

Paradoxical embolus straddling patent foramen ovale demonstrated by computed tomographic pulmonary angiography

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Author contributions: Both authors contributed to the conception and design of report, drafting the article and final approval of the version to be published.

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Received: January 22, 2013 Revised: April 24, 2013

Accepted: May 9, 2013

Published online: June 16, 2013

Abstract

An elderly gentleman presented to the emergency department with a recent history of dyspnoea, collapse and transient neurological symptoms. He was noted to be hypoxic with a significantly elevated D Dimer. A computer tomography pulmonary angiogram demonstrated a large embolus with a further filling defects within the left and the right atria, abutting the interatrial septum. Suspicion of a paradoxical pulmonary embolus was raised and the patient subsequently underwent echocardiography which confirmed a patent foramen ovale (PFO). He was commenced on warfarin therapy. In patients with elevated right heart pressure, a PFO can be unmasked and give rise to cerebral emboli. Clinical suspicion should be raised in patients with pulmonary emboli or deep venous thrombosis if there is a concomitant history of focal neurological symptoms.

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Key words: Pulmonary embolus; Paradoxical embolus; Computer tomography pulmonary angiogram; Patent

foramen ovale; Stroke

Core tip: Patent foramen ovale (PFO) are common but usually closed and asymptomatic due to the greater pressure in the left heart. They however pose a particular risk for patients with large pulmonary emboli (PE) where they can open providing a right to left shunt when the right heart pressure rises due to pulmonary arterial obstruction by PE. In these circumstances thrombus can transit the PFO paradoxically embolising systemically. We report a case of a patient with a large PE who had a cerebral embolus where thrombus is imaged straddling the PFO at computer tomography pulmonary angiography.

Cormack L, Murchison JT. Paradoxical embolus straddling patent foramen ovale demonstrated by computed tomographic pulmonary angiography. *World J Clin Cases* 2013; 1(3): 108-110 Available from: URL: <http://www.wjgnet.com/2307-8960/full/v1/i3/108.htm> DOI: <http://dx.doi.org/10.12998/wjcc.v1.i3.108>

INTRODUCTION

Patent foramen ovale (PFO) is estimated to be present in approximately 27% of the population^[1]. Under normal physiological conditions where left-sided heart pressure exceeds right-sided pressure, the foramen remains closed. However, in circumstances where right-sided pressure is elevated, for example in pregnancy, cor pulmonale or in the presence of pulmonary thromboembolic disease, the foramen can be opened which may result in paradoxical emboli entering the left-heart and systemic circulation. The presence of thrombo-embolic disease and a PFO thus increases the risk of stroke.

This case highlights the value of computer tomography (CT) pulmonary angiogram, for example when

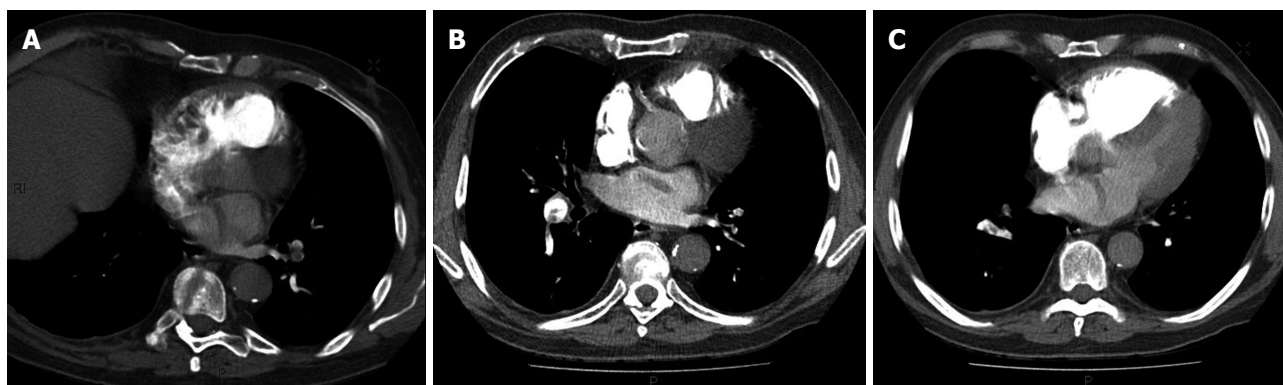


Figure 1 Findings at computed tomographic pulmonary angiography. A: Computer tomography pulmonary angiogram (CTPA) demonstrating a serpiginous low attenuation filling defect in the left atrium which extends across into the right atrium through a patent foramen ovale representing a paradoxical embolus (oblique axial view). There are also filling defects in the left lower lobe pulmonary artery due to pulmonary emboli; B: Demonstrating a filling defect in the left atrium filling defects in the right lower lobe pulmonary artery due to pulmonary emboli (axial view); C: CTPA demonstrating a filling defect in the left atrium, abutting the intra-atrial septum and bowing of the intra-ventricular septum due to raised right heart pressure (axial view).

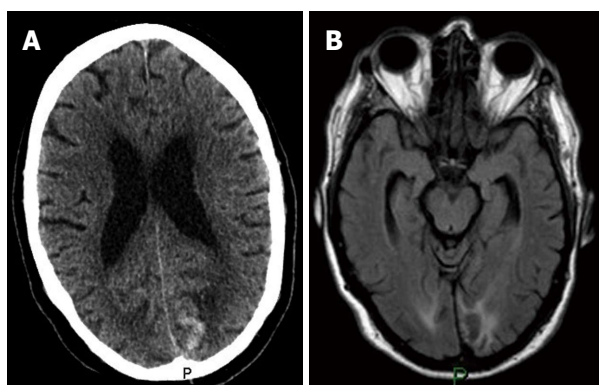


Figure 2 Neurological imaging. A: Unenhanced computer tomography brain examination (axial view) demonstrating left occipital high attenuation with surrounding low attenuation; B: Magnetic resonance imaging brain examination (axial view, FLAIR sequence) demonstrating left occipital lobe infarct with haemorrhagic transformation.

compared to perfusion scanning, in assessing right heart strain as a result of pulmonary embolus, in addition to the possibility of detecting paradoxical embolus when present.

CASE REPORT

Case presentation

An 80-year-old gentleman with history of type 2 diabetes, chronic renal impairment and hypertension presented to the emergency department with marked dyspnoea, dizziness and collapse but without loss of consciousness. There were no features to suggest underlying infection. He also described transient left-sided paraesthesia and weakness, which had largely resolved by the time he was assessed. He was noted to be hypoxic and tachycardic with a markedly raised D Dimer (34704 µg/L). CT pulmonary angiography was requested which confirmed the presence of large pulmonary emboli, but also a further filling defects within the left and right atria (see investi-

gations below). Bubble contrast echocardiography confirmed the presence of a PFO.

Investigations

CT pulmonary angiogram: Large bilateral pulmonary artery emboli with a further serpiginous filling defect visible within the left atrium, abutting the inter-atrial septum and extending into the left atrium. Appearances represent a paradoxical embolus caught in a PFO (Figure 1).

Unenhanced CT brain examination (performed the day after computed tomographic pulmonary angiography): High attenuation within the medial aspect of the left occipital lobe, in keeping with acute haemorrhage due to haemorrhagic transformation of an infarct/embolic infarct (Figure 2A).

Magnetic resonance imaging brain examination, without contrast: Performed 19 d after CT brain examination to rule out multiple emboli to the brain in order to help decide whether to surgically close the PFO. This showed bilateral occipital increased FLAIR signal with restricted diffusion in keeping with infarction. High T1 signal in the left occipital lobe consistent with a degree of haemorrhagic transformation (Figure 2B).

Echocardiography: With bubble contrast, confirmed the presence of a PFO.

Treatment

The patient was commenced on warfarin therapy to treat pulmonary embolus. He was not considered for surgical closure of the PFO.

Outcome and follow-up

The patient made a good recovery initially. A follow-up CT brain performed because of a fall and head injury sustained at home eighteen months following initial presentation did not show any further ischaemic events.

DISCUSSION

Previous case reports of paradoxical pulmonary emboli have been able to demonstrate thrombus within a patent septal defect on echocardiography^[2,3], however this finding has not been previously reported on CT pulmonary angiography. Further cases have shown a PFO only (without thrombus)^[4], or have failed to demonstrate the source of the right-to-left shunt^[5].

CT pulmonary angiography is the gold standard for detecting acute pulmonary embolus^[6]. It has a high sensitivity (83%-100%) and specificity (89%-97%)^[7,8]. An additional advantage of computed tomographic pulmonary angiography is the assessment of right ventricular/left ventricular (RV/LV) ratio as an indicator of severity in acute pulmonary embolism. Transverse RV/LV diameter ratio has been shown to be significantly higher in patients who die in hospital than amongst those who survive acute pulmonary embolus^[9].

Visualisation of thrombus within the atria or ventricles is an unusual finding which should prompt further investigation of a septal defect and right-to-left shunt. Whilst the clinical history alone in this particular case may have been sufficient to provoke investigation of a PFO, the finding of thrombus within the left atrium made the presence of a PFO almost certain and may therefore have expedited echocardiography and neuro-imaging.

According to National Institute for Clinical Excellence guidelines, the optimal treatment of patients with a PFO who have had a thromboembolic event remains undefined^[10]. Medical management with antiplatelet or anticoagulation therapy is frequently used to reduce the risk of further paradoxical thrombi. Closure of the PFO may be performed in patients who have further embolic events despite medical management, or in cases where anticoagulant therapy is contraindicated. Percutaneous procedures allow closure of the PFO without the need for major surgery. In this case the presence of acute haemorrhage, presumed to be haemorrhagic transformation of an embolic infarct, further complicated management, however the decision was made that it was in the patient's best interest to proceed with anticoagulation.

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