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ABOUT COVER

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Thrombus straddling a patent foramen ovale and pulmonary embolism: A case report

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Abstract

BACKGROUND

Venous thromboembolism is a common vascular syndrome presenting as deep vein thrombosis and/or pulmonary embolism. Thrombus has the possibility of migrating into the left circulation *via* patent foramen ovale in certain extreme circumstances. Thrombus straddling a patent foramen ovale is a direct evidence of this scenario. However, the confirmed cases of thrombus in transit are still rare.

CASE SUMMARY

A 32-year-old man suffered from recurrent syncope and intermittent dyspnea for 1 wk. Transthoracic echocardiography confirmed a thrombus straddling the patent foramen ovale, and thrombi were also found in the bilateral pulmonary artery by computed tomography. The man underwent inferior vena cava filter placement and thrombolysis with alteplase. Echocardiography showed the absence of thrombi in both the right atrium and left atrium 2 d after hospitalization. The man was discharged to home on warfarin without any complications 2 wk later.

CONCLUSION

Scrutinizing intracardiac thrombi provides measurable value in pulmonary embolism as closure of patent foramen ovale may be considered in certain patients. Early intervention plays a critical role in thrombus straddling a patent foramen ovale. A sedentary lifestyle may predispose young adults to thromboembolism, even if there are no other risk factors.

Key Words: Thrombus; Patent foramen ovale; Pulmonary embolism; Case report

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Core Tip: Thrombus straddling a patent foramen ovale is a life-threatening condition that is usually complicated with pulmonary embolism. We present a rare case of deep venous thrombosis, concomitant with pulmonary embolism and transient ischemic attack. Transthoracic echocardiography revealed a large thrombus straddling the patent foramen ovale. There was no significant predisposing factor for thromboembolism except the sedentary lifestyle of the young patient. This case highlights the crucial role of echocardiography in a patient with pulmonary embolism. Identifying intracardiac thrombi may modify the strategies of thromboembolic disease. Moreover, a vigorous lifestyle should be recommended for avoiding thrombotic disaster among young adults.

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INTRODUCTION

Venous thromboembolism (VTE), clinically presenting as deep vein thrombosis (DVT) or pulmonary embolism (PE) is a common vascular syndrome. Thrombus in transit can cause pulmonary embolism and paradoxical embolism, resulting in severe clinical outcomes. There is a link between paradoxical embolism and cryptogenic stroke^[1], and patent foramen ovale (PFO) plays a crucial role in this scenario. Echocardiography can detect PFO, which is a major cause of cryptogenic stroke. Therefore, screening PFO should be considered among patients diagnosed with pulmonary embolism.

The treatment of the thrombus in transit includes anticoagulation, reperfusion therapy, surgical embolectomy, venous filters and hemodynamic and respiratory support if necessary^[2]. We present a case of a young man who suffered from thrombus straddling a PFO and submassive PE simultaneously. The patient received thrombolysis with alteplase and recovered soon without any complications.

CASE PRESENTATION

Chief complaints

A 32-year-old man presented to the emergency room with repetitive episodes of syncope and intermittent dyspnea within 7 d.

History of present illness

The patient complained of chest distress on February 15, 2019. Then he had a transient, self-limited loss of consciousness lasting for 3-5 min, followed by prompt recovery. The syncope happened four times. The trigger of the attacks included physical exertion or inhaling cold air. There is no prodromal or accompanied symptom. He went to our hospital by himself on February 22, 2019 because of another onset of syncope.

History of past illness

The patient had no medical history nor family history of blood clotting disorders, but he had a sedentary lifestyle due to his job as a news editor.

Physical examination

His vital signs were stable at the time of the first medical contact. Physical examination results were as follows: Pulse rate: 96 beats/min; respiratory rate: 20 breaths/min; blood pressure: 15.5/10.1 kPa; body mass index: 23.1 kg/m²; pupils: Symmetric and responsive to light; prominent P2; symmetrical breath sounds without rales or wheezing; and warm extremities without edema. The neurological examination was negative.

Laboratory examinations

Initial laboratory test showed elevated serum D-dimer at 4150 ng/mL (reference < 500 ng/mL). Arterial blood gas analysis showed PaO₂ of 79 mmHg while he was breathing ambient air. N-terminal pro-B-type natriuretic peptide was 4460 pg/mL (reference < 450 pg/mL). The levels of serum cardiac enzyme series were normal.

Imaging examinations

The electrocardiogram showed sinus tachycardia. Doppler ultrasound revealed a deep venous thrombosis in the right popliteal vein (Figure 1). Transthoracic echocardiography showed a mass thrombus straddling a PFO concomitant dilated right atrium and moderate pulmonary hypertension (Figure 2). The size of the thrombus was 3 mm × 20 mm in the left atrium, 8 mm × 25 mm in the right atrium. Computed tomography angiography confirmed bilateral peripheral PE (Figure 3). The brain computed tomography scan was normal.

FINAL DIAGNOSIS

Thrombus straddling a PFO, PE and DVT.

TREATMENT

Given the risk of detachment of the thrombus from the right popliteal vein, inferior vena cava filter was placed immediately. Then the patient received thrombolysis with intravenous alteplase (100 mg over 2 h) and subcutaneous injection with enoxaparin (60 mg/12 h). Bedside transthoracic echocardiography showed the absence of a clot in the right and left atrium 2 d later. The inner diameter of the right heart chamber was also returned to normal.

Considering that there was no significant predisposing factor for the young patient, the thrombophilic screen was sent off. Antithrombin III, protein S and protein C were normal. Urine albumin was negative. Blood tests also ruled out autoimmune diseases. Dynamic electrocardiogram (Holter) showed no evidence of atrial fibrillation. The patient denied any medical history of trauma, surgery, cancer, drug abuse, long flight or dehydration. Therefore we speculated the sedentary lifestyle may be the major cause of the disease.

The inferior vena cava filter was removed on March 7, 2019. The patient was discharged to home on warfarin the next day.

OUTCOME AND FOLLOW-UP

The patient recovered quickly without any complications. Percutaneous closure of PFO was recommended, but the patient refused further interventional treatment. The patient followed the recommendation of exercise, such as jogging or swimming, five sessions per week lasting on average 30 min/session and involving moderate-to-vigorous intensity physical activity. Moreover, the patient was told not to stay up late at night and maintain a good mentality. He returned to his country 2 mo later. One year follow-up by WeChat showed that there was no recurrent thromboembolic event without anticoagulation therapy.

DISCUSSION

VTE, encompassing DVT and PE, is the third most frequent acute cardiovascular syndrome behind myocardial infarction and stroke^[3]. The incidence rate of VTE ranges from 115 to 269 per 100000 population^[4]. VTE may be lethal in acute phase or lead to chronic disease and disability. The predisposing factor of VTE includes hereditary disease and environmental factors. The patient was healthy before. Body mass index indicated that he was far from obesity. Laboratory examination ruled out autoimmune disease, nephrotic syndrome and hereditary coagulation disease. Furthermore, the patient was too young to be thrombophilic; the mean age of patients with trapped thrombus in a PFO is 59.3 ± 16.4 years^[5]. Nevertheless, the patient used to sit for a long



Figure 1 Doppler ultrasound revealed a deep venous thrombosis in the right popliteal vein.

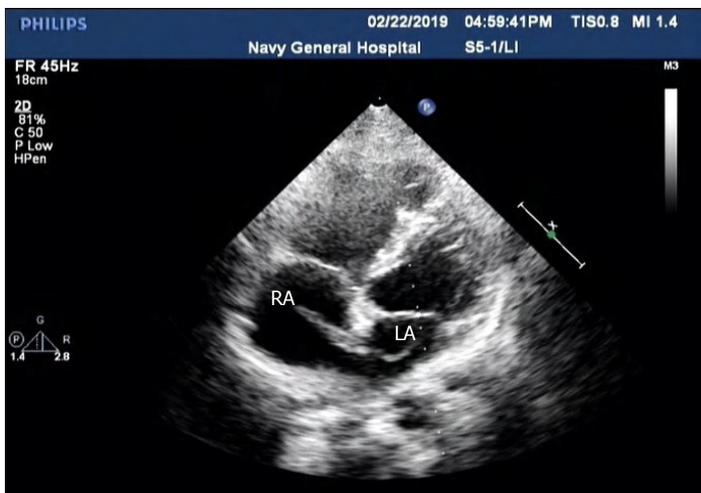


Figure 2 Transthoracic echocardiography showed a mass thrombus straddling a patent foramen ovale (3 mm × 20 mm in the left atrium, 8 mm × 25 mm in the right atrium). RA: Right atrium; LA: Left atrium.

time and burn the midnight oil as a news editor, which is a stressful job as he described. This may have predisposed him to develop spontaneous lower extremity DVT formation and subsequent thrombus straddling a PFO accompanied with acute submassive PE. Besides, there was another possibility that the thrombus originated from the PFO itself due to the special structure that can accelerate the blood flow. Because the DVT was confirmed, the diagnosis of thrombus in transit was our priority.

Thrombus in transit not only affects cerebrovascular but also migrates to other arteries. Wąsek *et al*^[6] reported a case of ST-segment-elevation myocardial infarction related to paradoxical embolization. Santangelo *et al*^[7] presented a patient diagnosed with PE complicated by right renal ischemia and multiple splenic infarcts due to a mobile thrombus entrapped in a PFO. Thus, it is necessary to pay attention to left circulation thromboembolism while unexplained organ damage happens.

PFO is a frequent finding on echocardiography and occurs in about 25% of the population^[8,9]. The presence of a PFO is implicated in the pathogenesis of cryptogenic stroke^[10]; the mechanism of which has been attributed to the paradoxical embolism of venous thrombi that shunt through the PFO while right atrial pressure is high. However, the diagnosis of paradoxical embolism is generally presumptive, mainly relying on the speculation of the physicians. The case we describe above provided direct evidence of thrombus passing through a PFO, which definitely confirmed the paradoxical embolism. Therefore, screening for a PFO with echocardiography seems to be plausible among patients diagnosed with PE. Because the detection rate of two-dimensional echocardiography is low, contrast-transesophageal echocardiography or

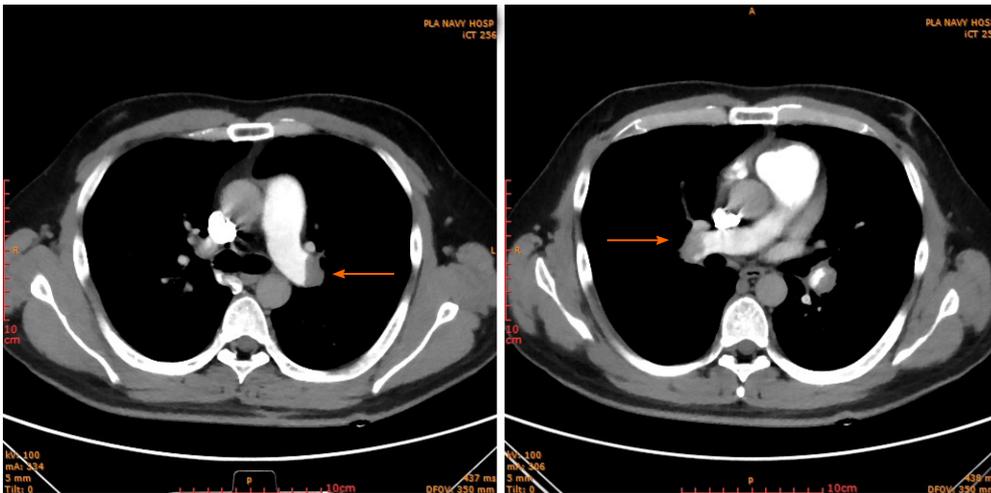


Figure 3 Computed tomography angiography confirmed bilateral pulmonary embolism.

contrast-enhanced transcranial Doppler should be taken into consideration^[11].

Theoretically speaking, patients with PFO and paradoxical embolism would benefit from closure of the PFO. But the evidence of PFO closure used to be controversial. The RESPECT study showed that there was no significant benefit associated with closure of a PFO in adults who had a cryptogenic ischemic stroke^[12]. Nevertheless, long-term follow-up revealed a lower rate of recurrent ischemic strokes in patients who received PFO closure than medical therapy alone^[13]. A meta-analysis also showed patients with PFO and cryptogenic stroke benefited from percutaneous closure in preventing future stroke compared to medical therapy^[14]. Given that the patient was diagnosed with PFO and transient ischemic attack, percutaneous closure PFO was suggested. However, he turned down the suggestion due to the concern about the complications of the surgery. The patient followed the advice of regular exercise. The long-term outcomes will be investigated by our heart team.

The therapeutic strategies of thrombus straddling a PFO include hemodynamic stabilization, respiratory support, filter implantation, anticoagulation, thrombolysis and thrombectomy. Because there is no guideline for the treatment of thrombus in transit, strategies should be personalized according to the patient's symptomology, hemodynamic stability, current clinical evidences, physician's decision and patient's intention. Initial shock or arrest were found in nearly 40% of the cases with trapped thrombus in a PFO^[5]. Extracorporeal membrane oxygenation plays a significant role in rescuing patients with PE complicating hemodynamic instability^[15]. The systematic review showed that thrombectomy was associated with a lower overall incidence of post-treatment embolic events and a lower 60-d mortality in patients with trapped thrombus in a PFO^[5]. Our patient fully and quickly recovered by filter placement and thrombolytics. Thus, conservative treatment with thrombolytics should be emphasized for the younger group, and therefore invasive strategies may be avoided in clinical practice. Although our patient did not accept the PFO closure, we will keep an eye on the long-term outcome of him since the precipitating factor was removed.

CONCLUSION

Thrombus straddling a PFO is a rare but severe clinical circumstance, which is always complicated with PE. Screening PFO with echocardiography should be considered among patients diagnosed with PE. The patient we describe above provides direct evidence of paradoxical embolism. Moreover, a vigorous lifestyle should be recommended for avoiding thrombotic disaster among young adults.

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