Pulmonary Vein Thrombosis: It is not Always Pulmonary Embolism

Alsararatee HH

Keywords:
Pulmonary vein thrombus; PVT; Pulmonary embolism; PE; CTPA

1. Abstract
Pulmonary vein thrombosis (PVT) is a rare but potentially life-threatening condition that presents with non-specific symptoms and is usually associated with lung malignancy and major pulmonary surgery. A male in his middle sixties with background of lung cancer, awaiting chemotherapy presents with sudden onset of pleuritic chest pain, exertional dyspnoea, and haemoptysis. A Computerised Tomography Angiography (CTPA) was performed, which showed an unexpected right pulmonary vein thrombus. Surgical or tumour-induced epithelial damage, pulmonary venous stasis, or hypercoagulable states can lead to PVT. If not treated, it can lead to pulmonary gangrene or fibrosis, massive haemoptysis, renal infarction, or peripheral thrombus. The treatment options depend on the degree of involvement of the pulmonary veins and the underlying cause, but thrombectomy or pulmonary resection may be required in some cases. Thus, clinicians should maintain a high index of clinical suspicion for PVT in patients with risk factors and non-specific symptoms.

2. Introduction
Pulmonary vein thrombosis (PVT) is a rare but potentially life-threatening condition that presents with non-specific symptoms and is usually associated with lung malignancy and major pulmonary surgery. A male in his middle sixties with background of lung cancer, awaiting chemotherapy presents with sudden onset of pleuritic chest pain, exertional dyspnoea, and haemoptysis. A Computerised Tomography Angiography (CTPA) was performed, which showed an unexpected right pulmonary vein thrombus. Surgical or tumour-induced epithelial damage, pulmonary venous stasis, or hypercoagulable states can lead to PVT. If not treated, it can lead to pulmonary gangrene or fibrosis, massive haemoptysis, renal infarction, or peripheral thrombus. The treatment options depend on the degree of involvement of the pulmonary veins and the underlying cause, but thrombectomy or pulmonary resection may be required in some cases. Thus, clinicians should maintain a high index of clinical suspicion for PVT in patients with risk factors and non-specific symptoms.
4. Case Presentation

A male patient in his middle sixties was referred to the medical team with a sudden onset of left-sided pleuritic anterior thoracic pain for the last 72 hours. The pain is associated with exertional dyspnoea and haemoptysis. He has lung cancer (T2bN1M0, stage 2) under the care of the respiratory team. Prior to this attendance, he was treated by the GP for chest infection on oral Doxycycline 100 mg OD for 5 days due to productive cough. His past medical history includes type two diabetes mellitus (T2DM) and hypertension. He denied any exertional chest pain, haemoptysis, nausea, or vomiting, and also denied any abdominal pain, weight loss, or night sweats. There was no history of trauma or falls, and he denied any recent COVID-19 vaccinations. There was no significant family history of respiratory or cardiovascular diseases.

During the examination, he was a well-nourished male, comfortable in bed, without jugular venous distention or calf tenderness/erythema. Respiratory rate was 18 breath per minutes and oxygen saturation was 98% on room air. Blood pressure measured 140/80 mmHg, and the heart rate was 85 beats per minute. There were no murmurs or rubs but reduced air entry to the right lower base. The abdomen was soft and non-tender with no signs of rebound or guarding. There was no lower limb pitting oedema. The Wells score for PE was 5.0, thus the CTPA was requested to rule out PE.

5. Investigations

Blood investigations show a C-Reactive Protein (CRP) level of less than 1 mg/L (normal range: 0 - 5) and a white blood cell (WBC) count of 6.0 x 10^9/L (normal range: 4.0 - 10.0). Troponin T levels were below 13 ng/L, which is normal, and urea and electrolytes remained within normal limits. The D-dimer test indicated a result of 224 ng/mL. A COVID-19 test yielded negative results, and blood cultures, along with sputum gram stain with culture, returned negative results. The electrocardiogram (ECG) displayed a normal sinus rhythm (Figure 1). An initial chest X-ray (CXR) four weeks prior to this attendance shows mild right lower base consolidation (Figure 2) but his CXR on this attendance show partial resolution of the right lower base consolidation (Figure 3). A PET scan from a week earlier showed a right lower base pulmonary tumour with no evidence of a thrombus or metastasis. As the patient presented with a sudden onset of pleuritic chest pain, exertional dyspnoea, and haemoptysis, CTPA was performed, revealing a thrombus in the right lower pulmonary vein (Figure 4 and Figure 5). Echocardiogram was obtained which was normal and could not visualise the extension of the thrombus.

Figure 1: 12 leads sinus rhythm ECG

Figure 2: Atelectatic changes in the right lower zone suggestive of infection.

Figure 3: The previously identified right-sided consolidation demonstrates partial resolution.
Figure 4: Axial image, red arrow demonstrates a thrombus in the right lower lobe pulmonary vein which is consistent with pulmonary vein thrombosis.

Figure 5: Coronal image, red arrow demonstrates a thrombus in the right lower pulmonary vein which is consistent with pulmonary vein thrombosis.

6. Treatments

The patient was subsequently started on oral clarithromycin 500 mg twice daily for 5 days and Enoxaparin 1.5 mg per kg twice daily as advised by the respiratory consultant. The choice of anticoagulant was initiated as per the respiratory teams advise as the PVT was provoked by the lung cancer.

7. Outcome and follow-up

The patient is doing well on follow-up. The patient was taking the enoxaparin for six months as the PV was provoked by cancer. No bleeding was identified. The patient is waiting for pulmonary tumour resection.

8. Discussion

PVT can be asymptomatic and may be detected incidentally through imaging [11]. However, when it obstructs pulmonary flow, it may lead to acute pulmonary oedema with manifestations including dyspnoea, haemoptysis, or cough, potentially leading to hemodynamic instability [12, 13]. PVT can be idiopathic, possibly as a result of hemoglobinopathy [14], although this was not reported in our search. The primary lung neoplasm, particularly bronchogenic carcinoma, is identified as the most common malignant cause of PVT [15]. Additionally, PVT can arise in cases with metastatic cancers, including metastatic sarcoma, liposarcoma, small-cell lung cancer, and mantle-cell lymphoma of the small intestine [16]. Furthermore, PVT has been observed in 15% of patients within the initial 48 hours following lung transplantation [17]. Nevertheless, occurrences of PVT have been documented to manifest as late as four weeks to two years after the lung transplantation procedure. Moreover, it has been reported in cases with lobectomy [18]. Chaaya and Vishnubhotla systematic review, 2017 explained that
six patients who had left upper lobectomy developed a thrombus in the left PV thrombus [18]. However, the exact incidence of PVT after lobectomy is unknown as it is underdiagnosed in asymptomatic patients. In Ohtaka’s retrospective study, it was found that 3.3% of the patients who underwent lobectomy developed PV thrombus and 17.9% of the patients who underwent left upper lobectomy developed PV thrombus (18). The association between atrial fibrillation inducing blood stasis and its role as a risk factor for thrombus formation remains uncertain [19]. Thus, it is unclear whether AF is leading to pulmonary vein thrombus, but radiofrequency ablation can result in pulmonary vein stenosis which can lead to PVT [20]. Other causes of PVT have been infrequently reported following blunt chest trauma [21].

The hypothesised mechanisms underlying PVT pathogenesis involve factors such as surgical or tumour-induced epithelial damage, direct tumour extension into the vein or vein compression by the tumour, pulmonary venous stasis arising from pulmonary fibrosis, and hypercoagulable states associated with conditions such as nephritic or antiphospholipid syndrome [18]. However, it can be idiopathic. If it is not treated; it can develop into life-threatening such as acute pulmonary oedema, pulmonary gangrene or peripheral embolization [8].

The clinical presentation of PVT typically lacks specificity, posing a challenge for clinical diagnosis. The signs and symptoms depend on various factors such as the number of involved veins, extent of occlusion, adequacy of venous collaterals, and degree of lymphatic obstruction [22]. In the acute phase, PVT is observed by septal venule obstruction leading to lung infarction, resulting in symptoms such as pleuritic chest pain, cough, and haemoptysis [8]. However, in the chronic phase, fibroblast and capillary proliferation occur, accompanied by fibrous thickening of the adventitia of intrapulmonary veins and intimal thickening of intrapulmonary arterioles. This chronic progression leads to pulmonary hypertension and fibrosis, presenting with symptoms such as exertional dyspnoea, chronic respiratory failure, and pulmonary oedema. Patients with chronic PVT are prone to have recurrent chest infections and in advanced disease or if a thrombus occurs in the pulmonary veins it can lead to heart failure [23].

Currently, there is no gold standard for diagnosing PVT, and thus clinical suspicion and diagnostic imaging are required to establish the diagnosis [24]. However, CTPA is frequently the primary diagnostic tool for detecting PVT, as its presentation often mimics PE [25]. The diagnosis in this case emerged through this approach. Echocardiography, particularly transoesophageal echocardiogram (TOE), proves valuable, given its enhanced sensitivity compared to transthoracic echocardiogram due to the close proximity of pulmonary veins to the distal oesophagus and its ability to identify if the thrombus extended to the right atrium [26, 27]. MR imaging becomes instrumental in distinguishing between a tumour and a bland thrombus within the pulmonary veins [18, 28]. Thus, authors suggest performing TOE post-lobectomy to rule out PVT. However, it is sometimes painful and requires sedation [12].

The management of PVT depends on the underlying cause, although anticoagulation is typically prescribed in the absence of bleeding [7]. In the presented case, anticoagulation was initiated with low-molecular-weight heparin. However, the risk of bleeding for postoperative patients should be considered. It is imperative to note that previous literature has not compared the choices of anticoagulants and duration, thus further data is required to compare the risks and benefits of anticoagulant choices. Antibiotics may be required to mitigate the heightened risk of secondary infection in any infarcted tissue [29]. Thrombectomy might be required for patients who develop thrombosis after lobectomy or lung transplant. Pulmonary resection might be required in cases with massive haemoptysis, pulmonary gangrene, or necrosis [30]. However, there are no national guidelines on optimal PV management. PVT poses a potential complication for various complications [31]. Previous studies have identified that atrial fibrillation can cause systemic emboli, which leads to stroke [32]. However, there is no randomized controlled trial to assess this prevalence. Other complications of PVT include renal infarction, pulmonary necrosis or fibrosis, right ventricular failure, peripheral thrombus, and massive haemoptysis [33].

9. Learning Points

- Pulmonary vein thrombus should be considered as a differential diagnosis in patients with pleuritic chest pain, shortness of breath or haemoptysis.
- Lung cancer or postoperative patients are at high risk of developing pulmonary vein thrombus.
- TEE is sensitive to identifying PVT as it could visualise if the thrombus extended to the RA.

References


