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Pulmonary embolism and patent foramen ovale, augmented risk for paradoxical embolism?

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CASE REPORT

A 72-year-old man who had been discharged earlier in the day from the emergency room (ER) on anticoagulation therapy with the diagnosis of left popliteal territory deep vein thrombosis (DVT), was brought back into the ER, intubated and hemodynamically unstable, after an episode of resolved syncope, followed by agitation and severe desaturation. Past medical history was marked by ongoing chemotherapy treatment for stage 4 intrahepatic cholangiocarcinoma. Pulmonary embolism was suspected, among other non-traumatic causes of syncope: arrhythmias, acute myocardial infarction, aortic stenosis, vasovagal reflex, orthostatic hypotension, and others. Due to difficult peripheral venous access, a femoral central venous catheter (CVC) was placed for sedoanalgesia and vasopressor drip. 12-Lead electrocardiogram was performed showing sinus tachycardia with S1Q3T3 sign (Figure 1). Point of care ultrasound (POCUS) showed a dilated right ventricle and McConnell's sign. It also revealed a patent foramen ovale (PFO) with the CVC crossing to the left atrium, in the context of right to left shunt (Figure 2). Arterial blood gas and lab tests were performed (Table 1). Thoracic computed tomography (CT) scan confirmed bilateral central pulmonary embolism (PE) (Figure 3). Brain computed tomography (CT) scan was performed in the absence of neurological examination to aid in therapeutic effort adequacy planning, which ruled out signs of acute paradoxical stroke. After intensive care unit (ICU) admission,

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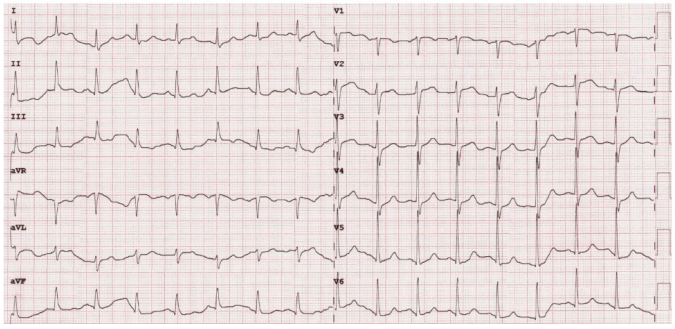

Figure 1: 12-Lead EKG at admission showing typical signs of PE with mild sinus tachycardia and S1Q3T3 sign (McGinn-White sign: S wave in lead DI, Q wave in lead DIII, and inverted T wave in DIII).

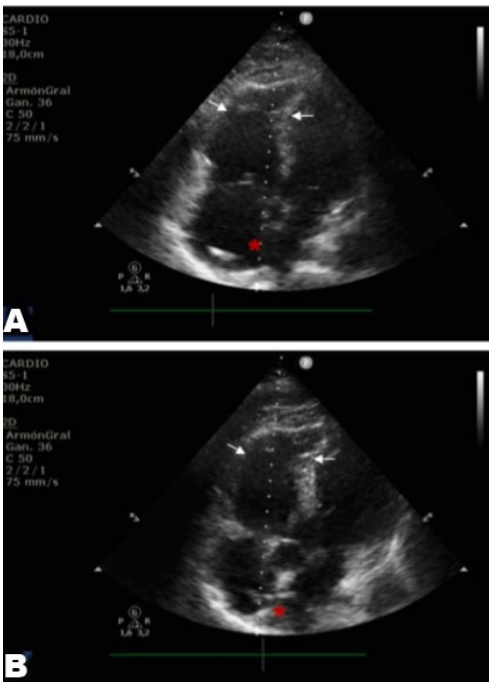

Figure 2: Cardiac POCUS apical four chamber view (A) and five chamber view (B) depicting a dilated right ventricle, with ventricle interdependence and McConell sign (arrows), which consists in: regional RV dysfunction with mid RV free wall bulging with normal RV apex, tethered to LV. These are all consistent with elevated right circulation pressures and right ventricle dysfunction compatible with high-intermediate risk PE. CVC can be seen crossing through the septum to the left atrium (*).

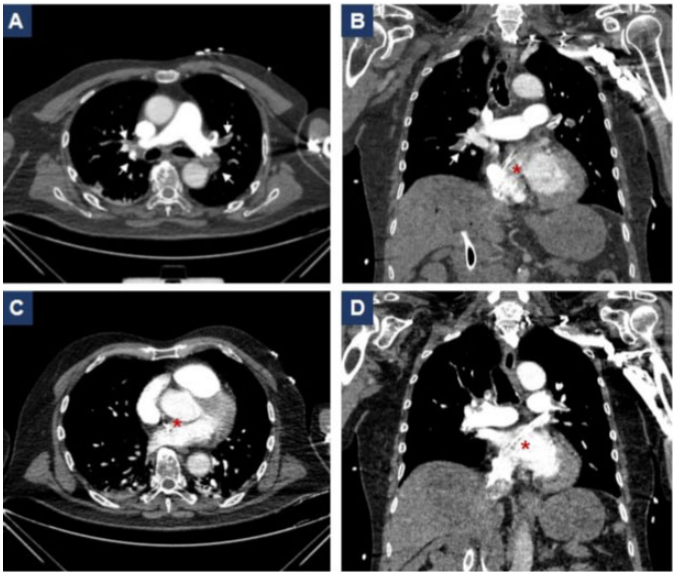

Figure 3: CT chest axial views (A, C) and coronal views (B, D) demonstrating a bilateral central PE (arrows) with a dilated pulmonary artery and showcasing CVC crossing into the right atrium (*), in the context of high right circulation pressures and PFO.

Table 1: Arterial blood and lab test results at admission, showing mixed metabolic (lactic) and respiratory acidosis with an $PaCO_2$-$EtCO_2$ difference of 20 mmHg ($EtCO_2$ 31 mmHg). Troponin I was elevated consistent with myocardial injury.

Arterial gas blood	
pH	7.27 (7.35–7.45)
PaO_2	103 mmHg (>100)
$PaCO_2$	51 mmHg (35–45)
HCO_3^-	23.4 mmol/L (22–28)
Lactate	2.7 mmol/L (0–1.8)
Lab test results	
D-dimer	23,018 ng FEU/mL (0–500)
BNP	27 ng/mL (0–100)
Troponin I	1396.7 pg/mL (1.9–34.2)

$EtCO_2$: End-tidal carbon dioxide; PaO_2: partial pressure of arterial oxygen; $PaCO_2$: partial pressure of arterial carbon dioxide; BNP: B-type natriuretic peptide.

percutaneous thrombectomy and thrombolysis were performed due to persistent hemodynamic instability. The patient's condition improved and he was discharged six days after admission in the ICU. No neurological symptoms were reported during evolution.

DISCUSSION

Paradoxical embolism through a PFO accounts for some 54% of cases of cryptogenic stroke [1] and it can be a potential complication found simultaneously or closely after PE presentation [2]. This is favored in the presence of PFO and high or intermediate risk PE, characterized by elevated right circulation pressures with right to left atrial shunt [2, 3]. Quick PFO ruled out with transthoracic echocardiogram could potentially serve as a negative predictive value. In our case we encountered the diagnoses of PFO by chance during our POCUS examination and chest CT. Brain CT was performed to rule out acute embolic stroke in the initial work-up.

CONCLUSION

The risk of paradoxical embolism stroke is augmented in severe PE cases with associated PFO, but more studies are needed to aid in the diagnostic approach and clinical management of these cases.

Keywords: Paradoxical stroke, Patent foramen oval, Pulmonary embolism

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Author Contributions

Pablo Lasa-Berasain – Conception of the work, Design of the work, Acquisition of data, Analysis of data,

Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Mario García Parra – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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Authors declare no conflict of interest.

Data Availability
All relevant data are within the paper and its Supporting Information files.