Coronary Artery Air Embolism Following Percutaneous CT Guided Lung Biopsy: Case Report and Literature Review

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Abstract

CT-guided lung biopsy is an effective method for diagnosing lung masses, with high accuracy. While generally safe, it can cause rare but severe complications like systemic air embolism (SAE), which may lead to coronary or cerebral embolism and death. This report discusses a 56-year-old male with a right lower lobe lung mass who developed SAE during biopsy, resulting in cardiac arrest and death. Risk factors included lesion location, large needle size, and prone positioning. Radiologists should be aware of SAE risks, ensure informed consent, and take preventive measures to minimize fatal outcomes.

Keywords: Lung Biopsy; Coronary Artery Air Embolism; CT Guided Biopsy, Oman.

Introduction

Computed tomography (CT)-guided percutaneous needle biopsy of the lung is a well-established procedure for the diagnosis of lung nodules or masses. It has a sensitivity of 93–98% and a specificity of 98–100% for the diagnosis of malignancy and is crucial for guiding further management and treatment decisions.[1]

It is considered a safe procedure with some possible complications. Common complications include pneumothorax (occurring in 25.3% of cases, with 5.6% requiring intervention), pulmonary hemorrhage (18.0%), and hemoptysis (4.1%).[2]

A rare but serious complication is systemic air embolism (SAE), which can occur if air enters the pulmonary veins and subsequently enters the systemic circulation.[3] The reported clinically apparent incidence according to two large case series is 0.02%[4] and 0.07%.[5] While clinically silent systemic air embolism estimated incidence can reach to 3.8%.[6]

Air embolism can move to the coronary arteries manifested as Coronary Artery Air Embolism (CAAE) leading to complete occlusion of the perfusion and subsequently myocardial infarction and death. As well it can lead to occlusion of the carotid artery and further to cerebral arteries leading to stroke. From a pathophysiological point of view, arterial air embolism originates from air entering the pulmonary veins during percutaneous needle biopsy of the lung.

According to the literature, certain mechanisms have been established for air entry into the pulmonary venous system. The first mechanism is through a hole in the pulmonary vein caused by the needle lumen after the removal of

the coaxial needle inner stylet. This will result in rising of the pressure gradient between atmospheric pressure and the pulmonary venous pressure. In this case, air may enter directly through the catheter. Second, air may be directly injected during the procedure into the pulmonary arterial circulation and then enter the pulmonary veins by crossing the pulmonary capillaries. Third, the needle may simultaneously penetrate the pulmonary vein and an adjacent aircontaining space (i.e., alveolar space, bronchus, air cyst, cavity), creating a communicating fistula which leads to air entry from the spaces to the pulmonary vein.[1]

Certain risk factors are associated with the development of SAE during the percutaneous CT guided lung biopsy. These include larger biopsy needles, parenchymal hemorrhage, lesion in the lower lobes and prone position.[7] Other risk factors which were described in case reports only with no solid evidence were biopsy of cystic or cavitary lesions including granulomas, coughing during the biopsy, and positive pressure ventilation.[8]

We report a case of a middle-aged man who underwent CT-guided percutaneous needle biopsy of a lung mass in the right lower lobe. Shortly after the procedure, the patient coughed up blood and was desaturating, a repeat CT imaging was obtained immediately. He was found to have a air embolism in the aorta and coronary arteries. The patient became unresponsive and, despite resuscitation efforts, was pronounced dead.

Case Report

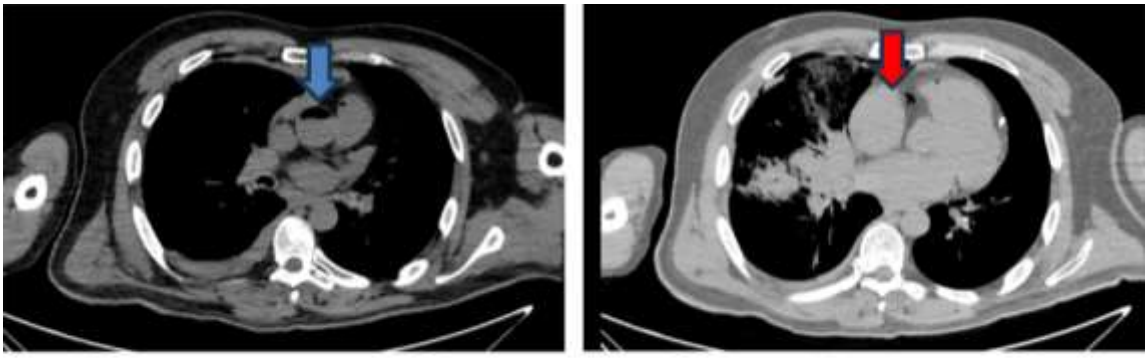
A 56-years-old male with a medical history of ischemic heart disease, including percutaneous coronary interventions in 2022 and 2023, and a smoking history of over 30 years. He presented with 3 weeks history of productive cough with occasional mild to moderate hemoptysis. He also reported mild exertional shortness of breath and significant weight loss of over 8 kg over several months.

The patient was evaluated in his local hospital, CT Chest revealed: Right lower lobe lung mass in close contact with adjacent pulmonary vein, as well as pleural fold and diaphragm, with associated enlarging peribronchial lymph nodes, suggesting a malignant neoplasm of the lung, with differential diagnoses including non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC). Pulmonary tuberculosis was ruled out with negative acid-fast bacilli testing in the sputum.

The patient subsequently underwent bronchoscopy, which did not reveal any endobronchial lesions. Bronchoalveolar lavage cytology was negative for malignancy.

The patient later underwent CT-guided Lung mass biopsy under local anesthesia, during the procedure, the mass in the right lower lobe was targeted while the patient was positioned prone. A local anesthetic was administered, and an 18-gauge biopsy needle with a coaxial needle was inserted. Three passes were made, after which the needle was withdrawn. The histopathology report came as adenocarcinoma, lipidic growth.

Immediately following the procedure, the patient began coughing up blood and experienced desaturation. He was placed on supplemental oxygen, and a repeat CT scan was promptly performed, which revealed air in the aorta and coronary arteries (Figure 1). The patient soon became unresponsive and arrested. Despite initiating cardiopulmonary resuscitation according to international guidelines, the patient was pronounced dead following resuscitation efforts.



A B

Figure 1: Non-contrast axial CT scan of the chest. (a) Air is seen within the ascending aorta (blue arrow). (b) Air is seen within the right coronary artery as well as in the left circumflex artery (red arrow).

Discussion

Percutaneous CT-guided lung biopsy is a minimally invasive and commonly accepted procedure for histopathological evaluation of lung nodules and masses. Common complications have been described in the literatures which include pneumothorax, lung hemorrhage and hemoptysis.[1]

Systemic air embolism (SAE) is another complication which is a rare complication but can have serious consequences. The overall incidence is variable and with reports ranging from 0.061% to 0.21%,[5,9] however the the incidence may be as high as 3.8% in some studies. This variation can be due to unrecognized cases of clinically silent SAE cases.[10]

Air entering into the pulmonary venous system embolizes mainly to the coronary and cerebral arteries. Only as little as 2 mL of air injected into cerebral circulation can be fatal causing disabling stroke and 0.5 to 1.0 mL injected into pulmonary veins can cause cardiac arrest from coronary air embolism.[11]

Coronary artery air embolism (CAAE) is a rare but fatal complication of percutaneous CT guided lung biopsy as a result of Systemic air embolism (SAE). It can end up with myocardial infarction and death.

Risk factors have associated with systemic air embolism include, including larger biopsy needles, parenchymal hemorrhage, a lower lobe lesion, a large biopsy needle, and the prone position. Our reported patient had three risk factors which are lower lobe lesion, large size biopsy needle and being in prone position.

Given that though systemic air embolism is rare but fatal complication of the CT guided percutaneous lung biopsy, it is recommended to obtain an informed consent with providing accurate and detailed information, including procedure related risks, even the rarest but potentially fatal one to reduce medicolegal issues.

In terms of prevention, positioning the patients on Trendelenburg position might prevent the air bubbles in arteries from reaching the brain and administering 100% oxygen is also helpful in reducing air bubble volume and promoting gas absorption, hyperbaric oxygen therapy also is helpful.[10] On the other hand, the operater should identify and avoid visible pulmonary viens and bronchi during the pathway. Lastly, the operator should minimize the needle insertion to avoid damage of the lung tissue and the vasculature.[11]

Therefore, if air embolism is suspected following a CT-guided lung biopsy, prompt intervention is crucial. The patient should be positioned in the left lateral decubitus and Trendelenburg position to minimize cerebral air migration, and administered 100% oxygen.[10,12] Supportive measures include intravenous fluids and continuous monitoring. In cases with neurological or cardiac involvement, early hyperbaric oxygen therapy—ideally within a few hours—can

greatly improve outcomes.[13] While imaging such as brain CT or echocardiography may aid diagnosis, treatment should not be delayed.[14]

Radiologists should be aware of the possibility of systemic air embolism after performing CT guided lung biopsy. Understanding the risk factors allows for the implementation of preventive measures before the procedure and may help avoid potentially harmful complications in the future.[15] Additionally, familiarity with the emergent management of such complications is essential.

Despite various recommendations to reduce the risk of systemic air embolism, it may be inevitable and can occur even with experienced and meticulous radiologists.[16]

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