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

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Key words:

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

Summary:

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

Case Presentations:

Case 1:

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

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

Case 2:

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

Discussion

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

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

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

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

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Figure Legends:

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

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

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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