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Turbulent flow artefact mimicking central pulmonary emboli in pulmonary hypertension: A report of two cases

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# Turbulent flow artefact mimicking central pulmonary emboli in pulmonary hypertension: A report of two cases.

**Running title:** Turbulent flow mimicking pulmonary emboli.

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5 Article type : Radiology Case Report

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8 **Turbulent flow artefact mimicking central pulmonary emboli in**  
9 **pulmonary hypertension: A report of two cases.**

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14 **Key words:**

15 Artefact, CT Pulmonary Angiogram, Pulmonary embolus, Pulmonary hypertension, Turbulence.

16 **Summary:**

17 Many artefacts can mimic pulmonary emboli (PE) on CT pulmonary angiography (CTPA), most  
18 commonly in the peripheral pulmonary arteries (PA's). We describe flow-related artefact  
19 mimicking PE in the central PA's of two patients, both with pulmonary arterial hypertension  
20 (PAH). To our knowledge, this is the first report of this PE mimic in the central PA's.

21 **Case Presentations:**

22 *Case 1:*

23 A 64 year-old female with PAH presented to a peripheral hospital with dyspnoea and chest  
24 pain. CTPA demonstrated a focal region of non-opacification in the distal main and proximal  
25 left PA. (Figure 1); this was reported as acute PE. The patient was transferred to a tertiary  
26 centre for urgent thoracotomy and pulmonary thrombectomy. No PE was present at surgery.

27 On subsequent review of the CTPA by two chest radiologists, the morphology of the filling  
28 defect was deemed consistent with artefact, rather than PE.

29

30 *Case 2:*

31 A 74 year-old man with PAH presented with an exacerbation of severe chronic obstructive  
32 pulmonary disease. CTPA demonstrated an ill-defined region of non-opacification at the  
33 bifurcation of the right PA, extending into the interlobar artery (Figure 2). The CT was reviewed  
34 by two chest radiologists who agreed the appearances were consistent with artefact, rather  
35 than PE. A repeat contrast enhanced CT chest was performed the same day, using a 20 second  
36 delay after PA density threshold was reached. This showed homogeneous opacification of the  
37 PA, confirming the initial appearance was due to artefact (Figure 3).

38

### 39 **Discussion**

40 Many artefacts can mimic the imaging appearances of acute PE on CTPA (1). In PAH, flow in the  
41 main PA can be chaotic and turbulent (2-4) and turbulence may be seen at CT if there is mixing  
42 of opacified and unopacified blood. Robb et al. described turbulent flow artefact in a  
43 peripheral PA as having a “smoke-like” appearance with ill-defined borders (1), which aptly  
44 describes the appearance in our cases.

45 Whilst CTPA cannot dynamically characterise flow phenomena, phase-contrast (PC) MRI  
46 confirms the presence of complex haemodynamic changes in the PA in PAH (2). In particular,  
47 four-dimensional PC MRI has identified vortical (spiral-shaped) blood flow (2-4) in the main PA  
48 in patients with PAH; this phenomenon is highly sensitive and specific for the diagnosis of PAH.  
49 Turbulent flow has also been described on CT-digital subtraction angiography. Rashied et al.  
50 reported a case of turbulent flow in a grossly dilated PA with the turbulent flow visible on this  
51 dynamic study due to heterogeneous streaming of contrast (5).

52 We propose that the artefact in the central PA’s on CTPA in our cases is due to turbulent flow,  
53 secondary to PAH. Vortical flow may play a role. This CT appearance in the central PA’s has not  
54 been previously reported and more cases are required to substantiate our findings. Patients  
55 with PAH often present with non-specific symptoms, including syncope and dyspnoea, and  
56 undergo CTPA as a result. In such cases, recognising this flow artefact will reduce false positive

57 reports of central PE and avoid subsequent unnecessary treatment. If there is suspicion that a  
58 PA filling defect is due to artefact, we suggest performing a delayed post contrast scan with a  
59 prolonged contrast injection. Artefact should change or resolve on the second scan.

60 **References:**

61 (1) Robb CL, Bhalla S, Raptis CA. Pitfalls in the Diagnosis of Acute Pulmonary Embolism on  
62 Computed Tomography: Common Pathologic and Imaging Mimics. *Curr Radiol Rep* 2018; 6:14.

63 (2) Reiter U, Reiter G, Fuchsjäger M. MR phase-contrast imaging in pulmonary hypertension. *Br*  
64 *J Radiol* 2016;89(1063):20150995.

65 (3) Reiter G, Reiter U, Kovacs G, et al. Magnetic resonance-derived 3-dimensional blood flow  
66 patterns in the main pulmonary artery as a marker of pulmonary hypertension and a measure  
67 of elevated mean pulmonary arterial pressure. *Circ Cardiovasc Imaging* 2008;1(1):23-30.

68 (4) Schäfer M, Barker AJ, Kheyfets V, et al. Helicity and Vorticity of Pulmonary Arterial Flow in  
69 Patients With Pulmonary Hypertension: Quantitative Analysis of Flow Formations. *J Am Heart*  
70 *Assoc* 2017; 6(12):e007010.

71 (5) Rashid HN, Lim AK, Lau KK. Use of Computed Tomography–Digital Subtraction Angiography  
72 in differentiating pulmonary thrombosis and pulmonary artery dissection in a large pulmonary  
73 artery aneurysm. *Respir Med Case Rep* 2016; 18: 24-26.

74 **Figure Legends:**

75

76 Figure 1: Axial CTPA images from case 1 (a and b) demonstrating a focal region of non-  
77 opacification within the distal main and proximal left PA. No PE was evident at surgical  
78 thrombectomy. The ill-defined margins and wispy appearance are consistent with turbulent  
79 flow artefact.

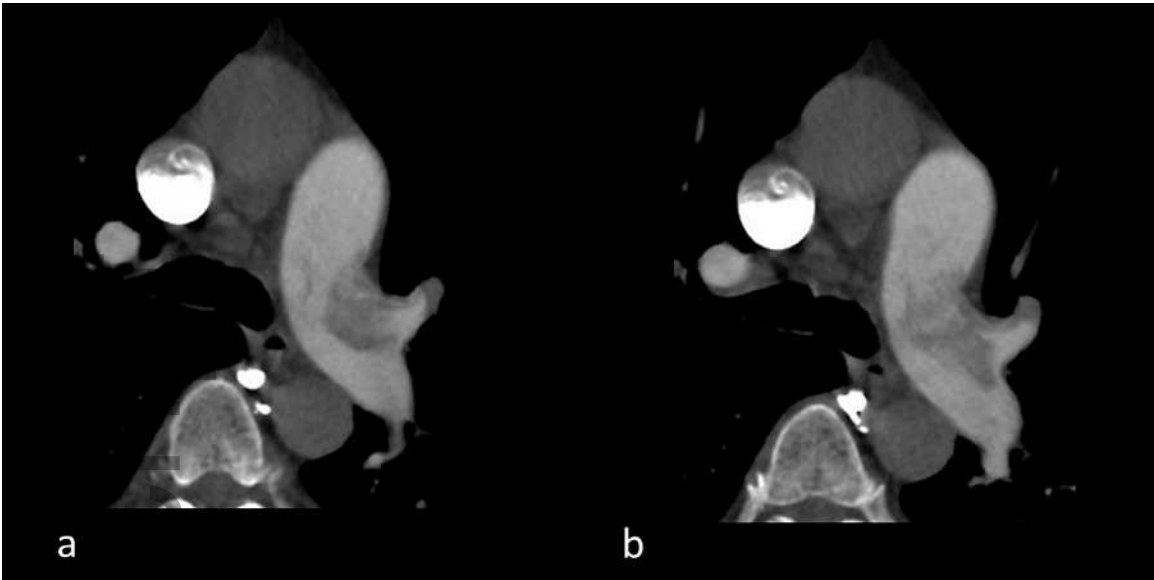
80

81 Figure 2: Axial CTPA images of case 2 demonstrating an ill-defined region of non-opacification  
82 within the distal right PA (Figure 2a) extending into the interlobar artery (arrow in Figure 2b).  
83 The ill-defined margins and wispy appearance are consistent with turbulent flow artefact.

84

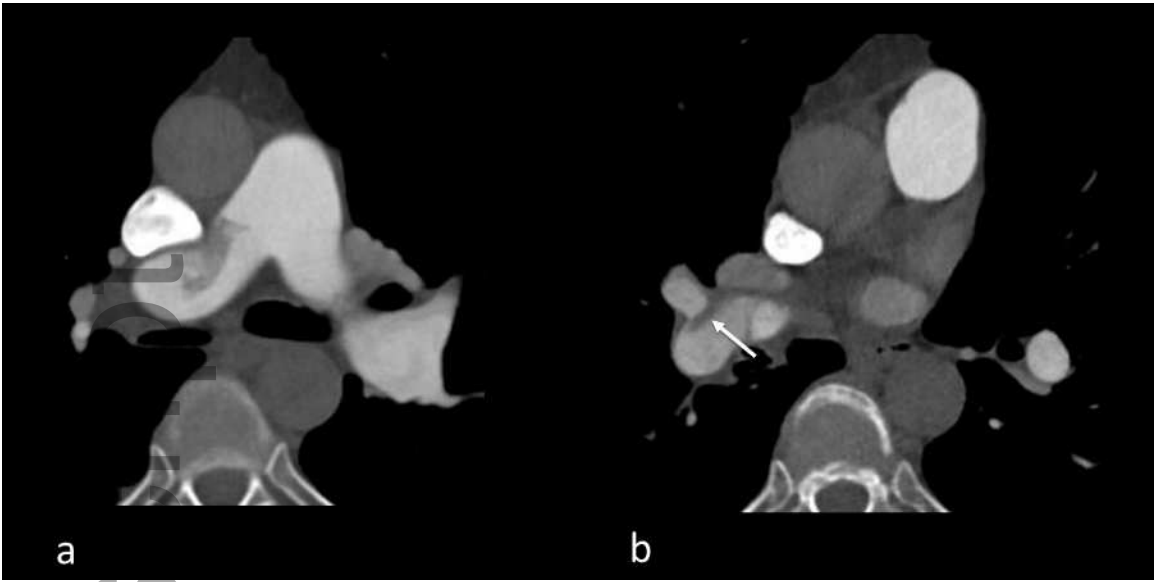
85 Figure 3: Delayed phase CT (a and b) performed same day as CTPA in Figure 2. This showed  
86 homogeneous pulmonary arterial opacification, confirming the initial appearance was due to  
87 artefact.

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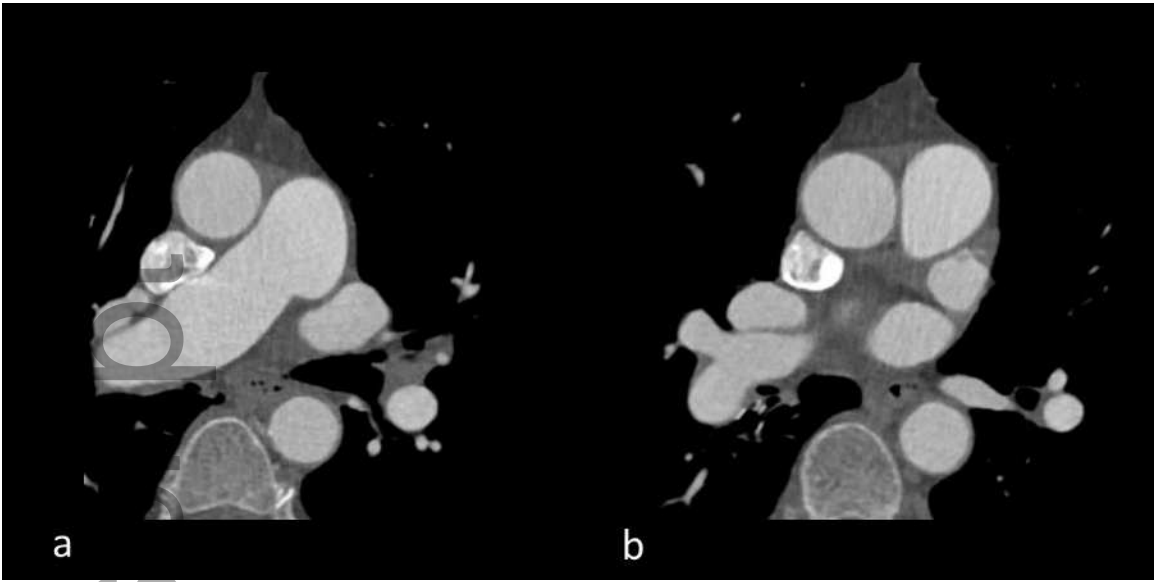
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