echocardiography demonstrated pulmonary artery dilatation, pulmonary hypertension (SPAP-65 mmHg), right ventricular (RV) dilatation with McConnell's sign, and severe tricuspid regurgitation (Figures 2 and 3). The rapid deterioration in RV function indicated impending circulatory collapse and need for urgent intervention.

Thrombolysis was not an option due to the massive intracranial bleed 9 days prior (Figure 3). The patient was immediately transferred to the operating room due to hemodynamic instability (BP 60/40 mmHg; pulse 140 bpm; CVP 22 mmHg; respiratory rate 22/min).

The heart was exposed through median sternotomy. The procedure was performed off-pump, by snaring the right pulmonary artery first and opening and extracting the emboli,

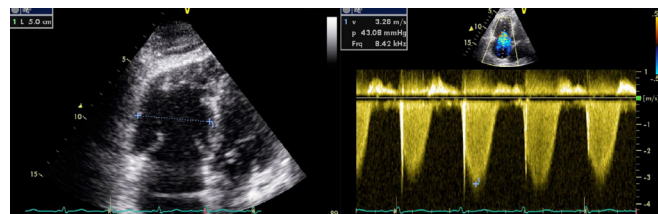


Figure 1. Preoperative echocardiogram showing dilated right ventricle (left) and severe tricuspid regurgitation (right).



Figure 2. Preoperative CT angiography showing massive bilateral pulmonary embolism with total occlusion of RPA.

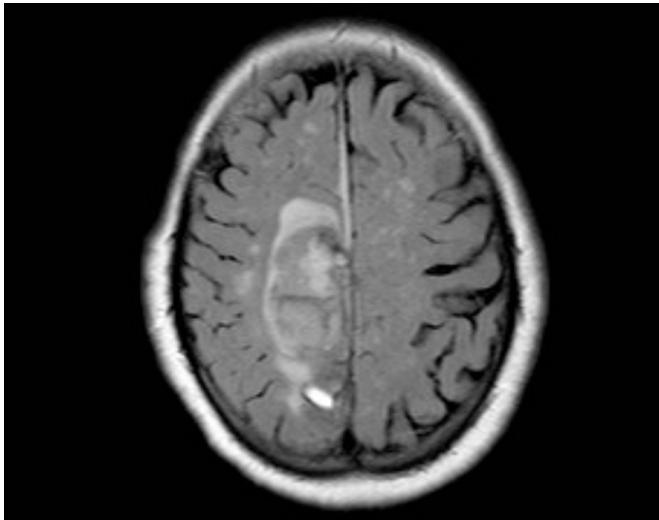


Figure 3. Preoperative CT brain showing right intracranial bleed.

ensuring good back flow (Figure 4). The opening was directly closed with 5-0 Prolene. The snare was released. The left pulmonary artery was next snared and the procedure repeated.

Systolic PAP intraoperatively reduced to 35 mmHg and RV contractility improved immediately.

Postoperatively, the patient remained hemodynamically stable. He was transferred to rehabilitation on the fourth day to continue physical therapy for hemiplegia. An IVC filter was placed in the referring center 1 week later.

## DISCUSSION

The risk of developing pulmonary embolism is related to recent trauma or surgery, malignancy, hypercoagulable conditions, immobility, pregnancy, and the presence of deep vein thrombosis [Dauphine 2005]. In 20% of cases, no obvious risk factor could be detected [Goldhaber 1999].

Improved diagnostic adjuncts, surgical techniques, and careful patient selection have seen a decline in mortality from 35% to 19% over a 30-year period [Stein 2007a].

Computed tomography pulmonary angiography (CTPA) has now replaced invasive pulmonary angiography as the primary imaging test for the diagnosis of PE. Recent evidence supports its use as a stand-alone test in the exclusion of PE, with high predictive values in concordance with clinical assessment [Torbicki 2008; Stein 2007b].

Thrombolytic therapy is considered to be the first line of treatment of PE [Kearon 2008]. It causes rapid resolution of pulmonary emboli and subsequent restoration of hemodynamic stability and right ventricular function [Aymard 2013].

However, thrombolysis can be associated with severe bleeding and intracranial hemorrhage.

Catheter embolectomy is effective in removal of clots and recovery of right ventricular function. However, it is associated with recurrence of pulmonary emboli, pulmonary hypertension, hemorrhage, injury, and perforation of pulmonary arteries [Samoukovic 2010].

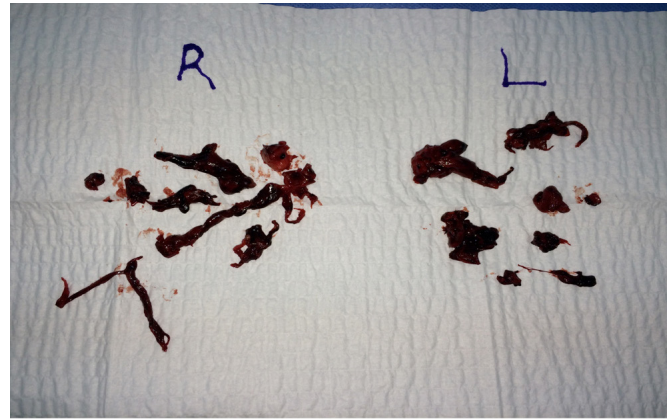


Figure 4. Emboli after extraction.

Surgical embolectomy is indicated in patients with: (i) massive PE, confirmed on angiography if possible; (ii) hemodynamic instability despite anticoagulation therapy and resuscitative efforts; (iii) failure of thrombolytic therapy or a contraindication to its use; and (iv) in critical patients with insufficient time for systemic thrombolysis to be effective [Torbicki 2008; Samoukovic 2010]. The procedure was first described by Trendelenburg in 1908 [Trendelenburg 1908].

Sharp was the first surgeon to successfully perform pulmonary embolectomy using extracorporeal circulation in 1962 [Sharp 1962].

The mortality rate of patients with RV failure undergoing surgery may reach 30%. In patients with cardiogenic shock or previous preoperative cardiac arrest the mortality increases to 70% [Leacche 2005]. Recent interest has focused on surgical pulmonary embolectomy as first-line treatment in hemodynamically stable patients showing echocardiographic RV dysfunction. Early surgery in these impending circulatory failure patients has shown promising results [Zarrabi 2011; Leacche 2005].

In our patient, the location of the emboli and total occlusion of the right pulmonary artery made individual snaring of the pulmonary arteries possible. Flow was maintained in the lungs throughout the procedure. Immediate improvement of RV function and reduction of pulmonary artery pressures were recorded on the table.

## Conclusion

Present day multidisciplinary approaches in diagnosis, risk stratification, and perioperative care have decreased the mortality associated with surgical pulmonary embolectomy. Massive bilateral PE can be extracted safely, even without the need for cardiopulmonary bypass, thereby avoiding full heparinisation in patients with recent intracranial bleed.

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