

CASE REPORT

Surgical Embolectomy for Acute Pulmonary and Biatrial Embolism. *Et vita in foraminis*. Case report

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Acute pulmonary thromboembolism is a dangerous event. Mortality has been reported from 25% to 65%. Currently, pulmonary embolectomy is indicated in patients where thrombolysis is contraindicated or failed, as well as in the presence of an impending paradoxical embolism. Surgery is feasible in patients previously by extracorporeal membrane oxygenation. Early thrombus removal decreases right ventricular failure, pulmonary hypertension and promotes recovery. We present a case of massive pulmonary thromboembolism with an image of a thrombus in transit between the two atria through a Patent Foramen Ovale. Pulmonary embolectomy and urgent atrial thrombectomy were performed with excellent outcomes. Direct pulmonary embolectomy is a safe and effective procedure.

Key words: ECMO; Pulmonary embolism; Pulmonary embolectomy; Patent foramen ovale.

El tromboembolismo pulmonar agudo es un evento peligroso. La mortalidad ha sido reportada entre 25% y 50%. Actualmente, la embolectomía pulmonar está indicada en pacientes en los cuales la trombolisis está contraindicada o ha fallado, así como ante la presencia de embolismo paradójico. La cirugía es factible en pacientes que han tenido previamente ECMO. La remoción temprana del trombo disminuye el riesgo de falla ventricular derecha, hipertensión pulmonar, y facilita la recuperación. Presentamos aquí el caso de un tromboembolismo pulmonar masivo con una imagen de trombo en tránsito entre las dos aurículas a través de un defecto del septum interauricular. Se realizaron las correspondientes embolectomía pulmonar y trombectomía auricular en forma urgente con excelentes resultados. La embolectomía pulmonar directa es un procedimiento seguro y efectivo.

Palabras clave: ECMO; Embolismo pulmonar; Embolectomía pulmonar; Comunicación interauricular.

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The severity of acute pulmonary embolism (PE) is graded according to its mortality, it can be low, intermediate (submassive) or high risk (massive). Massive PE is characterized by respiratory failure, right ventricular failure, and cardiogenic shock. There is no consensus regarding the indications for surgical embolectomy, traditionally reserved when thrombolysis was contraindicated or failed, however, recently there is a tendency to consider surgery as the first option, including hemodynamically stable patients [1]. Thrombolysis survival benefits are still controversial and in comparison, survival advantage with thrombolysis has not been demonstrated [2]. There is a population of patients with massive PE, those with patent foramen ovale (PFO), which carries the worst prognosis due to the risk of paradoxical embolism [3,4]. A thrombus is observed in transit through the atria, which is known as impending paradoxical embolism. These patients are considered candidates for urgent operation [1,5,6].

CASE REPORT

A 44 years-old woman with a neuroblastoma of the nasal cavity, undergoing chemotherapy and radiation therapy, presented to a tertiary hospital with symptoms of chest pain, dyspnea and syncope. Vitals signs showed sinus tachycardia with otherwise hemodynamically stable profile, systolic blood pressures remained above 100mmhg. Emergency Department evaluation was highly suggestive of PE with an elevated Well's score of 5.5 points.

Initial work-up included an electrocardiogram remarkable for sinus tachycardia, S-wave in lead I and inferior T wave inversion with an incomplete right bundle branch block pattern. Cardiac biomarkers were positive with a Troponin -I of 0.107 ng/mL (normal < 0.029ng/mL). Transthoracic Echocardiogram (TTE) evaluation showed thrombus formation in the right ventricle (RV), right atrium as well as left atrium, across a PFO. (Fig. 1) (Fig. 2) Computed Tomography Angiography (CTA) of the chest showed a saddle pulmonary embolus extending into the lobar, segmental, and subsegmental branches of the pulmonary arteries. Also, straightening of the interventricular septum was described suggestive of right ventricular strain. (Fig. 3) (Fig. 4). Non-occlusive deep vein thrombosis of the left femoral vein to the popliteal vein was also found.

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Figure 1. TEE showing thrombus on left atrium

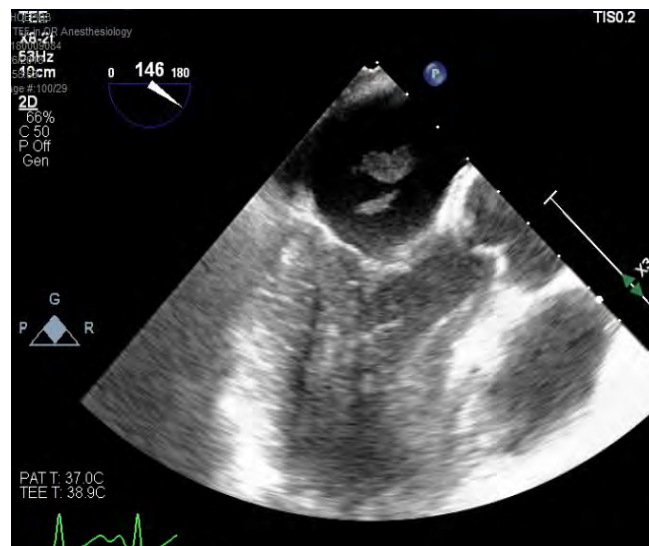


Figure 2. TEE showing thrombus in left atrium

The patient was started on Heparin infusion and admitted for close monitoring further management. EKOS system for catheter-directed fibrinolysis was not recommended as will carry increase risk of embolization. Surgical approach was considered. She underwent to open surgical thromboembolotomy, under hypothermia to 28C. Extensive thrombus burden found on the right atrium, in addition to a large clot in transit through the PFO reaching the left atrium, total retrieval of the thrombus was completed. Two pulmonary artery arteriotomies were performed, one in main pulmonary artery extending to the left, and the second in the right pulmonary artery (between entre aorta and superior vena cava) extracting large clot burden (Desjardins forceps are particularly useful) with complete thromboembolotomy (Fig. 5). Bypass was successfully weaned. Inferior vena cava filter was

performed after closure. Post-operative course complicated with bleeding, hemopericardium and tamponade, requiring additional operative procedure.

Advanced heart failure team was consulted in the post-operative period due to concerns of RV failure and TTE showing an estimated RV systolic pressure elevated at 40-50mmHg with dilated RV. Hemodynamic assessment by Swan-Ganz catheter showed right atrial pressure of 24 mm Hg, PA pressure of 21/9mm Hg, pulmonary wedge pressure of 10 mm Hg, and Cardiac Index in 1.8 L/min/m². Support was given by IV inotropes and inhaled nitric oxide. Oral sildenafil was started and continued throughout hospitalization.

Patient was discharge with pertinent medications included

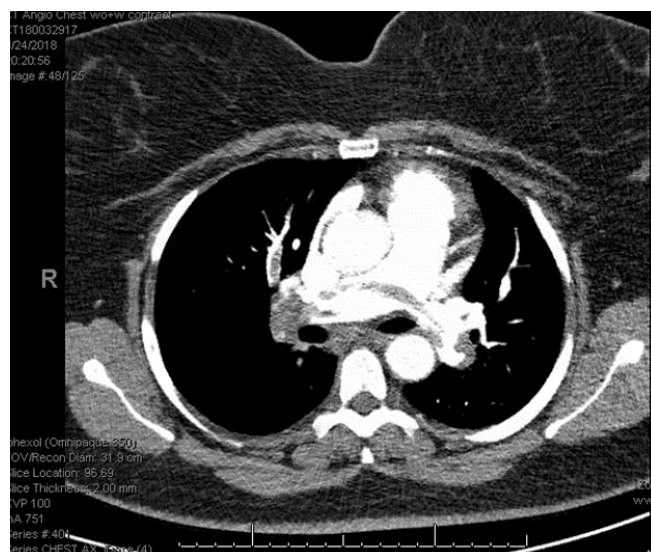


Figure 3. CTA Transverse plane showing saddle pulmonary embolism and thrombus in both pulmonary arteries.

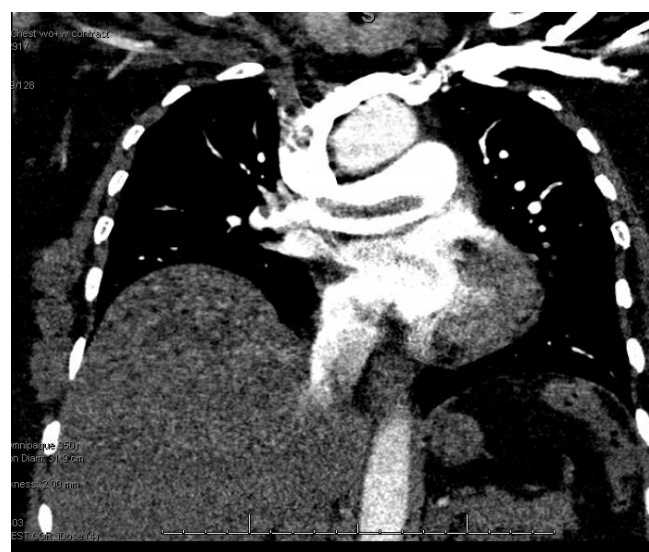


Figure 4. CTA coronal plane showing saddle pulmonary embolism and thrombus in left atrium.



Figure 5. Complete pulmonary embolus

oral vitamin K inhibitor for therapeutic INR level of anticoagulation between 2 to 3, and sildenafil. At follow-up, TTE performed at 5-month showed a normal biventricular function with no evidence of elevated pulmonary pressure. At 12-month interval her TTE showed stable findings with excellent functional status.

COMMENT

PE causes about 100,000 deaths annually in the US [7]. Massive embolism comprises only 8 to 10% of cases of PE. These patients by definition are in a state of cardiogenic shock and acute RV failure. The therapeutic strategy of submassive and massive pulmonary embolism is based on 3 aspects: cardiopulmonary support, anticoagulation, and reperfusion of pulmonary circulation [8].

Patients with frank cardiopulmonary collapse require mechanical ventilation. If this or inotropes fail to restore and stabilize cardiac and/or pulmonary function, extracorporeal membrane oxygenation (ECMO) is indicated, usually in a veno-arterial (VA) modality, recent guidelines recommend ECMO as a tool for hemodynamic support, only in patients with contraindication or failure to thrombolysis and as adjunctive therapy to surgical embolectomy [9-11]. A meta-analysis in 2015, reported 70% survival in PE treated with ECMO, similar to any other strategy. They found that cardiac arrest at the time of the ECMO leads to higher mortality [12-14].

If there is no contraindication, thrombolysis is effective

to restore pulmonary flow. Albeit, there are reports of 90% efficacy administered in the first 48 hours [15], few randomized studies have shown that tissue plasminogen factor (t-PA) improves the prognosis of massive PE [16,17]. The American Heart Association, and the European Society of Cardiology recommend surgical embolectomy only in cases of massive or submassive embolism, with contraindication or failure to thrombolytics, or with shock that will probably cause death before instauration of thrombolytics [9,18,19]. Also, surgery is considered an option when the thrombus is found in the interatrial septum through a PFO [8,20-22]. This case had clinical diagnosis that led to surgery.

Massive pulmonary thromboembolism can produce a right-to-left shunt through a PFO, with the risk of producing a paradoxical embolism. Impending paradoxical embolism is a clinical entity based on the findings of a thrombus through a PFO, with no evidence of arterial embolism [22,23]. The case presented herein had no clinical signs of systemic embolism. In general, the frequency of this entity is low with only 194 cases documented in a systematic review by Seo et al [6]. Previous case series have compared different treatment modalities for impending paradoxical embolism, with surgery being superior to anticoagulation and thrombolysis, less mortality and lower incidence of systemic embolism [24,25]. A systematic review in 2017 published the following data, surgery had less mortality with a (6.3%) incidence rate and fewer embolic events (4.5%), compared with anticoagulation with 18.5% and 13% respectively, and in the same way thrombolysis with 35.7% and 14.3%, demonstrating superiority [6]. The operative mortality of pulmonary embolectomy ranges from

6% to 59% [23,24]. Preoperative risk factors include preoperative cardiac arrest and age [25]. A recent meta-analysis that included 1,579 patients concluded an in-hospital mortality of 26.3% with bleeding complications ranging from 7 to 11%. One-third of these patients had cardiac arrest before embolectomy and 27.2% required preoperative ECMO. ECMO is a valuable therapeutic option for the stabilization of the patient before surgery. The decision of the preoperative strategy is essential since pulmonary embolectomy after a failed thrombolysis represents a very complicated scenario. Nonetheless, no increase in mortality has been demonstrated with the use of ECMO or thrombolysis before surgery [26,27].

The review of this data and records leads to several considerations. The current results support expanding the indications of pulmonary embolectomy as a first-choice treatment in massive and submassive PE, emphasizing the surgery indication before the development of hemodynamic instability,

consequently changing the perspective of reserving surgery only for patients in shock and/or as a last resource.

In conclusion, massive PE has a high risk of morbidity and mortality. Even though its real role as the first choice in massive embolisms is evolving, the presence of a PFO with impending paradoxical embolism is a strong indication for surgery. Pulmonary embolectomy is a safe procedure, with low morbidity and mortality.

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