

ANSWER TO THE PHOTO QUIZ

Why does the lung turn from black to white?

Keywords - COVID-19, pneumothorax, Macklin effect

Diagnosis: COVID-19 associated spontaneous pneumothorax

The chest X-ray (*figure 1*) shows a vertical strict line on the left hemi-thorax caused by the contrast between radiolucent air versus more radiopaque materials containing fluid or fat. The sudden change from black to white matches increased tissue density, possibly caused by a massive pleural effusion or atelectasis. However, the X-ray was taken in an upright position. In this position gravity would have caused a horizontal hydrothorax with blunting of the costophrenic angle. Furthermore, vascular markings are visible on the left lung base arguing against a massive pleural effusion. The sudden decline in the patient's condition raises suspicion of atelectasis; however, the abnormalities on the chest X-ray do not follow the anatomy of the lobes of the left lung. Therefore, this X-ray is not compatible with a diagnosis of atelectasis.

In this case the medial part of the left lung, which became more radiolucent, is the part where the diagnosis must be sought. Computed tomography (CT) of the thorax at the time of increased oxygen demand showed a large dorsal and small ventral pneumothorax on the left side (*figure 2B*). The lateral white part on the chest X-ray is the pre-existing consolidation compressed to the lateral chest wall.

Ventral and dorsal pneumothorax can be easily missed on conventional chest X-ray. Lung ultrasound provides a 95% sensitivity and 94% specificity in detecting pneumothorax, CT thorax being the gold standard.^[1] Point-of-care ultrasound of the lung by the BLUE protocol could have further differentiated between effusion and consolidation in the left lateral lung. However, the dorsal pneumothorax would have been outside the posterolateral alveolar and pleural syndrome (PLAPS) point

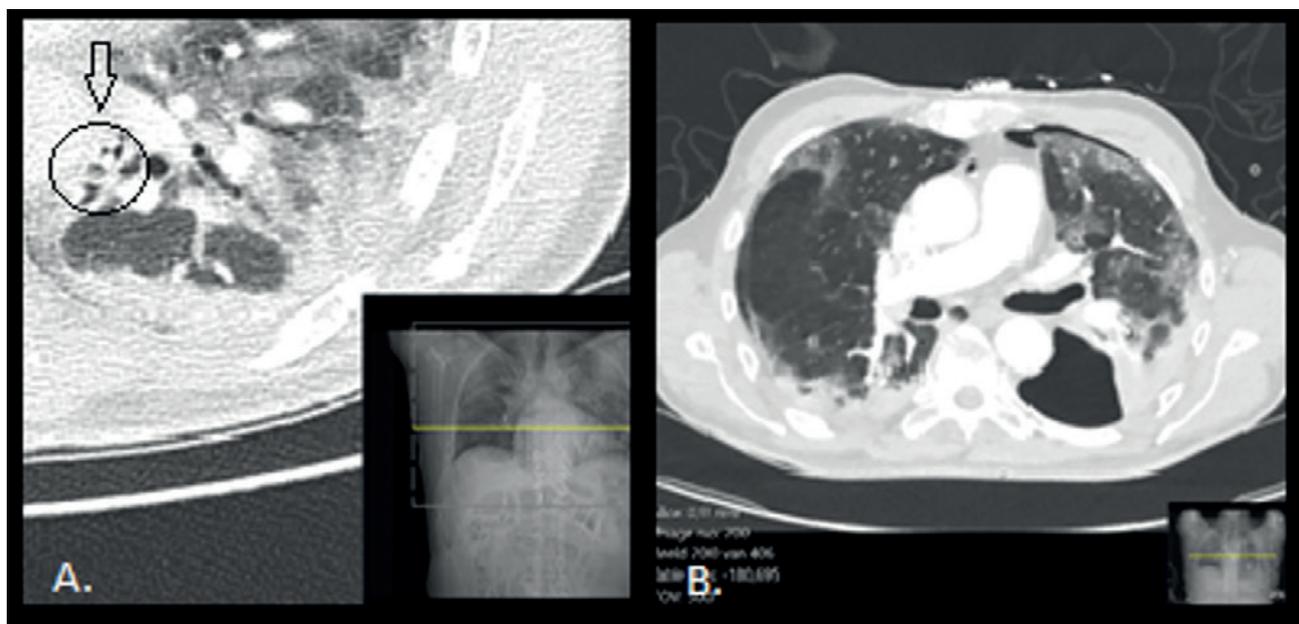


Figure 1. A. CT scan on admission: the Macklin effect. The arrow is pointing towards air next to the bronchovascular bundle (visible within the upper part of the circle)

B. CT scan of the chest at the time of increased oxygen demand. A small ventral and a large dorsal pneumothorax are visible at the location of the previously visible Macklin effect. The pre-existing consolidations is compressed to the left lateral chest wall

and in this specific case ultrasound would not have detected the pneumothorax.^[1]

Pneumothorax is a potential complication of COVID-19 acute respiratory distress syndrome (ARDS) with a reported incidence of 6-19% in patients admitted to the ICU.^[2,3] Pneumothorax is associated with increased hospital mortality and increased length of hospitalisation in COVID-19 patients.^[2,4] The higher reported incidence of pneumothorax in COVID-19 ARDS compared with non-COVID-19 related ARDS suggests a specific type of lung frailty. A one-to-one relationship with classic barotrauma or pre-existing lung disease has not been found.^[2-5] The exact pathophysiological mechanism of increased lung frailty in COVID-19 is not completely understood.

A sign of lung frailty and increased risk of pneumothorax is the Macklin effect, first described in 1939.^[3,6,7] This pathophysiological mechanism is caused by alveolar air leakage into the lung interstitium dissecting the bronchovascular sheaths.^[7] The collection of air contiguous to the bronchovascular sheath is visible on the lung parenchymal window of

the CT image of the chest. Conventional X-ray or ultrasound lack this distinctive power. The CT scan upon arrival of our patient showed a clear sign of the Macklin effect (*figure 2A*). Mechanically ventilated COVID-19 ARDS patients with Macklin effect on baseline CT have a very high risk of developing pneumothorax or pneumomediastinum with an odds ratio of 54.^[6]

This case presents a COVID-19 pneumonia associated pneumothorax with an atypical appearance on chest X-ray. When a patient with COVID-19 pneumonia suddenly deteriorates, pneumothorax should be high on your list of possible diagnoses. Let the Macklin effect be a warning sign. Don't let the white parts of the X-ray fool you.

Disclosures

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Informed consent was obtained from the patient for the publication of this case report and the accompanying images.

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