Air embolism: a complication of computed tomography-guided transthoracic needle biopsy

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Abstract
Air embolism is a pathological condition caused by the entry of gas into vascular structures. It is a rare but feared complication due to its serious morbidity. We report two male patients who were diagnosed with air embolism as a complication of computed tomography-guided transthoracic needle biopsy. Both patients referred respiratory symptoms minutes after the procedure. The chest computed tomography of one of the patients showed air in the left ventricle and ascending aorta, and in the other, air was noted only in the left ventricle. Both patients suffered myocardial infarction without associated mortality. One patient showed anthracotic dust deposits in the lung biopsy suggestive of pneumoconiosis, and there was no definitive diagnosis in the other. We strongly believe that because of the very low incidence but high mortality of this entity, all physicians should be aware of this complication in order to know how to proceed in this situation.

Introduction
Computed tomography (CT)-guided transthoracic needle biopsy is a commonly accepted procedure and is widely used for the diagnosis of pulmonary lesions. Pneumothorax is the most frequent complication followed by pulmonary hemorrhage or hemoptysis that usually requires conservative treatment with minimal intervention. Of all these well-known complications, air embolism is the less frequent and the most lethal of all. We report two cases of air embolism resulting in myocardial infarction after a CT-guided percutaneous needle biopsy of the lung.

Case Reports

First case
A 67-year-old male with a 20 pack-year history of smoking and arterial hypertension was admitted to the intensive care unit (ICU) of the Central University Hospital of Asturias because of worsening and progression of an interstitial lung disease of undetermined origin. Invasive diagnostic studies were not performed at the time because of his unstable condition. The patient started treatment with corticosteroids with clinical and radiological improvement. Two months later, the patient returns to our institution with progressive dyspnea, fever, and bilateral alveolar and subpleural lung infiltrates that had increased in size in comparison with previous radiological controls. A CT-guided transthoracic needle biopsy was performed. Minutes after the procedure, the patient experienced dizziness accompanied by hypotension and bradycardia. In the post-puncture CT control, air was noted in the left ventricle and ascending aorta in relation to air embolism (Fig. 1). Oxygen at high concentration and fluids were administered, and the patient was placed immediately into Trendelenburg position. Twenty-four hours after the patient was stabilized, a new chest CT was performed. The CT showed a decrease in size of the air bubbles. The patient was admitted to the ICU for 4 days, in which he remained asymptomatic and...
hemodynamically stable. Electrocardiographic changes with elevation of myocardial markers were observed, and the patient was diagnosed with anterolateral myocardial ischemia. The result of lung biopsy was not diagnostic. The patient had a favorable response to antibiotics and steroid treatment.

Second case

A 69-year-old male with a medical history of type 2 diabetes mellitus, pneumoconiosis, Sjogren’s syndrome, and B-cell lymphoma stage IIA (diagnosed in 2005; relapse in 2012 with lung and nodal involvement) was referred to our hospital because of dyspnea, fever, and left pleuritic chest pain. The patient was diagnosed with necrotizing pneumonia in the left lower lobe, and antibiotic and antifungal treatment were initiated and maintained for 16 days. During admission, the patient presented a new febrile peak, and a chest CT was taken. The CT showed the appearance of new bilateral alveolar infiltrates in the lower lobes. A bronchoscopy with bronchoalveolar lavage and transbronchial biopsy was performed but no diagnosis was reached. A percutaneous CT-guided needle biopsy was performed and 10 min after the procedure, the patient started experiencing acute chest pain. In the post-puncture CT control, air was noted in the left ventricle (Fig. 2). Oxygen was administered in high concentration and the patient was placed in Trendelenburg position. The patient remained hemodynamically stable without respiratory symptoms and was admitted in the ICU where electrocardiographic changes and elevation of myocardial markers were seen. The patient was diagnosed with lower and anterolateral myocardial ischemia. Three days later, the patient was discharged with antibiotic and antifungal treatment with a favorable evolution. The biopsy showed anthracotic dust deposits suggestive of pneumoconiosis.

Discussion

CT-guided transthoracic needle biopsy is a safe and widely used procedure for the diagnosis of pulmonary lesions. Large surveys [1, 2] show that the most common complication of percutaneous lung biopsy is pneumothorax. Other rare but serious complications are tension pneumothorax, pulmonary hemorrhage, air embolism, or death [1]. Another major complication are the neurologic events due to ischemia. Air embolism is a rare but life-threatening complication with an incidence of 0.07% [3], although its true incidence is considered to be higher because of underdiagnosis of asymptomatic patients [1, 4].

According to Peirce [5] and Marini and Culver [3], needle biopsy of the lung is a much less frequent cause of systemic air embolism than are other procedures, such as cardiac surgery, coronary angiography, and neurosurgery. The treatment of air embolism involves administering 100% oxygen by mask or endotracheal intubation, which facilitates the exchange of oxygen from nitrogen within the air bubble. The Trendelenburg position or right lateral decubitus is controversial and could be useful in cases of shock induced by right ventricular failure from air embolism.

In our series, 1600 CT-guided lung biopsies have been performed since 2004 at our institution; we have had two confirmed cases of air embolism (0.12%). The interventional radiologists in our hospital use the Menghini needle type (Surecut, TSK Laboratory, Tochigi-Shi, Japan) for these procedures (thickness of 17–19G). This needle

Figure 1. A chest computed tomography scan revealed a subpleural alveolar injury in the right lower lobe (A). Air was noted in the ascending aorta (B) and in the left ventricle (C).

Figure 2. A chest computed tomography revealed an alveolar injury in the left lower lobe (A). Air was noted in the left ventricle (B).
cuts a cylinder of tissue of 2 cm in length, and at the same
time gets cytological samples; it allows histopathological,
imunohistochemical analysis, and genetic mutations. It is
possible, as seen in our two cases, that lung biopsies per-
formed on alveolar infiltrates and not on a solid parenchy-
mal lesion could justify the complications described earlier,
but this cannot be confirmed. Myocardial ischemia
occurred in both patients, and conservative treatment was
given without mortality.

In conclusion, clinicians should keep in mind that (1) air embolism is a largely iatrogenic clinical problem with
a potentially fatal outcome, and can result from pro-
cedures performed in almost all clinical specialties; (2) cardiological tests (electrocardiogram, echocardiography,
myocardial markers) should always be performed due to
the high risk of developing myocardial ischemia in these
patients; and, finally, (3) we believe it would be very
important to evaluate the benefit to include a chest CT scan immediately after the lung biopsy is performed in the
CT-guided lung biopsy guidelines regardless of whether
the patient has symptoms or not as this can be a very silent pathology.

Disclosure Statements

No conflict of interest declared.

Appropriate written informed consent was obtained for publication
of this case report and accompanying images.

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