Successful surgical treatment of clot in transit with impending paradoxical embolism: A case report

Maria A. Medina, MD, a,b Albert F. Guerrero, MD, a Nestor F. Sandoval, MD, a,b and Juan P. Umana, MD, a,b
Bogotá, Colombia

Massive pulmonary thromboembolism remains a morbid and often-fatal event for which reperfusion treatment options have not changed over time: systemic thrombolysis, catheter-directed percutaneous thrombolysis, surgical thromboembolectomy, and systemic anticoagulation. Paradoxical embolism is a rare phenomenon, accounting for less than 2% of all arterial embolisms. Impending paradoxical embolism (IPDE), in which a thrombus extends across an atrial septal defect, is a clinical syndrome that is usually diagnosed incidentally but in the context of pulmonary hypertension secondary to pulmonary embolism becomes a life-threatening condition that requires immediate interdisciplinary management to guarantee a more favorable outcome.

CASE DESCRIPTION

We present the case of a 49-year-old male patient with a history of bilateral deep vein thrombosis on warfarin therapy who presented with dry cough and dyspnea at rest that worsened 2 days before admission. The patient was hemodynamically stable on admission, with moderate hypoxemia (oxygen saturation 87% with fraction of inspired oxygen 50%). Computed tomography showed massive bilateral pulmonary embolism, as well as thrombosis of the left subclavian artery. Transesophageal echocardiography (TEE) revealed a highly mobile elongated mass in the right atrium that crossed the patent foramen ovale (PFO) into the left atrium, with concomitant pulmonary hypertension (Figure 1). Anticoagulation with intravenous heparin was started as soon as the diagnosis was made.

Urgent surgical management was indicated, and bilateral pulmonary and atrial thromboembolectomy were performed, plus PFO closure with autologous pericardium (Figure 2). Total cardiopulmonary bypass time was 3 hours and 16 minutes; aortic crossclamp time was 2 hours and 21 minutes with 20 minutes of hypothermic circulatory arrest. Intraoperative TEE showed improvement in pulmonary hypertension, preserved biventricular function with mild tricuspid regurgitation, and satisfactory closure of the foramen ovale. In the intensive care unit, the patient presented with moderate hypoxemia due to reperfusion edema that was managed according to protocol.
Anticoagulation was started 24 hours after surgery, with intravenous heparin, transitioning to warfarin for a target international normalized ratio of 2.5 to 3.5 (Video 1). The postoperative period was uneventful; follow-up 1 week after discharge revealed no need for supplemental oxygen as well as adequate perfusion of his left arm. Oral anticoagulation plan was continued indefinitely, pending further study of his prothrombotic condition.

The patient’s informed consent regarding the publication of the study data was received and approved.

DISCUSSION

A clot in transit (CIT) with massive pulmonary embolism is an almost uniformly fatal condition with indication for surgical management in high-risk patients in whom thrombolysis is contraindicated or has failed (R I Level C). IPDE is an additional poor prognostic indicator, making a multidisciplinary approach and surgery the treatment of choice.

TEE is usually the study of choice, which also provides other essential data such as ventricular function, pulmonary artery pressure, other septal defects, as well as the identification of thrombi in the systemic circulation. In a systematic review by Seo and colleagues, TEE was superior to transthoracic echocardiography for direct thrombus visualization and should be considered in patients who develop pulmonary embolism with a paradoxical embolic event. It should be noted that, in our case, computed tomography played a very important role in the diagnosis, since it documented not only the characteristics of the pulmonary embolism but also the presence of thrombogenic obstruction of the left subclavian artery, which sharpened the diagnosis and efficiency of the intervention.
The association of CIT and IPDE is a rare condition, with a few reports in the literature. The only 2 systematic reviews of IPDE\(^4,5\) conclude that surgical thromboembolectomy is associated with lower mortality from systemic embolism compared with anticoagulation and thrombolysis. Seo and colleagues\(^4\) suggest that surgery is the most appropriate treatment option for a hemodynamically stable patient with thrombus trapped in a PFO, whereas thrombolysis should be used in patients with hemodynamic instability who cannot tolerate surgery.\(^7\)

More recently, AngioVac suction aspiration followed by transcatheter PFO closure might be considered in a case like this, but the evidence suggests that the effectiveness of catheter-based treatment of CIT and/or the IPDE is very limited, and no comparative data or clinical trials exist. Moreover, emergent surgical embolectomy is recommended for patients with a CIT entrapped in a PFO, given the impending risk of systemic embolization and the opportunity to simultaneously repair the PFO.\(^1,3,4\)

In conclusion, urgent surgical pulmonary embolectomy for CIT with acute massive pulmonary embolism and IPDE is safe and can be performed with excellent outcomes. Individualized assessment by a multidisciplinary team constitutes the cornerstone for its diagnosis and timely management.

**References**

1. Konstantinides SV, Meyer G, Bueno H, Galié N, Gibbs JSR, Ageno W, et al. 2019 ESC guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS). Eur Heart J. 2020;41:543-603.
2. Ma X, Song L, Yang H, Xia J, Wu C, He Y. Impending paradoxical embolism. Ann Thorac Surg. 2019;108:e73-5.
3. Kabrhel C, Rosovsky R, Garvey S. Special considerations in pulmonary embolism: clot-in-transit and incidental pulmonary embolism. Crit Care Clin. 2020;36:531-46.
4. Seo WW, Kim SE, Park MS, Lee JH, Park DG, Han KR, et al. Systematic review of treatment for trapped thrombus in patent foramen ovale. Korean Circ J. 2017;47:776-85.
5. Fauveau E, Cohen A, Bonnet N, Gacem K, Lardoux H. Surgical or medical treatment for thrombus straddling the patent foramen ovale: impending paradoxical embolism? Report of four clinical cases and literature review. Arch Cardiovasc Dis. 2008;101:637-44.

**VIDEO 1.** Removal of the large thrombus through the foramen ovale in a right atrial view. Video available at: https://www.jtcvs.org/article/S2666-2507(20)30357-6/fulltext.