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Case report

Use of Computed Tomography – Digital Subtraction Angiography in differentiating pulmonary thrombosis and pulmonary artery dissection in a large pulmonary artery aneurysm

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ABSTRACT

70 year-old female with chronic obstructive pulmonary disease (COPD) presented with typical symptoms of an exacerbation of COPD. Management of COPD resolved her wheezing, but ongoing hypoxia and retrospective history of atypical chest pain prompted exclusion of a pulmonary embolus. A CT Pulmonary Angiogram (CTPA) with standard 64-slice CT revealed an extensive non-occlusive defect in a grossly dilated right pulmonary artery. Presence of circumferential cuff of soft tissue within sub-segmental pulmonary artery branch raised the possibility of pulmonary artery dissection (PAD). Exclusion of PAD was important as it precluded full anticoagulation. A dynamic CT-digital subtraction angiography (CT-DSA) with the 320-slice multidetector CT (Aquilion-one Vision, Toshiba) did not reveal any intimal flap or contrast extension into the pulmonary arterial wall, suggesting it is unlikely to be PAD. The patient was started on full anticoagulation and reported improvement of symptoms with reduction in pulmonary thrombus burden on repeat CTPA at 4 weeks. To our knowledge, this is the first reported use of dynamic CT-DSA in ruling out PAD.

A 70 year-old female with a background history of chronic obstructive pulmonary disease (COPD) and type 2 diabetes mellitus presented with a four-week history of exertional dyspnea and two days of wheezing and productive cough. She denied any orthopnea, chest pain or calf tenderness. She ceased smoking five years ago (30-pack years).

Her SaO2 was 92% on 8 L/min of oxygen via Hudson mask with a respiratory rate of 22/min. She was only able to speak single words. Examination revealed expiratory wheeze, a loud pulmonary component of the second heart sound and right ventricular heave. The rest of her examination was unremarkable.

Arterial blood gas revealed acidosis with pH 7.30 (7.35–7.45), pO2 of 54 mmHg (85–100), pCO2 of 52 mmHg (35–45) and HCO3 of 19 mmol/L (21–30). Full blood examination, urea, electrolytes, creatinine and liver transaminases were normal. Chest radiography revealed a large right-sided pulmonary artery with an enlarged pulmonary outflow tract and moderate cardiomegaly suggestive of cor-pulmonale (Fig. 1).

The initial diagnosis was an infective exacerbation of COPD. Treatment was commenced with intravenous ceftriaxone and azithromycin, nebulized salbutamol, intravenous hydrocortisone and non-invasive ventilation. On Day 7, she was still hypoxic and required high-flow nasal oxygenation. A retrospective history of atypical chest pain and ongoing hypoxia raised the possibility of pulmonary embolism.

Contrast enhanced CT Pulmonary Angiogram (CTPA) with a standard 64-slice CT revealed extensive confluent non-occlusive filling defect in a grossly dilated right pulmonary artery that measured 6cm in calibre (Fig. 2). No filling defect was seen in the mildly dilated pulmonary trunk or left pulmonary artery branches. The presence of circumferential cuff of soft tissue more distally within a sub-segmental pulmonary artery branch made the differentiation between thrombosis and pulmonary artery dissection very difficult (Fig. 3). Thus, excluding dissection was important as it contraindicated therapeutic anticoagulation.

Subsequently, a dynamic iodinated contrast enhanced CT-digital subtraction angiography (CT-DSA) of the pulmonary arteries was performed with the 320-slice multidetector CT scanner (Aquilion-One Vision, Toshiba Medicals, Tokyo, Japan). This specific CT scanner had 320-row of detectors, each of 0.5 mm width, and could cover a 16 cm volume of body tissues. When the CT table position was fixed and by repeated scanning, the dynamic iodinated

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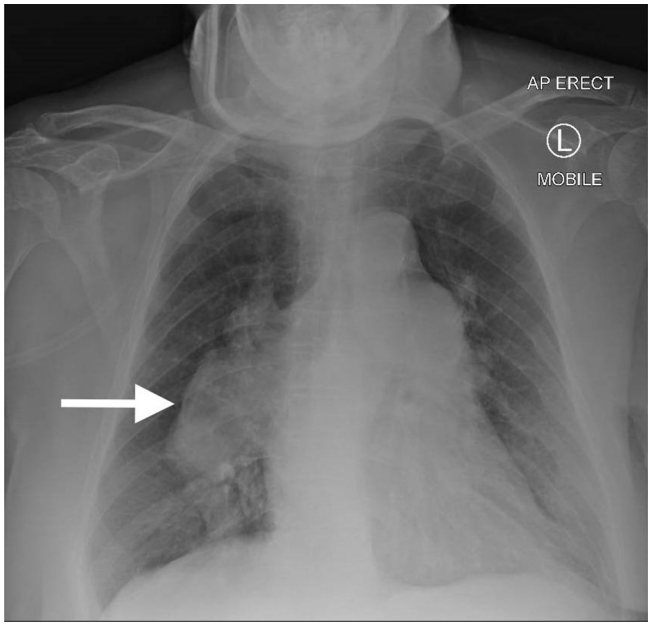

Fig. 1. Chest radiography exhibited cardiomegaly and hyper-expanded lungs with enlarged right-sided pulmonary artery (white arrow) suggestive of severe cor-pulmonale secondary to COPD.

contrast information within the 16 cm of body tissues could be obtained and CT-DSA was generated. The images could be viewed dynamically in cine-mode on workstation. This CT-DSA did not reveal any intimal flap or contrast extension to the media of pulmonary arterial wall, thus helped ruling out a pulmonary artery dissection (Fig. 4, Video 1 and 2). Heterogenous contrast enhancement within the lumen of the right pulmonary artery was consistent with significant flow turbulence. The filling defect did not demonstrate any early or late contrast enhancement. There was presence of calcification in the right pulmonary artery filling defect on the pre-contrast phase suggestive of a chronic thrombus.

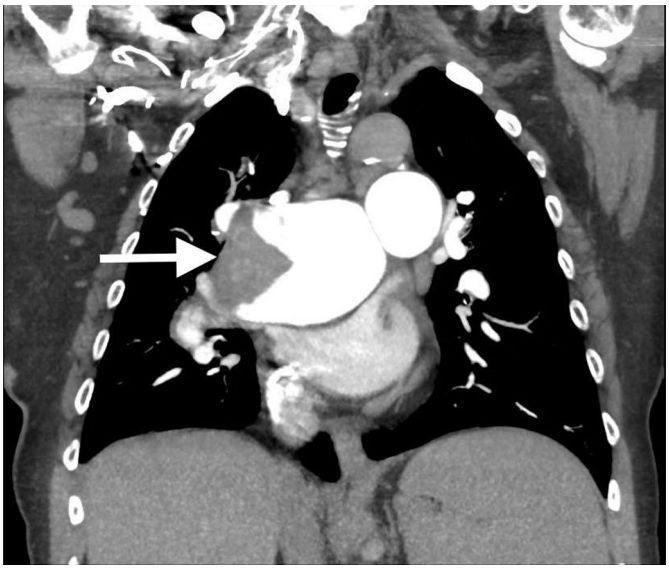

Fig. 2. Coronal reformat from contrast enhanced CT Pulmonary angiogram showed extensive confluent non-occlusive filling defect (white arrow) in a grossly dilated right pulmonary artery that extended to the 2nd, 3rd and 4th order pulmonary arterial branches. No filling defect was seen in the left pulmonary artery and its branches.

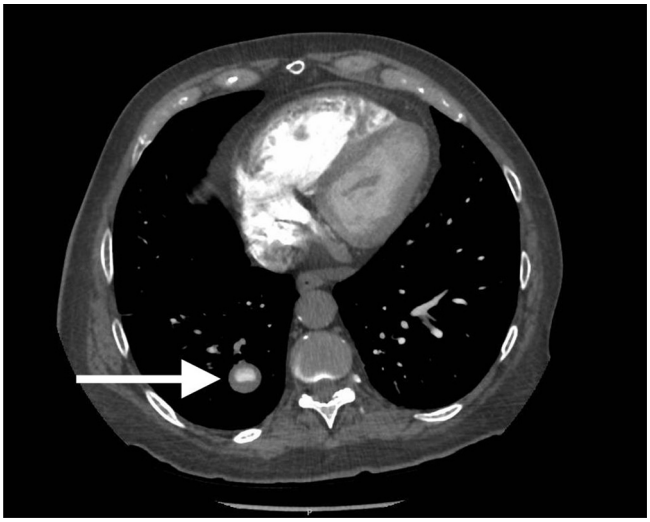

Fig. 3. Transverse image from the same CT Pulmonary Angiogram at a lower level demonstrated a circumferential smooth cuff of soft tissue density (white arrow) up until the 4th order pulmonary artery branches which required the exclusion of a pulmonary artery dissection.

Supplementary video related to this article can be found at http://dx.doi.org/10.1016/j.rmcr.2016.02.006.

An echocardiogram revealed systolic pulmonary pressures of 88 mmHg (normal 25–40 mmHg), right ventricular dilation and severe tricuspid regurgitation. Bilateral lower limb ultrasound was negative for deep vein thrombosis. A diagnosis of in situ pulmonary thrombus in a markedly dilated right pulmonary artery was made. The patient was anticoagulated with warfarin. An embolectomy was considered but the patient refused surgery. The patient was discharged with domiciliary oxygen. A repeat CTPA after 4 weeks revealed reduction in thrombus burden and she reported improvement in symptoms.

1. Discussion

The authors believe that abnormal and turbulent flow within the grossly dilated right pulmonary artery as demonstrated by the heterogeneous streaming density on the dynamic CT-DSA highly suggests in situ thrombus formation rather than embolism. Furthermore, the lack of contralateral disease made the diagnosis of pulmonary embolism less likely. There was also calcification present within the right pulmonary artery filling effect which would support the finding of chronic or recurrent thrombosis. No contrast enhancement was observed in the filling defect to suggest any blood vessel wall neoplasm.

The normal pulmonary artery diameter is below 3 cm and gross pulmonary artery aneurysms are rare [1]. Case reports have documented Takayasu arteritis initially presenting with dilated pulmonary arteries [2]. Although aortography was not performed, the thoracic aorta and arch branches on CTPA were unremarkable. Her erythrocyte sedimentation rate was 10 mm/h and vasculitis screen was negative. These help to rule out large or medium vessel vasculitis.

Pulmonary aneurysms have also been associated with Marfan and Ehlers-Danlos syndromes [3]. However, our patient did not demonstrate ascending aortic dilation, Marfanoid habitus or hyperlaxity of the joints characteristic of these syndromes. Human Immunodeficiency Virus (HIV) and parasitic infections, especially pulmonary schistosomiasis, have been known to cause massively dilated pulmonary arteries and chronic pulmonary thrombus [4].

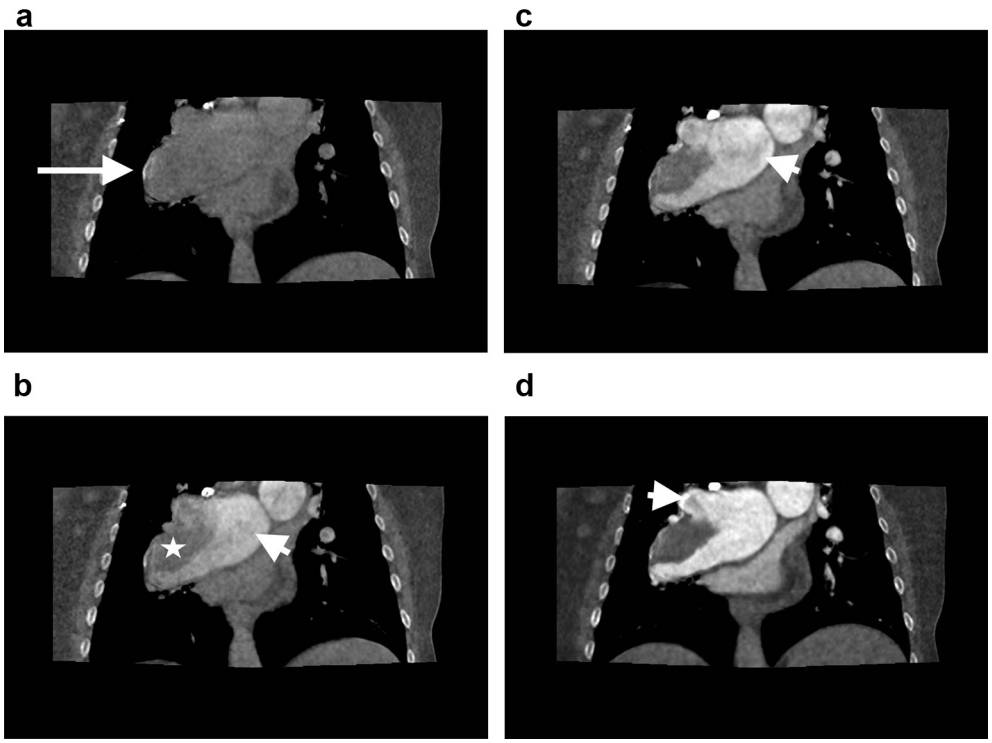

Fig. 4. Representative images from CT-DSA of pulmonary arteries in coronal plane showed calcification (long white arrow) in the deep layer of filling defect suggestive of chronic thrombus on the pre-contrast phase (a), thrombus in the dilated pulmonary arteries (star) and contrast flow turbulence (short arrow) on the very early (b), early (c) and full (d) arterial contrast enhanced phases. There was no evidence of any intimal flap or contrast extension into the media of the vessel wall to suggest any presence of dissection.

Serology for HIV, IgE Schistosomiasis and Strongyloides were negative in our patient.

The authors believe the aneurysm would have been resulted from pulmonary hypertension likely from long-term COPD (Type III). Chronic pulmonary hypertension then resulted in significant flow turbulence within the aneurysmal section, causing in situ thrombus deposition [5]. Advancement in CT with much improved spatial and temporal resolution allows high clarity cross-sectional images and four-dimensional capabilities of demonstrating contrast flow in vessels, such as in our case with the 320-slice CT (compared to standard 64-slice CT) [6]. It has been utilised in CT aortic and peripheral angiography. The ability of CT-DSA to show contrast dynamic information would assist differentiation of key condition such as dissection or thrombosis.

1.1. Ethical issues

Informed consent was sought from the patient for publishing this article.

1.2. Learning points

- Pulmonary artery aneurysm is rare and can be associated with significant pulmonary hypertension, such as in this case
- CT-DSA allows contrast dynamic information, such as flow turbulence, to assist in differentiating pulmonary thrombus from pulmonary artery dissection
- 320-slice CT allows higher clarity images compared with standard 64-slice CT, aiding in diagnoses of pulmonary vessel pathology

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