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Radiology

Spontaneous Subcutaneous Emphysema as a Clue to the Macklin Effect in Acute Asthma: A Case Report

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Abstract **Case Report**

The Macklin effect is a key radiological marker indicating the movement of air from the pulmonary interstitium into the mediastinum, which can lead to spontaneous subcutaneous emphysema, pneumothorax, and pneumomediastinum. We describe a clinically significant case in thoracic imaging, specifically on CT scans, which revealed this effect in a 65-year-old patient with Chronic Obstructive Pulmonary Disease (COPD) and interstitial lung disease (ILD). Thoracic CT scan confirmed the diagnosis of pneumomediastinum, bilateral pneumothorax, and subcutaneous emphysema. This case underscores the importance of thoracic imaging in managing pulmonary complications resulting from the Macklin effect.

Keywords: Subcutaneous Emphysema, Pneumomediastinum, Spontaneous Pneumothorax, COPD, Interstitial Lung Disease, Macklin Effect.

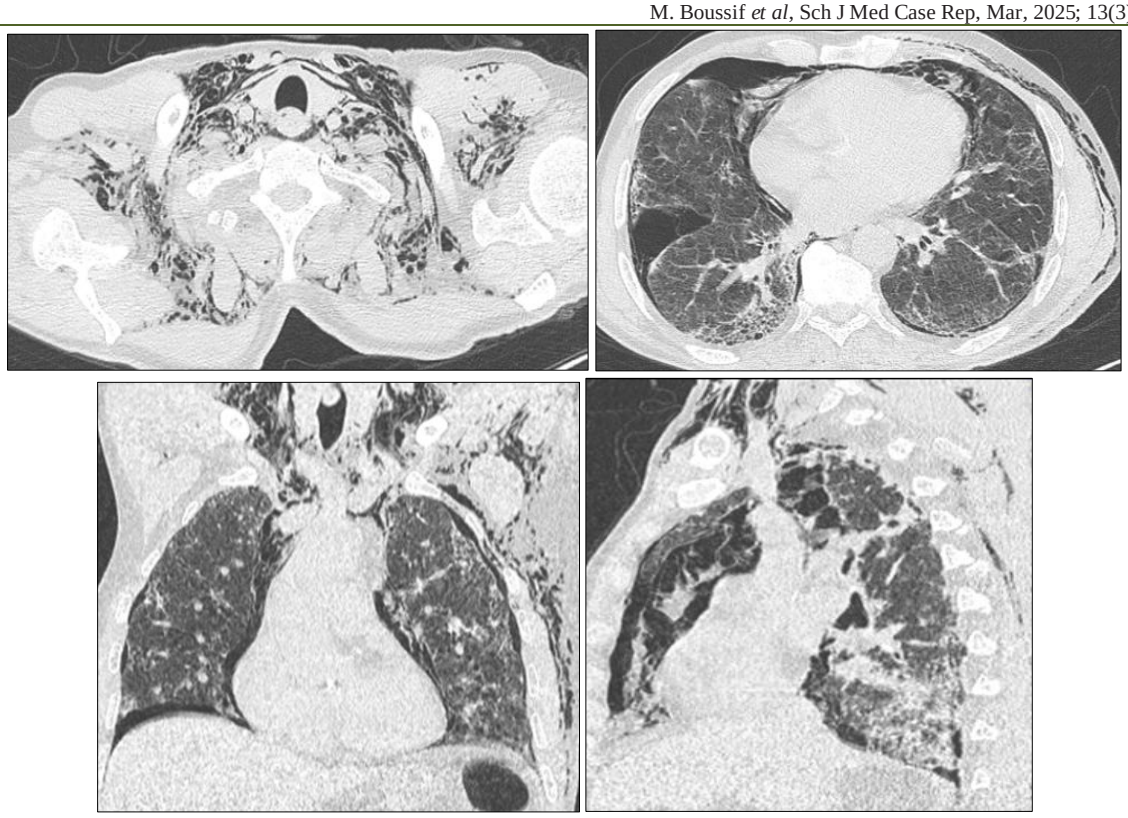
INTRODUCTION

First described by Macklin in 1939, the pathophysiology of the Macklin effect involves the rupture and ballooning of alveoli due to an acute increase in intrathoracic pressure, which allows air to track along the pulmonary vascular sheaths. This phenomenon is typically triggered by factors such as coughing, the Valsalva maneuver, or chronic respiratory disorders like COPD or interstitial lung disease [1, 2]. Thoracic imaging, especially CT scans, provides the best means to demonstrate the Macklin effect and its complications, such as pneumomediastinum and pneumothorax [3]. We present a case demonstrating how thoracic imaging detects the Macklin effect and reveals bilateral pneumothorax and pneumomediastinum in a COPD patient.

CASE PRESENTATION

A 65-year-old male, a chronic smoker with a 40 pack-year history and irregular medical follow-ups, presented to the emergency department with subcutaneous crepitus and chest pain. He reported the sudden onset of very sharp chest pain the previous day while coughing after smoking, accompanied by dyspnea. Physical examination revealed subcutaneous emphysema extending to the cervical region, anterior left chest wall, and bilateral axilla. The patient was tachycardic at 135 bpm, had an oxygen saturation of 81% on room air, and a blood pressure of 130/80 mmHg, although he was afebrile.

Chest X-ray demonstrated pneumomediastinum, and a CT scan of the chest confirmed localized pneumomediastinum, bilateral pneumothorax (moderate on the right and minimal on the left), and extensive subcutaneous emphysema. Imaging also revealed fibrotic interstitial lung disease, honeycombing lung, and interlobular reticulations suggestive of advanced disease [4]. Air dissecting within the pulmonary vascular sheath supported the conclusion that the pneumomediastinum occurred due to the Macklin effect as the most likely underlying mechanism [5].



Figures: Chest CT Scan 3D with parenchymal window: pneumomediastinum, bilateral pneumothorax, and extensive subcutaneous emphysema

DISCUSSION

Contribution of Thoracic Imaging:

Thoracic imaging, particularly CT scan, is vital for identifying the Macklin effect and its complications. In combination with the demonstration of air dissecting along the pulmonary vascular sheaths, CT enables the diagnosis of the Macklin effect [6].

This case clearly illustrates the Macklin effect, as the CT scan revealed pneumomediastinum, bilateral pneumothorax, and subcutaneous emphysema [7].

The radiological criteria for the Macklin effect include:

- Linear air collections along the bronchi and pulmonary vessels
- Peribronchovascular air dissection progressing into the mediastinum
- Associated pneumothorax and subcutaneous emphysema, as observed in this case

The Pathophysiological Basis for the Macklin Effect:

The Macklin effect is classically described as the rupture of alveoli due to a sudden increase in intraalveolar pressure from severe coughing or underlying pulmonary diseases such as COPD or ILD [8]. When the alveoli burst, air escapes along the vascular sheaths, dissecting into the mediastinum and soft subcutaneous tissues [9]. In this case, the most likely triggers were a paroxysmal coughing fit and underlying COPD, with the latter further compromised by fibrotic ILD, which reduced the integrity of the lung parenchyma [10].

Clinical Background:

The patient had several risk factors: untreated COPD and fibrotic ILD, combined with a significant coughing fit that initiated the chain of events [4]. The CT scan showed honeycombing lung and interlobular reticulations, findings that are suggestive of advanced ILD, predisposing the lung to the Macklin effect [5].

Incidental Discovery of ILD:

In this patient, ILD was an incidental finding that raised important clinical questions. Although CT suggested fibrosis with honeycombing lung, it did not clarify the etiology. The differential diagnoses for ILD included idiopathic pulmonary fibrosis (IPF), smoke-induced ILD, or ILD resulting from environmental or occupational exposures [6].

Management

The patient was admitted to the pulmonology department for specialized treatment. Management of the bilateral pneumothorax involved the insertion of a chest drainage tube and oxygen therapy to correct possible hypoxemia, along with corticosteroids for ILD.

CONCLUSION

Thus, this case reinforces the important role of thoracic imaging, in particular CT scan, in recognizing the Macklin effect and its associated complications.

Air dissecting along pulmonary vascular sheaths into the surrounding structures provides both diagnostic corroboration and guidance for management.

Most importantly, the case highlights the need to consider and investigate incidental lung diseases such as COPD and ILD, which can set the stage for the Macklin effect.

Early intervention to relieve the pneumothorax and address contributing factors is critical in preventing these life-threatening complications [9].

Conflict of Interest: The authors declare no conflicts of interest.

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