

Pneumomediastinum and air leaks secondary to COVID-19: expectant vs. invasive management of a rare complication

Neumomediastino y fugas de aire secundarias a COVID-19: manejo expectante vs. invasivo de una complicación infrecuente

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Abstract

Several alterations that, due to their pathophysiology, are collectively classified as “air leaks”, have been rare complications of COVID-19 pneumonia. In the context of infection by SARS-CoV-2, the debate arises as to whether these are classified as spontaneous or secondary, since the multiple mechanisms of pulmonary structural damage that COVID-19 entails condition lung fragility in a patient in short time. For the above, we presents the case of a 36-year-old female patient with COVID-19 complicated with pneumomediastinum and subcutaneous emphysema in order to illustrate and discuss these complications.

Keywords: Coronavirus infections. Lung injury. Air leaks. Pneumonia. Pneumomediastinum.

Resumen

Diversas alteraciones que, por su fisiopatología, son clasificadas en conjunto como «fugas de aire», han sido complicaciones raras de la neumonía por COVID-19. Respecto a la infección por SARS-CoV-2, se plantea el debate de si estas se clasifican como espontáneas o secundarias, ya que los múltiples mecanismos de daño estructural pulmonar que conlleva la COVID-19 condicionan fragilidad pulmonar en corto lapso. Por lo anterior, se expone el caso de una paciente de 36 años con COVID-19 complicada con neumomediastino y enfisema subcutáneo con el objetivo de ilustrar y discutir dichas complicaciones.

Palabras clave: Infecciones por coronavirus. Daño pulmonar. Fugas de aire. Neumonía. Neumomediastino.

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Introduction

The current pandemic caused by the SARS-CoV-2 virus continues to be a global public health problem. In Mexico, the first cases were reported in February 2020¹, a situation that has posed various challenges in all medical fields, from its identification and treatment to its synergy with underlying comorbidity or complications of COVID-19 *per se*.

Various alterations that, due to their pathophysiology, are collectively classified as “air leaks” have been rare complications of COVID-19 pneumonia, although they are more prevalent than in other respiratory conditions. Air leaks include pneumomediastinum (NM), pneumothorax (NMX), pneumopericardium, and subcutaneous emphysema, which may share the same pathophysiologic mechanism both in patients requiring mechanical ventilation and in ambulatory patients². In the context of COVID-19, the debate arises as to whether these are classified as spontaneous or secondary, since the multiple mechanisms of lung structural damage that this infection entails condition lung fragility, coupled with the fact that existing reports denote an absence of other predisposing factors³. On the contrary, in patients without COVID-19, the occurrence of spontaneous NM or NMX is usually accompanied by well-established risk factors such as interstitial lung diseases, cystic fibrosis, asthma, smoking, chronic obstructive pulmonary disease, or lung neoplasms.

Given this controversy, a clinical case is exposed that emphasizes the risk of air leaks (specifically NM) in patients with COVID-19 without apparent classic risk factors, its conservative management and its possible association with a worse course of the illness.

Clinical case

A 36-year-old woman with no significant personal history, height 1.65 m, weight 85 kg, and body mass index of 31.2 kg/m². Her condition began 8 days prior to hospital admission, with headache, hyaline rhinorrhea, sore throat, non-productive cough, fever, and chest pain. Subsequently, dyspnea of small to medium efforts was added, which is why she went to the emergency department, where she had an O₂ saturation of 78%, a heart rate of 113 beats per minute, a respiratory rate of 27 breaths per minute, and blood pressure of 115/74 mmHg, so treatment with supplemental oxygen was started. A polymerase chain reaction test



Figure 1. Posteroanterior chest X-ray with the presence of linear radiolucent images that extend into the cardiac silhouette (pneumomediastinum) and the subcutaneous cell tissue of the neck and axilla bilaterally (subcutaneous emphysema).

with reverse transcriptase was performed for the detection of SARS-CoV-2, which was reported positive, as well as a simple chest X-ray in which bilateral subcutaneous emphysema was observed in the cervical region, soft tissues of the axillary region and right hemithorax (Fig. 1), in addition to severe lung disease with a bilateral ground-glass pattern. 7 points were given on the RALE scale (*Radiographic Assessment of Lung Edema*), so it was decided to admit her to hospital.

Her laboratory studies on admission reported leukocytes 18×10^3 , hemoglobin 16.54 g/dl, lymphocytes 0.78 cell./ μ l, platelets 270 cel./ μ l, prothrombin time 13 s, partial thromboplastin time 24 s, fibrinogen 261 mg/dl, D-dimer 0.769 μ g/ml, albumin 3.7 g/dl, lactic dehydrogenase 440 U/l, creatinine 0.8 mg/dl and glucose 286 mg/dl; the rest of the values were within normal parameters.

On physical examination, subcutaneous emphysema and crepitus were found in the right lateral region of the neck and the right hemithorax. Simple computed tomography (CT) of the chest and neck was performed, which revealed the presence of subcutaneous emphysema at the level of the parapharyngeal, left cervical, perithyroid, and retroesophageal spaces; chest with air in the upper and posterior mediastinum, and severe involvement of the lung parenchyma with a ground glass pattern predominantly subpleural

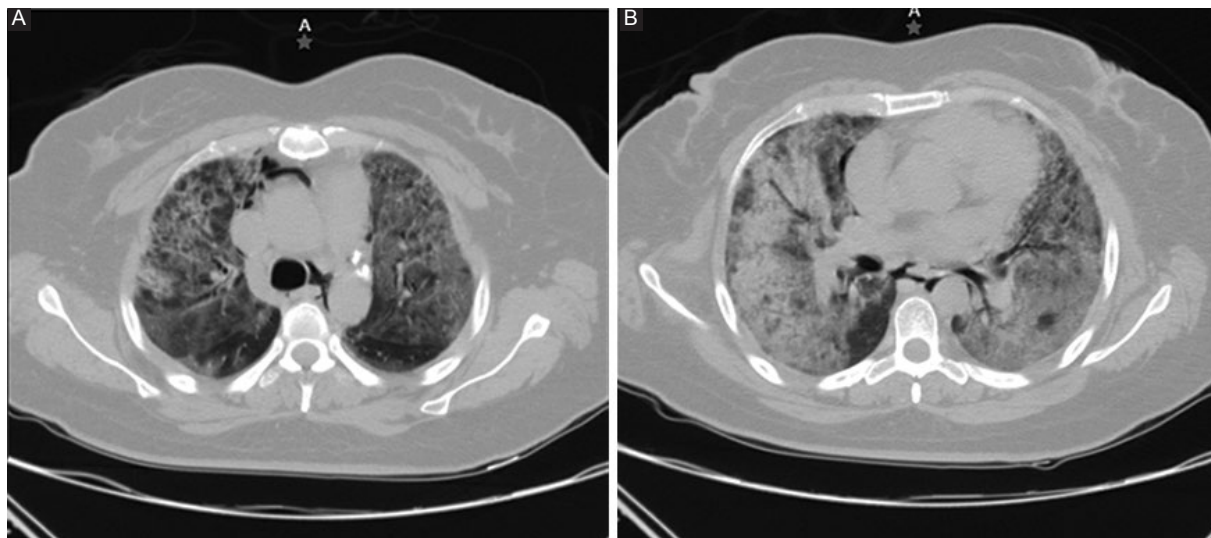


Figure 2. Simple chest computed tomography in axial section showing air at the level of the anterior and posterior mediastinum, as well as severe disease in a ground-glass pattern.

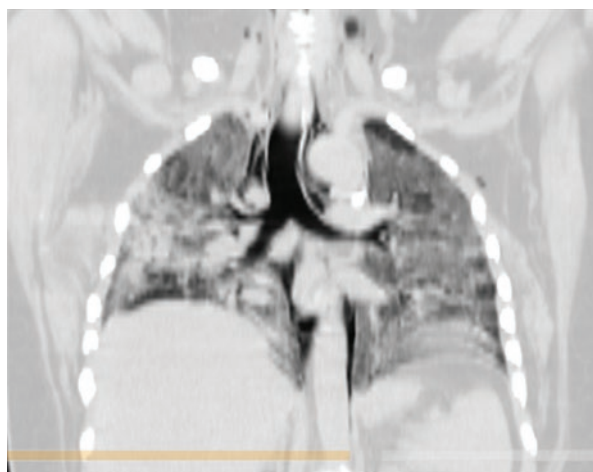


Figure 3. Simple computed tomography of the thorax in coronal section showing air at the level of the mediastinum.



Figure 4. Simple computed tomography of the neck in axial section in which air is observed at the level of the parapharyngeal space.

(Figs. 2 to 4). No invasive intervention was considered, since she did not present NMV, and conservative treatment with oxygen therapy, anticoagulation, antipyretics, analgesia, and steroids was continued for 10 days.

The patient continued with clinical and gasometric deterioration up to an PO_2/FiO_2 index of 65 mmHg despite supplemental oxygen at maximum flows with a reservoir mask, for which the need for invasive mechanical ventilation was raised; however, the patient flatly rejected it. Oxygen therapy was provided with

high-flow nasal cannulas, observing partial improvement in saturation (up to 85%). 7 days after admission, remission of subcutaneous emphysema was found, so simple chest X-ray and CT were performed again, in which complete resolution of emphysema and MN was observed, but with greater involvement in the lung parenchyma (Fig. 5). The patient continued her hospital stay with clinical and gasometric criteria for invasive ventilatory management, which she continued to reject until her death on day 15 from her admission and 23 from the onset of the symptoms.



Figure 5. Resolution of subcutaneous emphysema and evidenced pneumomediastinum. **A:** on the posteroanterior chest radiograph. **B:** simple computed tomography of the thorax in axial section.

Discussion

NM can be spontaneous or secondary to traumatic or iatrogenic processes⁴. It has been described as anecdotal cases in the presence of fungal pneumonia infection, *Mycoplasma pneumoniae*, whooping cough and influenza⁵; however, a higher prevalence of these alterations has been observed in patients with COVID-19⁶ regardless of whether they are under positive pressure ventilation⁷. The possibility has been raised that this process is no longer spontaneous and is secondary to this infection⁸, since it occurs in the context of pulmonary fragility.

As in the case presented here, numerous reports include people who lack the classic risk factors, such as age⁹ and smoking¹⁰; the latter, the greatest risk factor for developing spontaneous NM⁴. On the other hand, there are characteristics that do not change between patients with and without COVID-19 since men and those with greater comorbidity continue to be the ones with the least favorable evolution and prognosis¹¹.

In patients with COVID-19 pneumonia, the risk of sudden deterioration in ventilatory mechanics is high, mainly caused by pulmonary thromboembolism¹², the same COVID-19 pneumonitis and rarer processes such as MN, pneumopericardium³ and NM⁹. Therefore, the clinician must consider these last diagnoses,

especially in patients with spontaneous ventilation in whom they usually go unnoticed and are erroneously attributed to the same course of the disease. When this deterioration is secondary to air leak disorders, the average time of onset is variable (9 days on average) from the onset of symptoms¹³.

The most common symptoms of NM are dyspnea, cough, chest pain, neck pain, tachycardia, tachypnea, dysphagia, hoarseness, and rhinolalia¹⁴, in addition to subcutaneous emphysema in up to 70% of cases¹⁵ (especially at the base of the neck). In massive NM with mechanical obstruction of the heart and decreased venous return, hypotension is also seen¹⁶; this only occurs when the air does not find an escape route into the pleural cavity, the subcutaneous tissue of the neck, or the retroperitoneum. Chest X-ray is of the utmost importance due to its availability, since it can detect NM in up to 70% of patients¹⁷, as long as it is searched intentionally; the most obvious sign is the “double contour” caused by dissection of air in the peribronchovascular sheaths. Despite being very useful, the aforementioned study is undervalued and it is not uncommon for the diagnosis to be missed both by non-radiologists and by radiologists⁷. If the NM is very small, it will only be visible by TC.

Faced with impaired respiratory function, the clinician should consider the following differential diagnoses: pulmonary thromboembolism, MN, pneumopericardium,

superaggregated bacterial infection, acute myocardial infarction, Takotsubo heart disease, and esophageal perforation¹⁸.

In case of NM, the recommended management is conservative, with close monitoring of cardiovascular and respiratory functions; this treatment approach has not been associated with instability of these systems¹⁹. Invasive management with placement of intrathoracic tubes is unusual and is applied when there is cardiopulmonary compromise, although a “prophylactic” strategy has been reported in which a chest tube is inserted when there is NM in the absence of NM²⁰, with the justification that in patients with COVID-19 and borderline PO levels₂, the appearance of an NM subsequent to an NM would further and rapidly deteriorate respiratory function; however, this conduct has had results that aggravate the patient's condition, with increased intrathoracic air and subcutaneous emphysema¹⁸.

Whether or not the presence of air leaks is an indicator of poor prognosis is still under debate, and the evidence available to date comes from case series and small cohorts. In the pandemic caused by SARS-CoV in 2004, the presence of NM in patients without mechanical ventilation increased mortality²¹. So far, the evidence is contradictory, since in some series a 21-100% mortality rate has been reported^{2,8,16,21}; however, these studies have small samples and selection biases. Therefore, in order to fully elucidate this relationship between air leaks and a worse prognosis in patients with COVID-19, better controlled studies will be needed.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical disclosures

Protection of people and animals. The authors declare that no experiments were carried out on humans or animals for this research.

Data confidentiality. The authors declare that they have followed the protocols of their work center regarding the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

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