

# Paradoxical Pulmonary Embolism in a Patient with Bilateral Renal Infarction: The Role of Contrast-enhanced Ultrasound Imaging

Francesco Negri, Massimo Burelli<sup>1</sup>, Linda Pagura<sup>1</sup>, Camilla Sachs<sup>2</sup>, Massimo Imazio, Gianfranco Sinagra<sup>1</sup>

Department of Cardiothoracic, University Hospital, Udine, Departments of <sup>1</sup>Cardiovascular and <sup>2</sup>Radiology, University Hospital, Trieste, Italy

## Abstract

We present the case of a 52-year-old male who was admitted to the hospital for a bilateral pulmonary embolism. On the 5<sup>th</sup> day of hospitalization, an acute kidney injury (AKI) occurred. A transesophageal echocardiogram was performed and it demonstrated a large patent foramen ovale with a consistent right-to-left shunt. Contrast-enhanced ultrasound (CEUS) was performed and it demonstrated multiple bilateral renal ischemic areas. CEUS represents a valid alternative to computed tomography or magnetic resonance to confirm the diagnosis of bilateral kidney infarction, especially in patients who experience an AKI.

**Keywords:** Acute kidney injury, paradox embolism, patent foramen ovale, pulmonary embolism, renal kidney embolism

## INTRODUCTION

A rare scenario in pulmonary embolism is paradoxical embolism, manifesting in this case with acute kidney injury. In this particularly scenario, contrast-enhanced ultrasound is a valid diagnostic tool alternative at CT scan or MRI imaging.

## CASE REPORT

A 52-year-old male, severely obese, recently hospitalized for 4 days due to influenza syndrome, was admitted to the emergency department for worsening dyspnea.

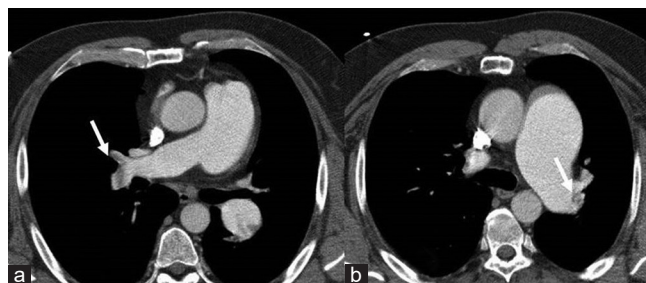
His vital signs were stable. For a high suspicion of pulmonary embolism, a thoracic computed tomography (CT) was performed and it demonstrated the presence of bilateral pulmonary embolism [Figure 1a and b].

About the medical history, it was discovered that, at the age of 5 years old, the patient underwent commissurotomy for congenital pulmonary stenosis with subsequent severe residual pulmonary insufficiency, pulmonary artery, and right ventricular dilatation.

According to the ESC guidelines on pulmonary embolism, the patient was stratified in an intermediate–high risk class.<sup>[1]</sup> The Pulmonary Embolism Shock Index was a Class IV<sup>[1]</sup> and there

was evidence of a right ventricular dysfunction [Figure 2] and a rise of troponin I up to 0.28 ng/ml.

Because of the relatively young age and for the intermediate–high risk class, it could be performed thrombolytic therapy.



**Figure 1:** (a and b) CT shows the right and left pulmonary artery thrombosis. CT = Computed tomography

**Address for correspondence:** Dr. Francesco Negri, Department of Cardiothoracic, University Hospital, Udine, Italy. E-mail: francesco\_negri@yahoo.it

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**For reprints contact:** WKHLRPMedknow\_reprints@wolterskluwer.com

**Submitted:** 25-Apr-2022 **Revised:** 16-Jun-2022

**Accepted:** 30-Jul-2022 **Published:** 16-Nov-2022

**How to cite this article:** Negri F, Burelli M, Pagura L, Sachs C, Imazio M, Sinagra G. Paradoxical pulmonary embolism in a patient with bilateral renal infarction: The role of contrast-enhanced ultrasound imaging. *J Cardiovasc Echography* 2022;32:180-2.

### Access this article online

Quick Response Code:



Website:  
[www.jcecho.org](http://www.jcecho.org)

DOI:  
10.4103/jcecho.jcecho\_25\_22

However, because of a nonhigh thrombotic load at CT, it was decided to start anticoagulant therapy with unfractionated heparin (UFH).

A venous echo Doppler demonstrated the presence of thrombosis of the right popliteus veins [Figure 3] and of the left anterior tibial vein.

Moreover, a complete screening for thrombophilia syndromes and neoplastic markers was performed and no signs of disease were shown.

On the 5<sup>th</sup> day of treatment with UFH, the patient complained about right flank pain with subsequent onset of acute kidney injury with a creatinine rise up from 1.3 to 3.1 mg/dl with a preserved diuresis.

The sudden onset of acute renal failure in the context of pulmonary embolism poses a clinical suspicion of paradoxical embolism with renal infarction.

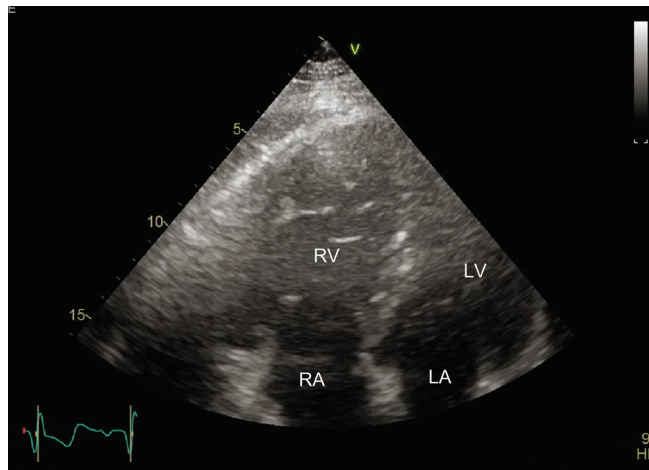
A transesophageal echocardiogram was performed, which demonstrated a large patent foramen ovale (PFO) with a consistent right-to-left shunt [Figure 4a and b].

To demonstrate the presence of renal infarction, a bolus of 1, 2 ml of SonoVue® (sulfur hexafluoride microbubbles) was injected into a peripheral vein. The images of the kidneys were then acquired during the arterial phase: 60 s

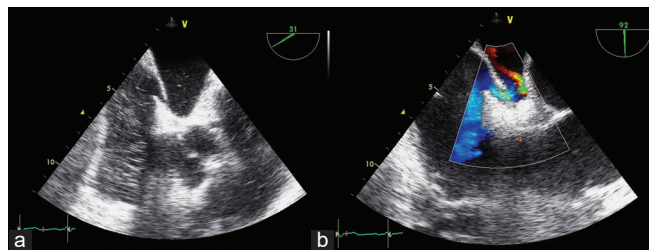
after bolus injection for the left kidney and 70 s after bolus injection for the right kidney. This technique is well known as contrast-enhanced ultrasound (CEUS). The images showed multiple bilateral renal ischemic areas [Figure 5, white stars]. CEUS did not find any other infarcted organs in the abdomen. The continuation of anticoagulant therapy brought the creatinine back from 3.1 to 1.7 mg/dl.

## DISCUSSION

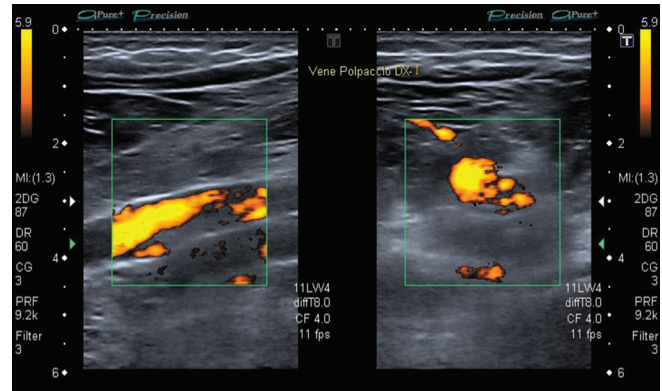
Rapid rise up of creatinine, in a patient with pulmonary embolism, should lead the suspicion of paradoxical kidney embolism.<sup>[1]</sup>



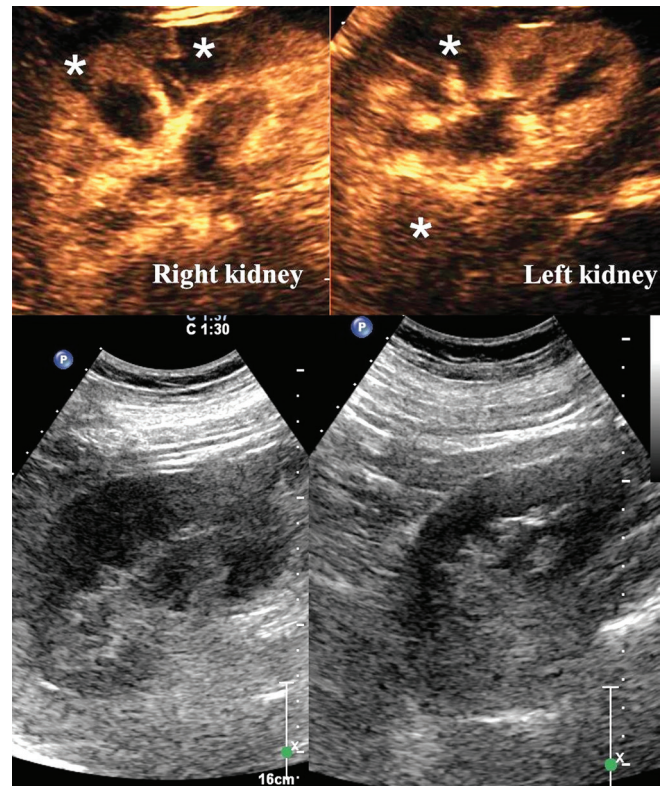
**Figure 2:** Transthoracic echocardiography shows the right ventricular dilation and dysfunction. RV = Right ventricle, LV = Left ventricle, RA = Right atrium, LA = Left atrium



**Figure 4:** Transesophageal echocardiogram shows a large PFO. Panel A; right-to-left shunt after agitated saline solution. Panel B Aliasing at color Doppler. PFO = Patent forame ovale



**Figure 3:** Echo color Doppler shows the thrombosis of the right popliteus veins



**Figure 5:** Right and left kidneys: Bottom panel before contrast ultrasound injection, Upper panel after contrast-enhanced ultrasound injection, imaging shows multiple areas of emboli lesions (white stars)

**Table 1: Paradoxical pulmonary embolism clinical signs and embolic site**

Patients	Gender	Age (years)	Presentation Laboratory test	Embolic site	Diagnosis	Shunt	References
1	Female	45	Acute, abdominal pain Creatinine raise	Lu, K, E	CT	PFO	Am J Emerg Med 1985;3:206-7
2	Female	70	Acute, lumbar pain Creatinine raise	Lu, K	CT, arteriography	PFO	Nephrol Dial Transplant 2006 Aug; 21:2315-7
3	Female	48	Acute, flank pain ND	H, K	CT	PFO	Catheter Cardiovasc Interv 2007 Dec 1;70:1010-2
4	Male	48	Acute, flank pain ND	K	CT, MR	PFO	Kidney Res Clin Pract 2012 Sep; 31:196-9
6	Female	52	Slurred speech ND	B, K	CT	PFO	Korean Circ J 2012 Dec; 42:853-6
7	Female	22	Subacute, hypertension Creatinine normal	K	CT	PFO	Clin Exp Nephrol 2011;15:582-5
8	Male	52	Acute, flank pain Creatinine raise	K	CEUS	PFO	Actual case

Lu=Lung, K=Kidney, E=Extremity, H=Heart, B=Brain, ND=Not defined, CT=Computed tomography, MR=Magnetic resonance, CEUS=Contrast-enhanced ultrasound, PFO=Patent foramen ovale

In Table 1, we report the English literature cases describing bilateral kidney infarction with a PFO shunt. In all cases reported, the diagnosis of kidney infarction was performed with CT or magnetic resonance (MR) or direct arteriography. In some cases, particularly those with anuria, the therapy was not limited to anticoagulant therapy, but they required Fogarty catheters, followed by local thrombolysis.<sup>[2]</sup>

The CEUS of the renal arteries is a valid alternative to CT/MR for kidney infarction<sup>[3]</sup> diagnosis.

CEUS does not expose the patient neither to ionizing radiations nor to the risk of worsening kidney failure related to iodine or gadolinium toxicity.

Direct arteriography should be used only if a therapeutic option is planned such as embolectomy or local thrombolysis.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

### REFERENCES

1. Konstantinides SV, Torbicki A, Agnelli G, Danchin N, Fitzmaurice D, Galiè N, *et al.* 2014 ESC guidelines on the diagnosis and management of acute pulmonary embolism. *Eur Heart J* 2014;35:3033-69, 3069a-3069k. 3.
2. Goueffic Y, Carbajal R, Burbajal M, Blanco G. Successful endovascular treatment of bilateral renal artery paradoxical embolus by a modified standard technique. *Nephrol Dial Transplant* 2006;21:2315-7.
3. Cokkinos DD, Antypa E, Kalogeropoulos I, Tomais D, Ismailos E, Matsiras I, *et al.* Contrast-enhanced ultrasound performed under urgent conditions. Indications, review of the technique, clinical examples and limitations. *Insights Imaging* 2013;4:185-98.