

Complete Surgical Correction for Impending Paradoxical Embolism with Pulmonary Embolism, Tricuspid Regurgitation, and Atrial Flutter

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ABSTRACT

Impending paradoxical embolism through a patent foramen ovale with concomitant pulmonary embolism is a rare entity that requires urgent treatment. We present the case of a 74-year-old woman with acute pulmonary embolism and atrial flutter and with echocardiographic features of impending paradoxical embolism through the patent foramen ovale and tricuspid regurgitation. We performed an open pulmonary embolectomy with removal of thrombus from both atria, closure of the patent foramen ovale, a right-sided modified Maze procedure, and De Vega's tricuspid annuloplasty. The patient made a satisfactory recovery. Surgical management is preferable in this setting because it provides the opportunity to correct any associated cardiac abnormalities.

INTRODUCTION

Isolated pulmonary embolism can be successfully managed by thrombolysis. In the presence of impending paradoxical embolism with thrombus entrapped in a patent foramen ovale, thrombolysis may lead to systemic embolism; therefore, surgery is advisable in such cases [Ozgul 2006]. Surgical management also provides the opportunity to correct associated conditions, such as a patent foramen ovale, tricuspid valve regurgitation, and atrial flutter.

CASE REPORT

A 74-year-old woman was admitted to our hospital with a 1-week history of dyspnea and palpitations. Examination of the patient revealed an irregular heart rate of 148 beats per minute and a blood pressure of 96/60 mm Hg. Heart sounds were normal. Examination of the respiratory system produced unremarkable findings, as did the neurological assessment. An electrocardiogram showed atrial flutter with a 2:1 block; chest radiography demonstrated no specific

abnormalities. There was no evidence of systemic arterial embolization.

Echocardiographic evaluation showed a serpentine thrombus in the right and left atria that passed through a patent foramen ovale. The thrombus was mobile, protruding into the right ventricle through the tricuspid valve during diastole (Figure 1A). There was moderate tricuspid regurgitation with dilatation of the right atrium and right ventricle. The pulmonary artery pressure was 45 mm Hg. Doppler ultrasound examination of the lower limb showed thrombus in the left popliteal vein. Computed tomography pulmonary angiography showed bilateral pulmonary emboli affecting the right pulmonary artery more than the left (Figure 1B). Heparin infusion was commenced, and the patient was prepared for surgery.

A right atriotomy (oblique incision) and a left atriotomy (incision parallel to the interatrial groove) were performed. We first removed a left atrial thrombus measuring 9×1.5 cm and then removed the right atrial thrombus (12×1.5 cm; Figure 2A). The right and left pulmonary arteries were then incised, and the emboli were removed. De Vega's tricuspid annuloplasty was subsequently performed, and a right-sided modified Maze procedure (with cryoablation of the right atrial isthmus)

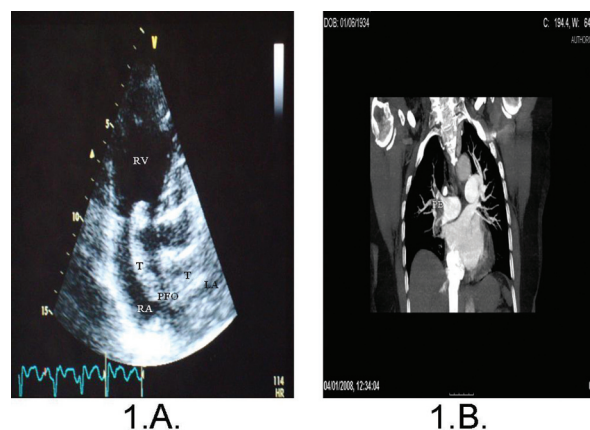


Figure 1. A, Echocardiogram showing thrombus (T) in the right atrium (RA) and left atrium (LA) communicating through a patent foramen ovale (PFO). RV, right ventricle. B, Preoperative computed tomography scan showing pulmonary embolus (PE) in the right pulmonary artery.

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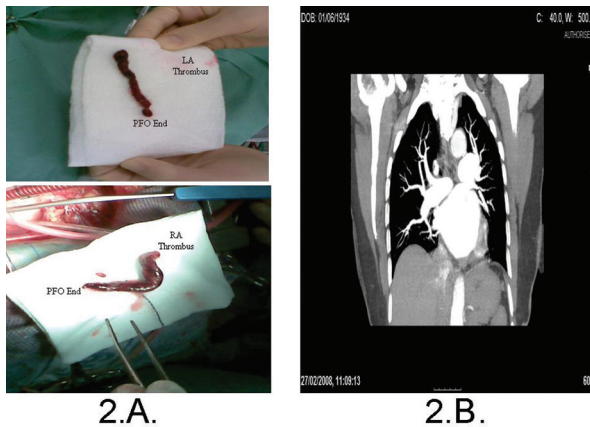


Figure 2. A, Intraoperative image showing the right atrial (RA) and left atrial (LA) thrombi. PFO, patent foramen ovale. B, Postoperative computed tomography scan showing the pulmonary artery without residual thrombus.

was carried out. An intraoperative transesophageal echocardiogram showed only trivial tricuspid regurgitation.

The patient tolerated the procedure well and made an uneventful recovery. Postoperatively, the patient remained in sinus rhythm, and we commenced prophylactic warfarin therapy. Computed tomography pulmonary angiography performed 3 months after surgery showed minimal residual thrombus in the distal right pulmonary arterial tree (Figure 2B). Doppler ultrasound evaluation of the patient's lower limb showed no remaining thrombus in the popliteal veins.

DISCUSSION

The clinical diagnosis of paradoxical embolism requires at least 2 of the following features: deep vein thrombosis and/or pulmonary thromboembolism, intracardiac defect with right-to-left shunting, and arterial embolism without a corresponding source in the left heart [Ozgul 2006].

The incidence of deep vein thrombosis in the general population is approximately 5 per 10,000 population per annum, and increases with age [Fowkes 2003]. Risk factors for the development of venous thromboembolism are recent surgery, immobilization, a history of thrombosis, obesity, malignancy, and thrombophilia [Meacham 1998; Theologou 2007].

Autopsy data suggest that patent foramen ovale may be present in 20% to 35% of the general population [de Belder 1987]. Paradoxical embolism frequently follows pulmonary thromboembolism because of increased pressures, which augment right-to-left shunting through a patent foramen ovale [Ozgul 2006]. Other conditions that predispose to increased right-to-left atrial shunting, and hence to paradoxical embolism, include structural or mechanical disorders of the tricuspid valve, right ventricular failure with increased end-diastolic pressure, positive-pressure ventilation, a positive end-expiratory pressure, hypoxemia, a right-sided myocardial infarction, cardiopulmonary bypass, platypnea and orthodeoxia associated with pneumonectomy or chronic liver disease,

neurosurgical procedures complicated by air embolism, and Valsalva maneuvers in normal patients [Meacham 1998].

The echocardiographic characteristics of an intracardiac thrombus are a mobile mass of irregular shape, serpentine or lobulated, whose configuration changes during the cardiac cycle [Farfel 1987].

Thrombus trapped in a patent foramen ovale causes an unstable pathophysiological state because of the risk of fragmentation and recurrent pulmonary or paradoxical embolization. Patients with impending paradoxical emboli are best treated with initial systemic heparinization followed by urgent surgical embolectomy [Chow 2003]. Placement of inferior vena cava filters to prevent further embolic episodes should be considered and weighed against the possible complications, such as filter malposition, filter migration, and vena cava occlusion and perforation [Decousus 1998].

The therapeutic options available for the treatment of paradoxical embolism are surgery, thrombolysis, and anti-coagulation therapy. Surgical treatment is preferable to medical management for patients with thromboemboli entrapped in the right heart chambers because of the risk of recurrent embolism [Farfel 1987; Aboyans 1998]. The advantage of surgery, in addition to thromboembolectomy, is the opportunity to correct any concomitant cardiac abnormalities. Medical therapy can be an alternative to surgical treatment for high-risk patients or where surgical facilities are unavailable.

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