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Pulmonary artery pseudoaneurysm secondary to COVID-19 treated with endovascular embolisation

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ABSTRACT

Pulmonary artery pseudoaneurysms are uncommon and can cause severe, life-threatening haemoptysis. We present a case of a 74-year-old gentleman who was being treated for COVID-19 pneumonitis and a concomitant segmental pulmonary artery thrombus with conventional treatment and anticoagulation. The patient developed significant haemoptysis during admission. A repeat computed tomography pulmonary angiogram revealed an 8 mm left upper lobe pulmonary artery pseudoaneurysm. Anticoagulation was withheld and the pseudoaneurysm was successfully treated with endovascular embolisation with an Amplatzer® IV plug, leading to resolution of the haemoptysis. To our knowledge this is the first case of a pulmonary artery pseudoaneurysm secondary to COVID-19.

1. Introduction

Pulmonary artery pseudoaneurysms (PAPs) are an uncommon and potentially fatal cause of haemoptysis [1,2]. These are defined as a focal dilatation of a pulmonary artery branch, exclusively confined to the outer vessel layer known as the tunica adventitia. The aetiology of PAPs can be separated into idiopathic or acquired causes. *Mycobacterium tuberculosis* infection with associated cavitation has traditionally been associated with development of PAPs and these are referred to as Rasmussen aneurysms. Additional causative factors include: trauma, vasculitis, neoplasia, pulmonary hypertension and Hughes-Stovin Syndrome [1]. Early recognition and treatment is crucial to reduce the high risk of mortality.

There is a breath of knowledge emerging in recent times regarding the severe acute respiratory syndrome coronavirus 2 (SARs-CoV-2), also known as COVID-19, and its multi-systemic effects on the human body. There is evidence to support its link with vasculitic processes such as pulmonary vasculitis, Kawasaki's disease and cutaneous vasculitis [3]. In addition, COVID-19 infection has also been associated with increased risk of arterial and venous thrombosis, which is treated currently with anticoagulation [4]. Furthermore, there have been a scarce number of case reports highlighting an association of COVID-19 with cerebral aneurysms and pseudoaneurysms [5].

We present a challenging case of a 74-year-old gentleman with COVID-19 pneumonitis who, during his admission to intensive care, was diagnosed with a left upper lobe PAP following an episode of life-threatening haemoptysis whilst on anticoagulation for a concomitant pulmonary thrombus. This was successfully treated with emergency endovascular embolisation. We highlight this rare finding and discuss the challenges of managing multiple coexisting pulmonary pathologies secondary to COVID-19.

2. Case report

A 74-year-old gentleman presented to the emergency department with a one week history of fever, shortness of breath, dry cough and fatigue. His past medical history included type 2 diabetes mellitus, hypertension and acid reflux. A chest radiograph on admission showed bilateral patchy consolidation with a peripheral predominance. The clinical and radiological features were in keeping with a likely diagnosis of COVID-19 pneumonitis. The patient was tested positive for COVID-19 on nasopharyngeal polymerase chain reaction (PCR) swab. He initially received a combination of dexamethasone and intravenous antibiotics. Unfortunately, 3 days into the admission, he clinically deteriorated and was transferred to the intensive care unit (ICU) for intubation and ventilation.

Abbreviations: CT, computed tomography; CTPA, computed tomography pulmonary angiogram; PAP, pulmonary artery pseudoaneurysm; LMWH, low molecular weight heparin.

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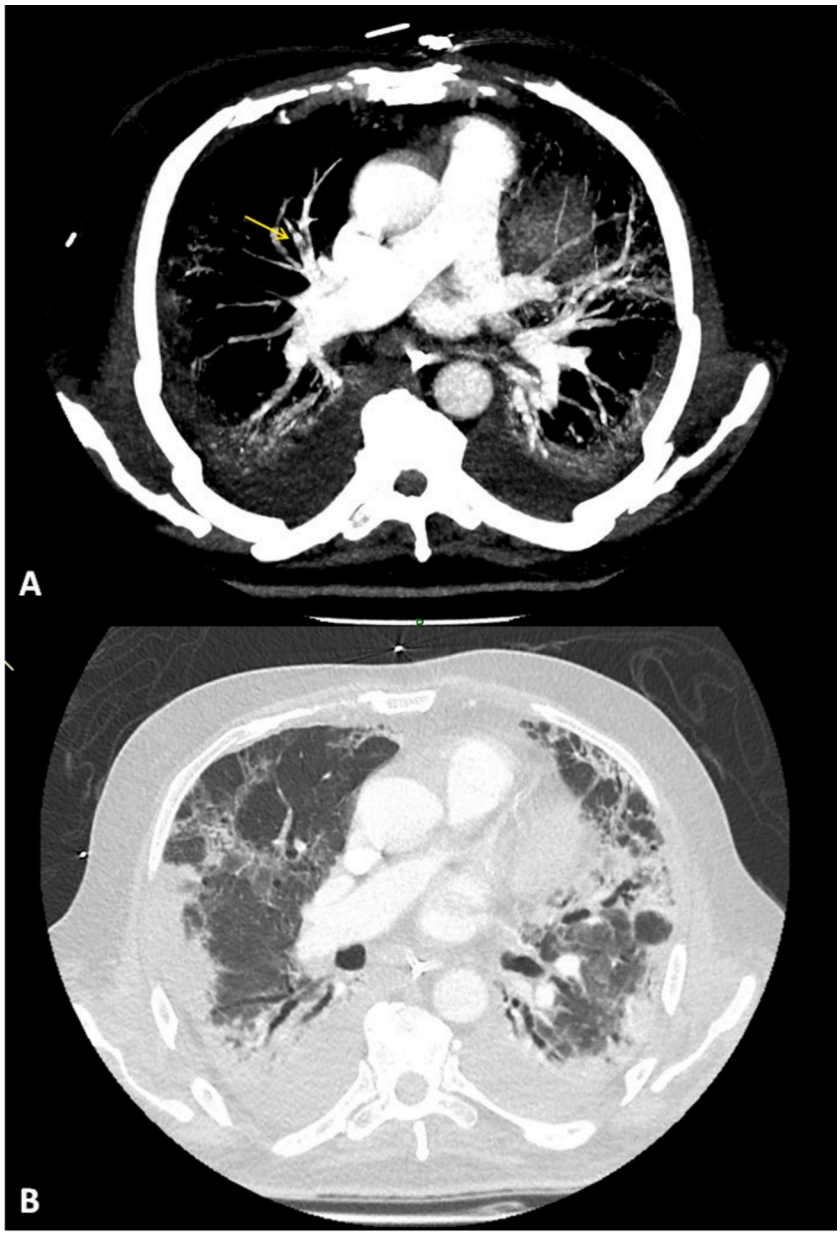

Fig. 1. CTPA. A) Non-occlusive filling defect within the segmental branch of the middle lobe pulmonary artery within the right lung, in keeping with pulmonary embolus/immunothrombus (yellow arrow). B) Diffuse bilateral peripheral patchy ground glass attenuation, consolidation and subpleural reticulation consistent with COVID-19 pneumonitis. Note is made of bilateral pleural effusions, likely secondary to concomitant fluid overload (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

One week into ICU admission, due to persistently low saturations and a rising D-dimer, a CT pulmonary angiogram (CTPA) was performed (Fig. 1). This revealed a non-occlusive pulmonary thrombus within the right lung middle lobe segmental pulmonary artery, on a background of diffuse lung parenchymal changes consistent with COVID-19 pneumonitis. He was initiated on subcutaneous treatment dose low molecular weight heparin (LMWH).

Two months into his prolonged stay, the patient developed acute life-threatening haemoptysis and underwent a repeat CTPA. This illustrated an 8 mm left upper lobe pulmonary artery pseudoaneurysm with an adjacent left apical pneumatocele (Fig. 2). Anticoagulation was withheld and the patient underwent emergency embolisation of the pseudoaneurysm in interventional radiology (Fig. 3). Pulmonary artery angiography was performed using a right common femoral vein access. Initially, a 4 French 11 cm (Cordis®) sheath was placed. The left main pulmonary artery was cannulated with a 4 French 100 cm multi-purpose A-2 (MPA2) catheter (Cordis®) and a 6 French 55 cm Flexor sheath (Cook Medical®) was placed into the pulmonary trunk. The left upper lobe pulmonary artery was selectively cannulated with a 6 French 100 cm Judkins right 4 (JR4) catheter (Cordis®) and measured 5 mm in diameter. A pulmonary angiogram, following administration of contrast, demonstrated an 8 mm pulmonary artery pseudoaneurysm arising from the left upper lobe pulmonary artery branch. This was embolised with an 8 mm Amplatzer® IV plug (Abbot®), therefore having an upsizing of 60 %. A satisfactory post-procedure angiographic result was obtained. This was a technical and clinical success since the patient remained free of haemoptysis two weeks after the procedure. An interval CTPA demonstrated no contrast filling the previously seen pseudoaneurysm secondary to the successful placement of the Amplatzer® IV plug (Fig. 4).

3. Discussion

PAPs are uncommon and associated with a high mortality rate if left untreated secondary to significant haemoptysis. They are often solitary and a large majority have a predilection to peripheral pulmonary artery branches [1]. Infection remains the leading cause of acquired PAPs and historical data demonstrates strong associations with tuberculosis and syphilis infection, both of which have significantly reduced in incidence

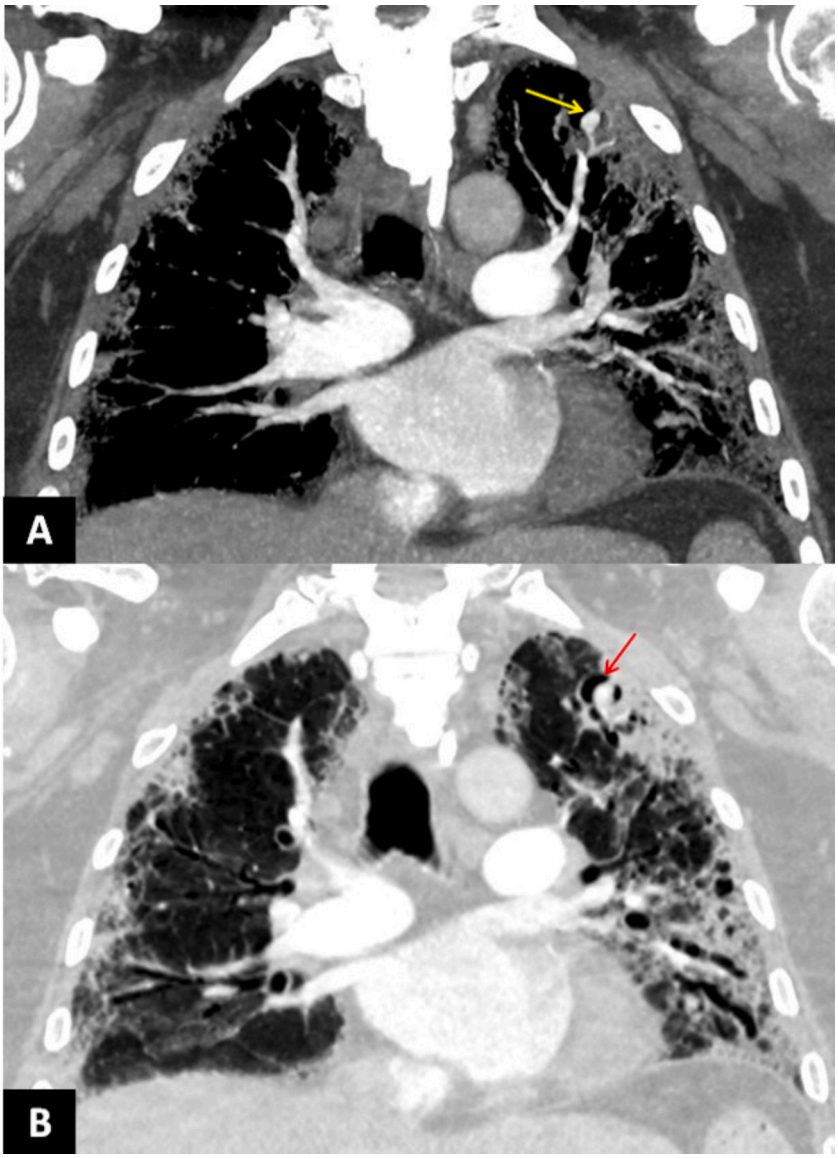

Fig. 2. Repeat CTPA. A) Left apical pulmonary artery pseudoaneurysm measuring 8 mm (yellow arrow). B) Left apical pneumatocele adjacent to the pseudoaneurysm (red arrow) (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

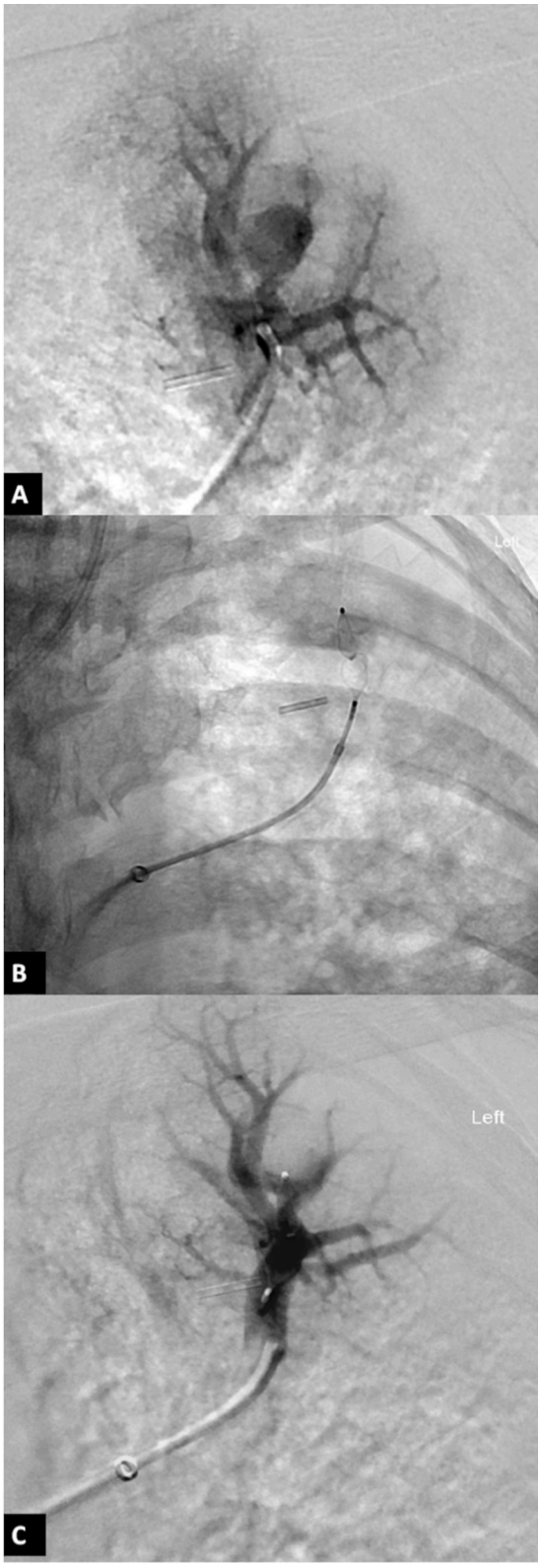

Fig. 3. Endovascular embolisation of the left apical pulmonary artery pseudoaneurysm.
A) Pulmonary artery angiogram confirming a small pseudoaneurysm arising from a branch of the left upper lobe pulmonary artery. B) Pseudoaneurysm selectively cannulated and embolised with an 8mm Amplatzer ® IV vascular plug. C) Satisfactory post-embolisation angiographic result demonstrating reduced flow of contrast within the pseudoaneurysm.

due to the success of antibiotic therapy [1,6]. Rasmussen aneurysms are PAPs caused by direct local invasion secondary to an adjacent tuberculous cavity. This leads to weakening of the vessel wall, pseudoaneurysm development and an increased likelihood of rupture [1,6]. Furthermore, there have been reported cases of mycotic PAPs secondary to endovascular seeding from septic emboli in the context of infective endocarditis [7]. However, a main cause of PAP formation in the current era includes trauma or iatrogenic pulmonary injury for example: stab wounds, chest wall injury, lobectomy, lung biopsies and placement of pulmonary arterial catheters (Swan-Ganz catheterisation) [1,2,8].

CT pulmonary angiography is the initial investigation of choice in which a focal dilatation of a branch of a pulmonary artery can be demonstrated with appropriate timing of intravenous contrast [1,9]. However, due to their uncommon presentation, the suspicion of PAPs amongst reporting radiologists is quite low and therefore,these can often be initially overlooked or detected on retrospective evaluation [1]. This can potentially have a profound negative impact on patient outcome which is why a careful correlation with the patient's clinical history and a high index of suspicion is required.

Endovascular embolisation using coils, gelofoam or plugs is the preferred method of managing PAPs [1,9,10]. This has a good technical and clinical success rate. In our case, we utilised the Amplatzer® IV vascular plug which is a self-expandable and locally adaptable occlusion device which also has the advantage of selective positioning and repositioning prior to deployment within a vessel [11]. It is particularly useful for targeting distal and tortuous vasculature and has been extensively and successfully used for the treatment of pulmonary arteriovenous malformations [12]. Pre-procedural evaluation with CT pulmonary angiography can also assist with accurate, targeted embolisation and can help distinguish between a bronchial artery versus a pulmonary artery pseudoaneurysm [9].

Research into COVID-19 and its systemic effects has demonstrated a definitive increased risk of mortality secondary to diffuse alveolar damage and the development of immunothrombi in the pulmonary vasculature. In addition, COVID-19 has been directly linked to inflammatory and vasculitic processes affecting the skin, pulmonary vasculature and a Kawasaki-like disease phenomenon [3]. The proposed mechanisms for these include upregulation of pro-inflammatory cytokines, complement activation, endothelial damage/dysfunction. Moreover, systemic vasculitides such as Behcet's syndrome have also been associated with the formation of PAPs which have been treated with both immunosuppressive treatments and endovascular embolisation in severe cases [13]. We therefore postulate that severe inflammation and pulmonary vasculitis secondary to COVID-19 may have contributed to the development of PAP in our case.

Furthermore, there are several reports of iatrogenic and non-iatrogenic pneumatoceles forming in patients with advanced COVID-19 infection [14,15]. These are prone to rupture causing an increased risk of pneumomediastinum, pneumothorax and surgical emphysema [15]. In our case, a pneumatocele was present adjacent to the left upper lobe PAP. This along with the severe parenchymal inflammation, may have been associated with the development of the PAP in the first place, similar to Rasmussen aneurysms forming in the context of tuberculosis cavitation.

To our knowledge, we have reported the first case of a PAP on a background of COVID-19. There have however been a few case reports highlighting intracerebral aneurysm formation in patients with the infection [5]. As previously described, COVID-19 is associated with an increased risk of arterial and venous thrombosis and there is strong evidence to support poorer outcomes in patients who develop thrombotic complications [4]. Many institutions therefore adopt a pragmatic approach to anticoagulate patients early with LMWH. This poses a significant challenge to patient management since in the event of incidental pseudoaneurysmal formation, such as the one in our case, the increased risk of bleeding secondary to anticoagulation can potentially prove to be fatal. Clinicians should therefore recognise PAP as a possible

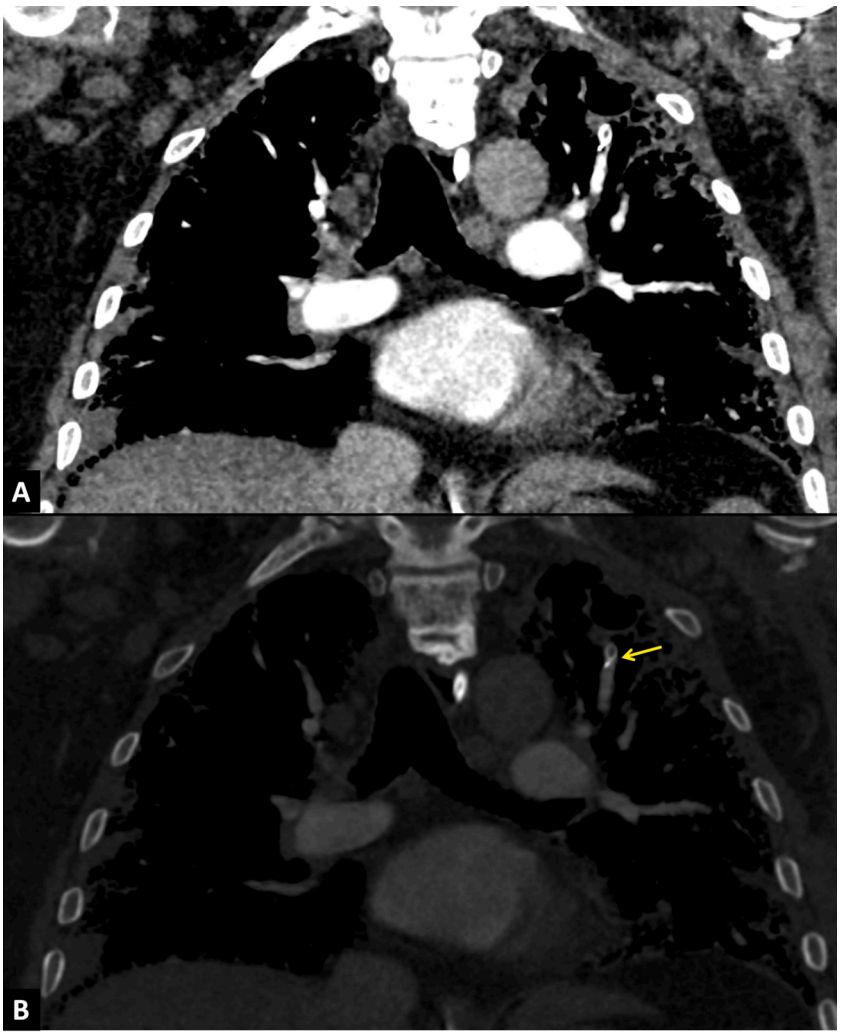

Fig. 4. Interval CTPA performed 2 weeks following the embolisation. A) No filling of contrast is seen at the site of the previously demonstrated left upper lobe pseudoaneurysm. B) Amplatzer ® IV plug in situ in the left upper lobe pulmonary artery branch (yellow arrow) (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

complication of COVID-19 and aim to identify and treat this early. We recommend an individualised approach to anticoagulating patients with thromboembolic disease and COVID-19, with careful consideration of the risks of bleeding secondary to a possible underlying PAP.

4. Conclusion

We describe an index case of a pulmonary artery pseudoaneurysm secondary to COVID-19 which was successfully treated with endovascular embolisation. Prompt recognition and treatment is vital to prevent mortality. Clinicians and radiologists should be aware of this phenomena in the context of COVID-19, especially in patients anticoagulated for concomitant venous thromboembolism.

Ethical statement

The authors have obtained written, informed consent from the patient to publish details and images pertaining to the case.

We have ensured anonymity of all identifying information, including the clinical and pictorial data.

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Declaration of Competing Interest

The authors report no declarations of interest.

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