Thrombus straddling patent foramen ovale and massive pulmonary embolism

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Abstract

A thrombus straddling the foramen ovale is rare; and optimal management is controversial. Most of the literature on this topic is available only in the form of case reports. Here, we present a case of 30-year-old female with recent history of fibular fracture and thrombus in transit through patent foramen ovale and massive pulmonary embolism who was successfully managed with pulmonary embolectomy, extraction of serpentine thrombus straddling patent foramen ovale, and closure of patent foramen ovale.

Keywords Foramen ovale · Thrombus · Pulmonary embolism

Introduction

Deep venous thrombosis is not so uncommon after fracture of lower limbs; which might easily be complicated by pulmonary embolism. Patent foramen ovale (PFO) is a common finding, occurring in up to 25% of people [1]. PFO is associated with a number of conditions which include cryptogenic stroke, decompression sickness, migraine, obstructive sleep apnea, paradoxical myocardial infarction, and other distal embolizations [2]. Thrombus straddling foramen ovale (TSFO) is a rare entity and management strategies include thrombolysis, anticoagulation, and surgical extraction, with no consensus over the superiority of one versus another [3]. Intracardiac thrombus in transit wedged in a PFO is associated with high mortality and morbidity [4]. The combination of a TSFO and acute pulmonary embolism significantly increases the likelihood of the occurrence of paradoxical embolism [5].

Case report

A 30-year-old female was referred to us from another hospital with shortness of breath, cough, and palpitations for 6 days.

Significant past history included left posterior malleolar and proximal fibular fracture 1 month earlier, which was treated by applying circumferential cast. Clinical examination revealed a dyspneic patient with SpO₂ of 94% at room air. Chest revealed bilateral crepitations; cardiovascular system examination was positive for soft systolic murmur in tricuspid area with loud P2. Other systemic examination was within normal limits. Local examination revealed circular cast in left leg below knee. Baseline hematology, biochemistry, and chest x-ray were within normal limits. Electrocardiogram (ECG) showed sinus tachycardia. Transthoracic echocardiography revealed dilated right atrium (RA), right ventricle (RV), and inferior vena cava (IVC), severe tricuspid regurgitation with estimated pulmonary artery systolic pressure (PASP) of 90 mmHg, and RV strain, although we did not measure tricuspid annular plane systolic excursion (TAPSE) to quantify RV dysfunction. Transesophageal echocardiography showed a thrombus in both right and left atria, which was straddling through interatrial septum (Fig. 1a). Contrast-enhanced computed tomography (CECT) of chest showed pulmonary embolism in both right and left pulmonary branches (Fig. 1b, c). Venous Doppler of lower extremity and pelvis revealed deep venous thrombosis of left leg including left popliteal vein, common peroneal vein, and posterior and anterior tibial veins, with no thrombus noted in abdominal and pelvic veins. With the diagnosis of pulmonary embolism and straddling thrombus through PFO, the patient was planned for emergency thrombectomy and PFO closure. With standard bicaval and aortic cannulation, cardiopulmonary bypass was established.

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Fig. 1 **a** Transesophageal echocardiography showing floating thrombus (arrow) through patent foramen ovale. **b** Computed tomography showing multiple filling defects (arrow) in pulmonary arteries (axial view). **c**

Computed tomography showing multiple filling defects (arrow) in branch pulmonary arteries (coronal view)

After aortic cross clamping, right atrium was opened. Thrombus was extracted from the foramen ovale (Fig. 2a). Interatrial septum was incised to enlarge the PFO to inspect left atrium and mitral valve for completeness of thrombus removal prior to closing the PFO. Main pulmonary artery was opened and thrombi in the right and left pulmonary arteries were extracted (Fig. 2b). Schematic representation of the extracted thrombi is shown in Fig. 3 a and b. The entire procedure was performed under normothermic cardiopulmonary

bypass. Patient was weaned off cardiopulmonary bypass uneventfully (aortic cross clamp time: 22 min, and cardiopulmonary bypass time: 45 min). She was transferred to intensive care unit (ICU) with minimal inotropic support, extubated a couple of hours after arrival to ICU, transferred to ward on the 2nd postoperative day, and discharged home on the 6th postoperative day with optimum prothrombin time/international normalized ratio (PT/INR). Pre-discharge transthoracic echocardiography showed slightly dilated RA and RV, RV systolic

Fig. 2 Intraoperative picture of **a** thrombus through patent foramen ovale and **b** thrombus in the main pulmonary artery

Fig. 3 Schematic representation of **a** extracted thrombi and **b** total extracted thrombi. RA, right atrium; LA, left atrium; MV, mitral valve

dysfunction, and mild to moderate tricuspid regurgitation with moderate pulmonary artery hypertension (estimated PASP of 56 mmHg). At 2-year follow-up, she has been doing well with estimated PASP of 26 mmHg and no recurrence of thrombo-embolic events.

Discussion

Although surgical removal of pulmonary emboli was proposed in the early 1900s; successful pulmonary embolectomies were not performed until the late 1950s using cardiopulmonary bypass [6]. There was a time when pulmonary embolectomy used to be a scenario in which an operation was declared a failure before the skin incision was made, regardless of the results, and this operation almost slipped away as a legitimate tool for managing complex acute pulmonary embolism [7]. However, recently it has been rediscovered and cardiothoracic surgeons have been able to show improved surgical outcomes.

Under normal circumstances, the flap valve mechanism seals the potential opening of PFO. However, in the presence of pulmonary hypertension and acute right ventricular dysfunction, which is the case in massive pulmonary embolism, shunt reversal is the rule resulting into systemic embolization of venous emboli. Thrombus straddling PFO is rare and the published cases in the current literature are scant. Its management strategies include thrombolysis, anticoagulation, and surgical extraction, with no consensus over the superiority of

one versus another. Treatment should be individualized based on the clinical presentation and comorbidities of the patient [4]. Mostly, patients with unstable hemodynamics tend to be put on medical management [3]. Randomized trials regarding management options (surgical or medical) are not feasible due to the rarity of the condition; and the literature builds on the pile up of case reports. Here, we share our experience of this rare entity hoping that it will add up the existing literature.

We chose to undertake emergency thrombus extraction due to possible migration of thrombus through PFO resulting in systemic embolization. Simultaneous pulmonary and coronary embolism in a patient with PFO has also been described [8]. Our team was concerned about the risk of migration of floating thrombus intraoperatively, so we made sure that there was minimal manipulation to the chambers of the heart, and we avoided blind instrumentation. We opened right atrium and removed the serpentine thrombus prior to opening the main pulmonary artery and removing pulmonary thrombi, which we believe is a very simple but important surgical caveat. Placement of an IVC filter would have further prevented the risk of recurrent pulmonary embolism; however, we were a bit conservative because the cause of her deep venous thrombosis was pretty obvious and the risk itself would be minimal in the context of her healed fracture and early mobilization.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval Ethical clearance was obtained from institutional review committee of our center.

Informed consent Informed consent was obtained from patient. Patient gave consent for publication.

Human and animal rights Human rights were not breached in any way during the entire process.

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