CLINICAL MEETING SUMMARIES ON 20TH JULY 2017

Thin Edge of the Wedge


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Case 1

Mr. Tam, a 31 year old non-smoker, enjoyed good past health and he worked in Pest Control Division in Food & Environmental Hygiene Department. He complained chest discomfort which was persistent, non-exertional but pleuritic in nature. He also complained intermittent haemotysis for 1 month. It was associated with fever and night sweating. On physical examination, there was reduced air entry with crepitation over left lower zone of the chest. The cardiac, abdominal and neurological examinations were unremarkable. Blood tests showed elevated white cell count 11.3 x10^9/L and inflammatory markers (ESR 91 mm/hr and CRP 107 mg/L). Chest X-ray (CXR) on admission (Figure 1A) showed left lower lobe consolidation.

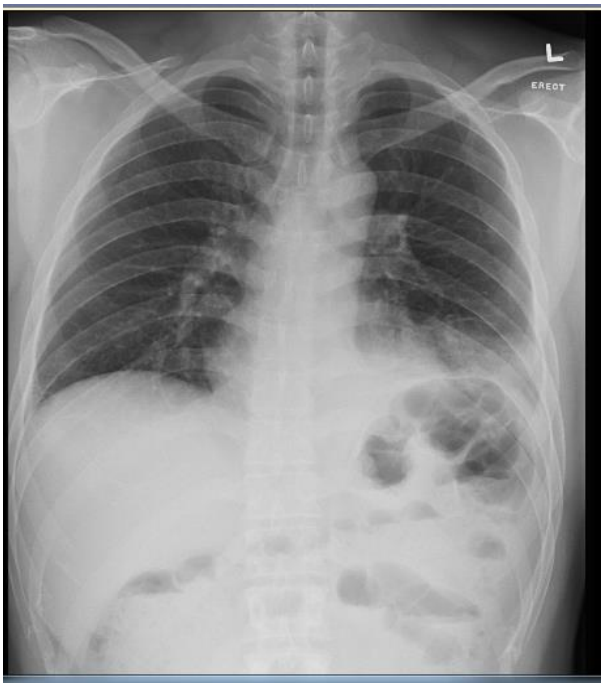


Figure 1A, left lower lobes consolidation

He was treated as community acquired pneumonia. Augmentin was given initially, antibiotics was changed to Tazocin and doxycycline in view of persistent fever. Microbiological work-up did not yield any specific pathogen. Further investigations including nasopharyngeal aspirate for atypical pneumonia screening and urine for legionella antigen were negative. Paired Weil-Felix titer was not raised. Ultrasound abdomen did not reveal any intra-abdominal source of sepsis and echocardiogram showed no valvular vegetation. Auto-immune markers like ANA, anti-ds DNA, ANCA and ENA and tumor markers including CEA and PSA were all negative.

Plain Computed Tomography (CT) scan of thorax showed left lower lobe consolidation (Figure 1B). Bronchoscopy finding was normal and there was no endobronchial lesion detected. Broncho-alveolar lavage (BAL) showed no growth on bacterial culture. Acid fast bacilli (AFB) smear and mycobacterium tuberculosis polymerase chain reaction tests were negative. BAL cytology test was also negative. Transbronchial lung biopsy showed evidence of pulmonary infarct (Figure 1C and 1D). Subsequent contrast CT thorax (Figure 1E) confirmed filling defects at the lobar branches of left upper and lower lobe, extending to some of the segmental branches of the left lower lobe. These were suggestive of pulmonary embolism. There was consolidation at the left lower lobe posterobasal region. One of the thrombosed pulmonary arteries supplied the consolidation area.

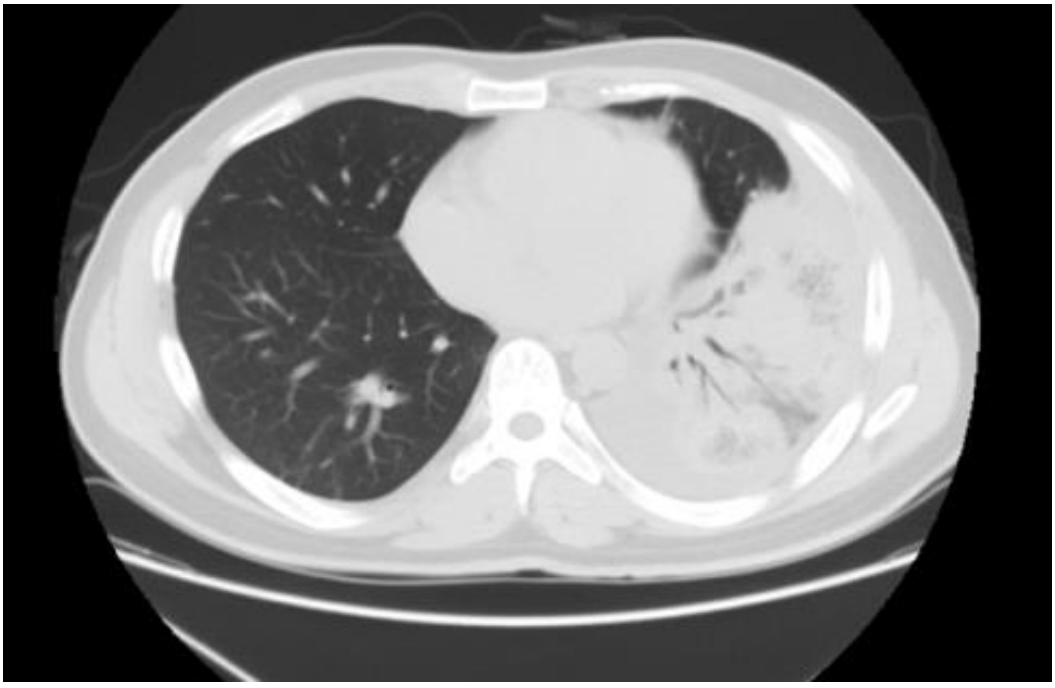


Figure 1B, left lower lobe consolidation

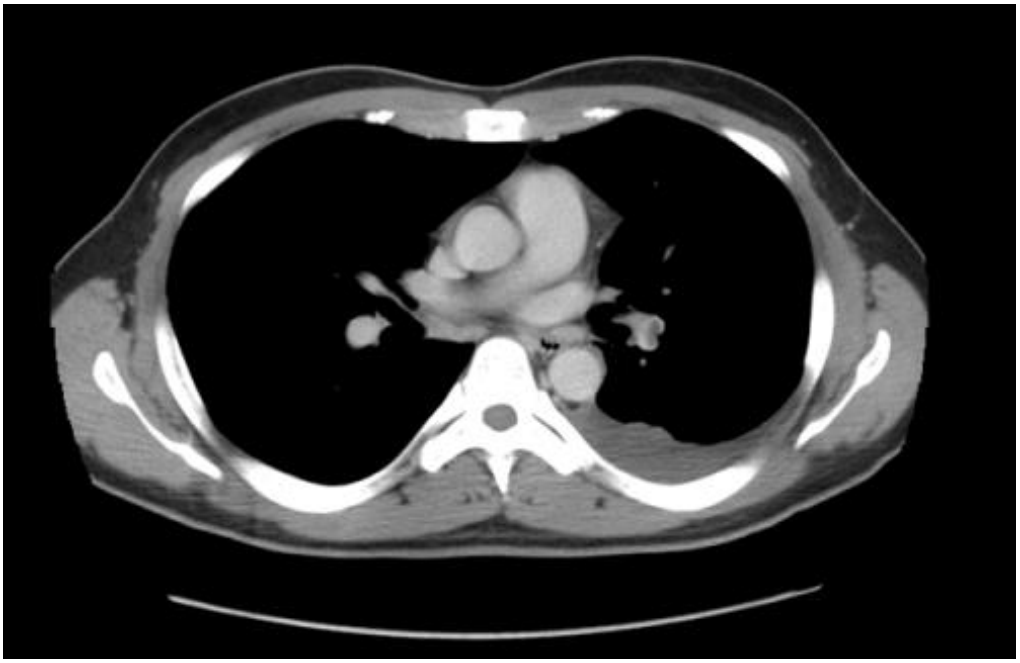
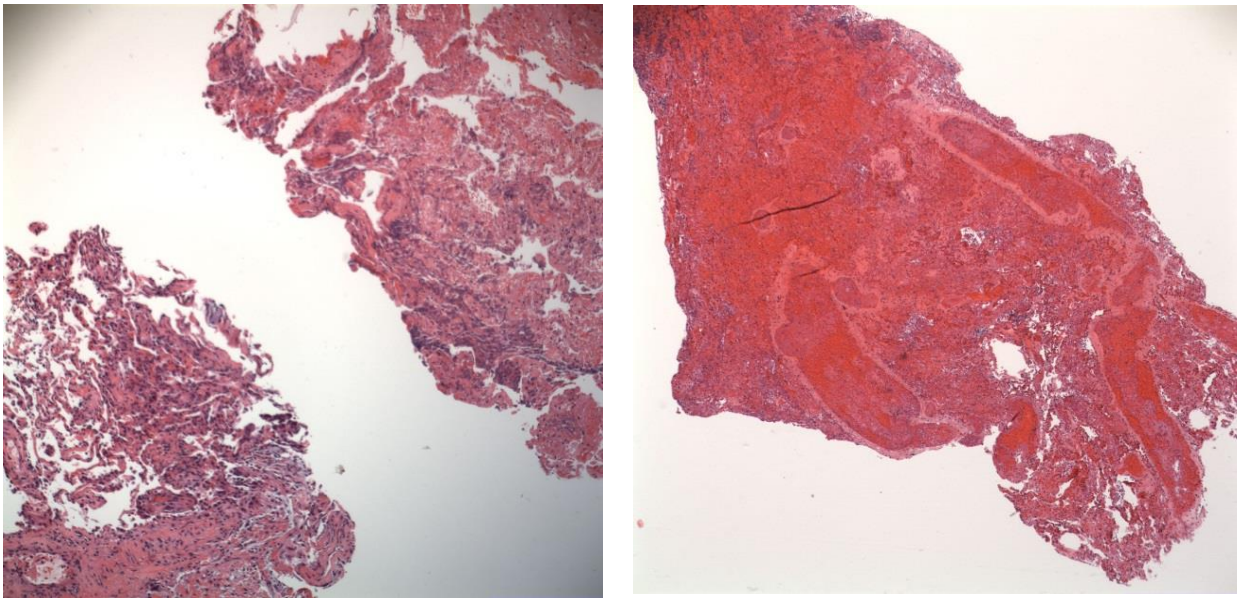


Figure1C, filling defects at lobar branches of pulmonary arteries



Figures 1D, left specimen: Presence of reactive pneumocytes in viable lung tissue, right specimen: less well defined alveolar structure with degenerated nuclei, non-viable tissue

Doppler of bilateral lower limbs showed no evidence of deep vein thrombosis. Positron emission tomography (PET) –CT scan found FDG foci (SUV max 3.9) over subpleural atelectasis at left lower lobe lung base, which could be due to inflammation or infection. There was no other gross FDG-avid tumour detected. Blood tests for thrombophilia screening including lupus anticoagulant and anti-cardiolipin were normal. Hematologist

recommended one year treatment of anti-coagulation and further thrombophilia work-up like protein C, protein S and anti-thrombin deficiency to be done after completion of the treatment.

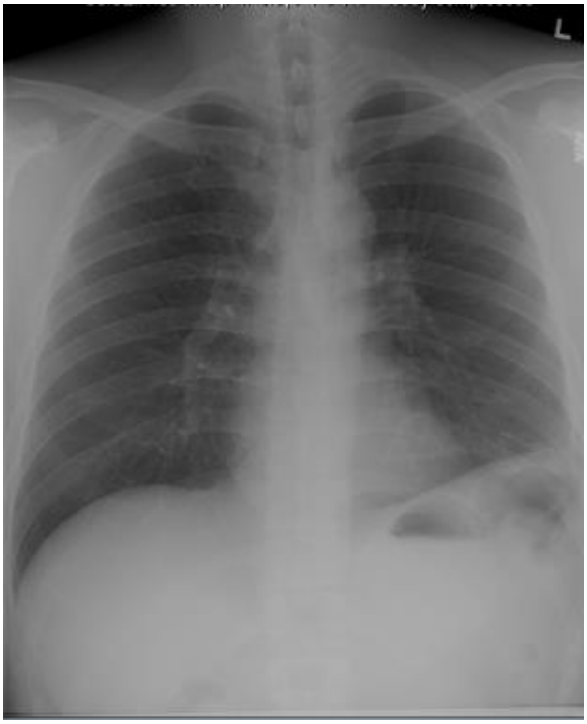


Figure 1E, scarring at left lower zone

Mr. Tam was started on low molecular weight heparin injection and then switched to novel oral anti-coagulant rivaroxban, and planned for one year of treatment. CXR (Figure 1E) after 4 months of treatment showed resolution of the consolidation with residual scarring.

Case 2

Mr. Wong was a 73-year-old ex-smoker. He had past medical history of left lower lobe pneumonia in 2007. He first presented to Accident and Emergency Department (AED) on 2nd September 2016 for cough with blood stained sputum for one week. CXR (Figure 2A) was clear and he was treated with a course of oral augmentin.

He re-attended AED on 24th September due to persistent haemoptysis. He was transferred to medical ward for further management. Blood tests showed normal white cell count and liver and renal function. Sputum grew oral commensals and there was no growth for acid fast bacilli. Sputum cytology was negative for malignancy. CXR was clear (Figure 2B) with no evidence of consolidation or lung mass. He declined contrast CT thorax. He was treated with levofloxacin.

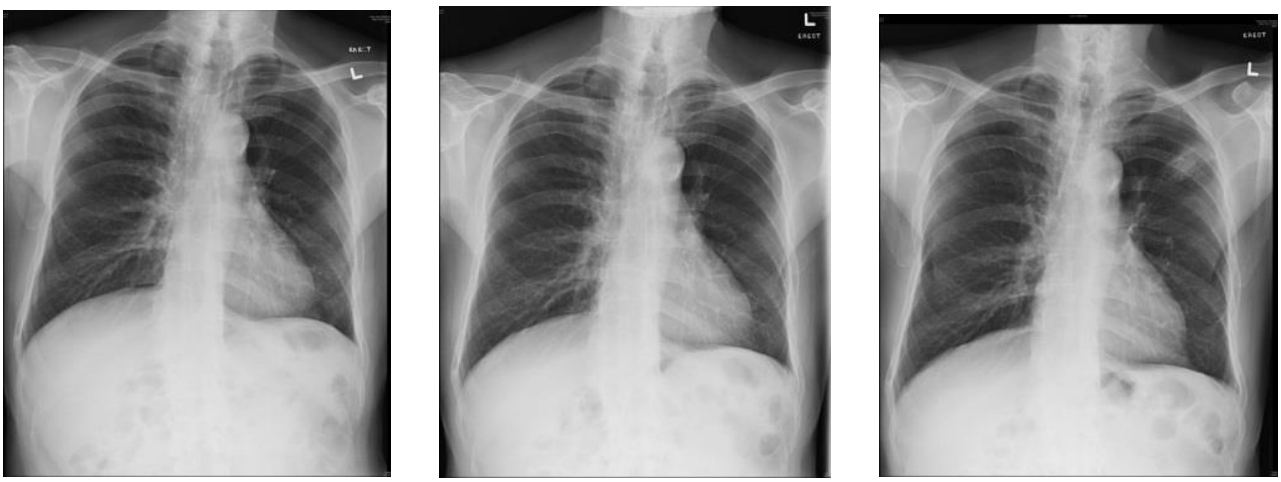
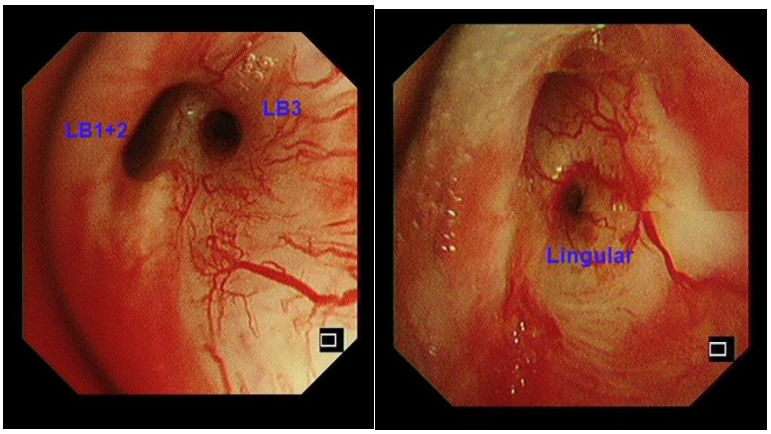
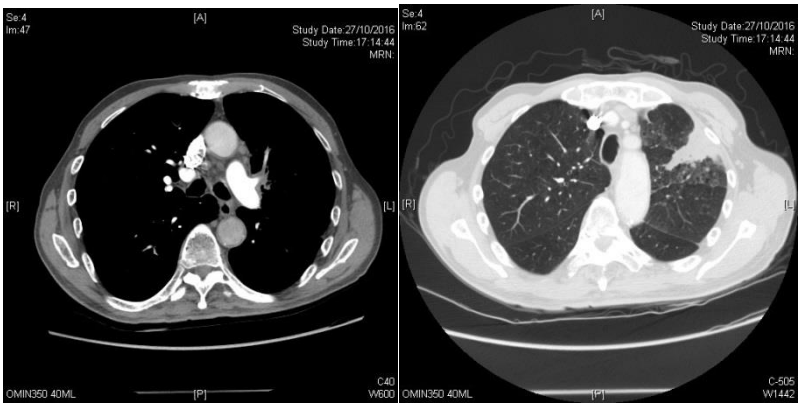


Figure 2: CXRs taken at different time points: A, on 2/9/2016; B, 24/9/2016; C, 12/10/2017 which showed new LUL opacity.

On 12th October, he was readmitted due to haemoptysis. CXR (Figure 2C) showed new onset left upper lobe opacity. Bronchoscopy found swollen left upper lobe bronchus with neovascularization over the bronchial mucosa (Figures 2D). There was no endobronchial obstruction. In view of the mucosal appearance, biopsy was not attempted. BAL was saved and there was no growth on bacterial and AFB culture. Cytology of the specimen revealed the presence of scanty atypical cells. Contrast CT thorax (Figures 2E) showed eccentric wall thickening of left upper lobe pulmonary artery, raising suspision of chronic thrombus. A thin filling defect was seen in the anterior left upper lobe segmental artery, suspicious of acute thrombus. There was peripheral wedge-shaped collapse-consolidative change at the anterolateral side of the left upper lobe, which could represent an infarct or haemorrhage. Adjacent interlobular septal thickening and ground-glass densities were noted.



Figures 2D, neovascularization over bronchial mucosa



Figures 2E, eccentric wall thickening of left upper pulmonary artery and peripheral wedge-shaped collapse-consolidation.

Further investigations included USG Doppler lower limbs, which showed no evidence of deep vein thrombosis, and blood tests for malignancy and autoimmune disease screening. Tumor markers including AFP, CEA and CA19-9 were normal, except PSA which was raised at 38ug/L. Urologist had been referred but patient declined trans-rectal ultrasound guided prostatic biopsy. Blood tests included ANA, ANCA, ENA and anti-cardiolipin antibodies were normal. He was treated with low molecular weight heparin and then switched to rivaroxaban. Thromobophilia screening after a 6-month course of anti-coagulation treatment was planned.

Discussion

Dual Pulmonary circulation

There are two separate but vital vascular networks supplying the entire respiratory system. The primary pulmonary circulation receives the whole body venous returns flowing from the main pulmonary arteries. It then ramifies throughout the pulmonary interstitium and airways, reconstituting itself into pulmonary veins before entering the left atrium. It is a high flow but low pressure system. The second system is the bronchial circulation which draws approximately 1% of the systemic cardiac output and transmits blood at six times the pressure of the pulmonary circulation. It is a high pressure but low flow system. Due to the presences of anastomosis between the bronchial and pulmonary circulation, the bronchial circulation will respond by enlargement, hypertrophy and focal proliferation when there is decreased pulmonary blood flow. Bronchial blood flow had been showed to increase by 300% in the weeks following pulmonary artery embolization (1).

Causes of pulmonary infarction

Pulmonary infarction usually results from pulmonary thromboembolism, but it can also occur in other conditions like pulmonary infection, vasculitis, or pulmonary torsion. In a retrospective case series (2), 43 patients with

pulmonary infarction diagnosed by surgical lung biopsy were studied for the cause of infarct, determined by reviewing the clinical evaluation, radiologic findings, microbiologic results, and histopathologic findings. Eighteen patients (42%) suffered from thromboembolism resulting in pulmonary infarct, which is the commonest cause in this case series. But the proportion of thromboembolic pulmonary infarction may be underestimated as the diagnosis was usually based on the results of clinical and radiologic evaluation performing lung biopsy. Non-thromboembolic causes of pulmonary infarct were identified in 13 cases. The causes included infections, diffuse alveolar damage, pulmonary torsion, lung cancer, amyloidosis, embolotherapy, and catheter embolism.

Pathophysiology and histopathology of thromboembolic pulmonary infarction

Only about 10% (2) of all pulmonary embolisms will cause pulmonary infarct. In case of central pulmonary arterial occlusion, massive bronchial collateral flow is easily accommodated by the pulmonary arterial circuit. If distal medium to small sized arterioles are obstructed, the high-pressure collateral bronchial influx must be accommodated within a smaller intravascular volume. This reperfusion by the bronchial circulation, combined with locally increased vascular permeability due to tissue ischemia and capillary endothelial injury, causes the intra-alveolar extravasation of blood cells resulting in pulmonary hemorrhage. Within this area, the underlying tissue architecture is preserved and usually restored to a normal state once blood cells are resorbed. However, localized pulmonary hemorrhage tends to progress to infarction in settings of underlying malignancy, high embolic burden, diminished bronchial flow due to hypotension or impaired circulation in chronic disease, vasodilator use, or elevated pulmonary venous pressure, and interstitial edema as in the case of congestive heart failure. The characteristic histologic changes of a recent pulmonary infarct are the presence of dark and necrotic material surrounded by a narrow rim of hyperemia and inflammation. After a few weeks, this area will be replaced by vascular fibrosis tissue producing pleural retraction.

Clinical and radiological presentation of pulmonary infarct

Patients with pulmonary infarct may present with respiratory symptoms including dyspnea, haemoptysis and pleuritic chest pain. But in some cases, patients can be asymptomatic. In a case series (2), 28 out of 43 patients were accidentally found to have pulmonary infarct on computed tomographic images. Seventeen of them had a diagnosis of underlying malignancy which is the risk factors of pulmonary embolism and infarct.

In 1940, Hampton and Castleman (3) described the classic appearance of pulmonary infarction on chest radiographs as the Hampton hump appearance which is a wedge-shaped pleural based density with a convex or hump-shaped margin. However, there are other conditions such as pneumonia or malignancy can also present as peripheral wedge shaped opacities. Furthermore, the classic arterial filling defect may not always be seen.

Apart from peripheral consolidation, other characteristic radiological features of pulmonary infarct may be seen. In a retrospective study (4), 24 of 74 patients with pulmonary embolism had CT images of pulmonary infarct. The infarcts were mostly located at the lower lobes with the incidence of 73%. The most common feature in this study was focally decreased enhancement within the lesion, a direct reflection of the diminished perfusion of the lung.

Internal air lucency was present in 32% of the infarct. This may represent the aerated non-infarcted lung co-existing with the infarcted lung in the same lobule. This phenomenon could be explained by the dual blood supply to the lung. Pulmonary infarct could occasionally cavitate, which could also explain the presence of central air lucency within the infarct.

Linear strands from the apex of the infarct toward the hilum were present in 24% of infarcts in this series. The linear strands were believed to represent either branches of the pulmonary artery containing emboli or dilated patent vessels proximal to the obstruction.

Vascular sign which was the thickened vessel leading to the apex of the subpleural opacity was only present in 14% of the infarct. The contour of the infarcts in the present series demonstrated a broad pleural base in 65%, a truncated apex in 57%, and a convex border in 46%. Pleural effusion could sometime be found in cases of pulmonary infarct. Presence of pleural line could help differentiating the abnormally low attenuation lung parenchyma from adjacent pleural effusion.

In another study (5) examined whether peripheral opacities due to pulmonary infarction can be differentiated from other causes based on the characteristic morphological features including triangular shape, vessel signs, central lucency and air-bronchogram. Triangular shape refers to the board and pleural based consolidation with the apex in a more central portion of the lung. Vessel sign is defined as presence of enlarged vessel that leads to the apex of wedge-shaped opacity. Central lucency is defined as the round foci of hypoattenuation in the central portion of wedge-shaped opacities and are larger than bronchial lumen. Air-bronchograms are defined as linear

bifurcated areas of hypoattenuation that corresponded to aerated small bronchi inside consolidations. One hundred and fifty peripheral consolidations were analyzed in 134 patients. The findings suggest that presence of vessel sign and central luncencies in peripeheral consolidiation is specific for pulmonary infarction with specificity of 89% and 98% respectively while absence of air-bronchogram in peripheral consolidation is only relatively specific for pulmonary infarction with specificity of 60%. Presence of air-bronchogram is more suggestive of pneumonia.

Management of pulmonary infarct and its complications

Treatment of pulmonary infarct depends on the underlying causes. For example, in the case of pulmonary embolism, embolectomy, thrombolysis and anti-coagulation are possible options.

Cavitatory pulmonary infarction is a rare but serious event. It is found in about 4-5% of all pulmonary infarct (6). Due to the lack of blood flow to the cavity, there is high risk of infection. Complication like pneumothorax, empyema, lung abscess, broncho-pleural fistula and lethal haemorrhage can occur. Mortality rate as high as 43% for noninfected and 73% for infected pulmonary infarct had been reported (7). Medical treatment including intravenous antibiotics injection and anti-coagulation can be used alone for non-complicated case. However, aggressive surgical resection of the pulmonary infarct may be indicated if there is evidence of uncontrolled sepsis or lethal haemorrhage.

Conclusion

Patients with pulmonary infarct may present with acute-onset shortness of breath, haemoptysis or pleuritic chest pain while some can be asymptomatic. Radiologically, the classical arterial filling defect can be absent. Broad pleural base, convex border, truncated apex consolidation with presence of vessel signs, central lucencies and absence of air-bronchogram may give further clues to the underlying diagnosis of pulmonary infarction. Treatment is readily available and reversible for pulmonary embolism. Left undetected, pulmonary infarction can lead to devastating complications with high mortality.

Reference

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