

Re-Expansion Pulmonary Edema: A Case Report of Cardiorespiratory Collapse After Thoracic Drainage

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ABSTRACT

Introduction: Re-expansion pulmonary edema (RPE) is a rare but serious complication associated with rapid drainage of air or fluid from the pleural cavity, often following procedures such as thoracentesis or tube thoracostomy. Despite its low reported incidence, RPE can lead to complications ranging from hypoxia to cardiorespiratory collapse, even in otherwise healthy individuals.

Case Presentation: We present a case of a 65-year-old male with metastatic bronchial adenocarcinoma admitted for a femoral neck fracture requiring surgical intervention. Preoperative evaluation revealed respiratory distress and a large right pleural effusion, prompting thoracic drainage. Following drainage, the patient developed acute RPE postoperatively, necessitating intubation and mechanical ventilation, leading to fatal cardiorespiratory collapse.

Discussion: RPE's pathophysiology involves vascular endothelial injury and increased vascular permeability, exacerbated by factors such as rapid lung re-expansion and underlying pulmonary conditions. Diagnosis relies on post-drainage respiratory symptoms and chest radiographs. Treatment includes oxygen therapy, non-invasive positive pressure ventilation, and, in severe cases, endotracheal intubation. Prevention strategies focus on careful drainage management and limiting drainage volume.

Conclusion: Preventing RPE is paramount, requiring proactive management and prompt symptom recognition. This case underscores the importance of vigilance during thoracic drainage procedures and highlights the potentially fatal consequences of RPE, even in patients with underlying comorbidities.

Keywords: Re-expansion Pulmonary Edema; Malignant Pleural Effusion; Pneumothorax; Thoracic Drainage; Thoracostomy

Introduction

Re-expansion pulmonary edema (RPE) presents a rare, yet serious complication linked to rapid air or fluid drainage from the pleural cavity, often following procedures such as thoracentesis or tube thoracostomy or a huge mediastinal mass removal. This condition is marked by an abrupt reduction in intra-pleural pressure, particular-

ly notable in cases of extensive and rapid pneumothorax or pleural effusion drainage, or in instances of long-term pulmonary collapse. The consequences can range from varying degrees of hypoxia and hypotension to cardiorespiratory collapse, necessitating interventions like endotracheal intubation and mechanical ventilation. Despite its low reported incidence of less than 1%, RPE can prove fatal, even in otherwise healthy young adults without underlying comorbidities.

Case Presentation

Patient Information's

This concerns a 65-year-old North African male patient, a chronic former smoker who is being treated for 1 year for metastatic bronchial adenocarcinoma under palliative care. He was admitted to the emergency room following a minor pelvic trauma.

Clinical Findings

The clinical assessment reveals a deteriorated overall health status marked by anorexia and a significant weight loss of 30kg within one year, along with pale conjunctivae and evident signs of dehydration such as skin folds and ocular hypotonia. Musculoskeletal examination highlights a shortened and deformed left limb, particularly noticeable around the greater trochanter, accompanied by pain and immobility. However, pulses in the tibial and pedal arteries are present, sensitivity remains intact, and distal motor function is preserved.

Pleuropulmonary examination identifies a patient exhibiting polypnea at 35 breaths per minute, orthopnea, discomfort in the supine position, forward-leaning posture indicative of respiratory distress, and an oxygen saturation level of 88% in ambient air, with reduced breath sounds on the right side. Despite these findings, the patient maintains hemodynamic stability, with a blood pressure reading of 127/56 and a heart rate of 109 beats per minute with not assessable functional capacity and no effort angina. He is conscious and show no signs of neurological impairment.

Diagnostic and Assessment

The hip X-ray showed a displaced fracture of the femoral neck. Moreover, the pelvic injury assessment revealed no other abnormalities. In the presence of dyspnea, a chest X-ray revealed a large right-sided pleural effusion with passive atelectasis (Figure 1). As part of the preoperative assessment, the ECG showed no abnormalities, the blood tests showed a hemoglobin level of 9.5, a platelet count of 187.000, no coagulation abnormalities, and normal renal function.



Figure 1: Chest Xray showing huge right pleural effusion.

Therapeutic Interventions

To prepare the patient for surgery, thoracic drainage was indicated. A chest tube was inserted at the 4th intercostal space on the right anterior axillary line with suction set at -15 centimeters of water, brought back 3,5 liters of serosanguinous fluid within 30 min. Radiological control confirmed proper drain placement, and partial re-expansion of the lung (Figure 2). The patient's respiratory status improved with a respiratory rate of 20 breaths per minute, oxygen saturation of 92% on ambient air, absence of orthopnea, and toler-

ance of dorsal decubitus, and the patient remained hemodynamically stable. The drain was no longer productive. The patient was deemed fit for surgery. Under spinal anesthesia, a gamma nail was inserted without any intraoperative incidents. Postoperatively, 6 hours after drainage, in the recovery room, the patient developed rapidly evolving acute respiratory distress necessitating orotracheal intubation. A Chest X-ray showed the development of acute RPE of the right lung (Figure 3). The patient was transferred to the intensive care unit and treated with furosemide via auto-pulsed syringe, and mechanic ventilation.

Follow-up and outcome of interventions

Despite the mechanical ventilation and furosemide, 24 hours later, the patient developed refractory cardio-circulatory collapse, which

did not improve with vasoactive drugs. The patient succumbed to refractory cardio-circulatory collapse 3 days later.

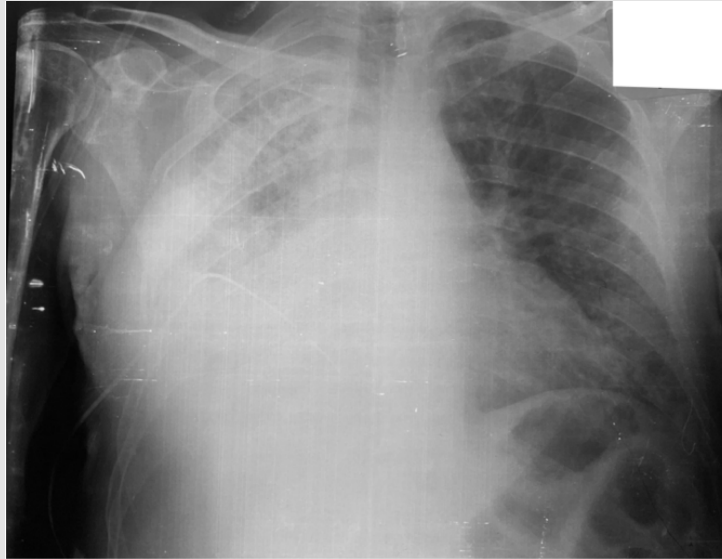


Figure 2: Chest X-ray showing partial pulmonary reexpansion, and proper drain placement.

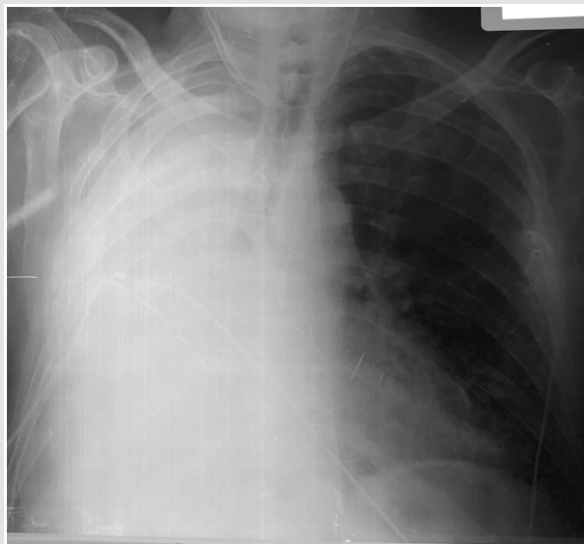


Figure 3: Chest X-ray showing proper drain placement, and massive reexpansion pulmonary edema.

Discussion

RPE is a clinical entity first described in 1875 [1]. It is a serious and potentially life-threatening condition. It is important to be aware of the risk factors associated with its occurrence to prevent it, as well as to be able to diagnose and treat it [2,3]. The RPE mostly happens within a few hours after expansion of the collapsed lung. However, the onset can occur anytime within 24 h of re-expansion [4]. The pathophysiology of RPE remains poorly understood. However, rapid re-expansion of the lung following drainage results in injury to the vascular endothelium, which increases vascular permeability and leakage of fluid into the interstitial space [4]. Another mechanism that may be associated is the injury to the alveolar-capillary barrier after rapid re-expansion, leading to injurious edema [5]. Inflammatory mechanisms are also involved, such as interleukin-8 and reactive oxygen species [6]. RPE edema typically occurs in the drained lung, but in rare cases, contralateral edema can occur. Many hypotheses have been suggested to explain this phenomenon: oblivious aspiration, compressive forces due to severe mediastinal shift, systemic inflammatory response followed by re-expansion, especially in a previously injured lung or in those with significant pulmonary disease, and significant increased cardiac output after rapid re-expansion of lung [7]. The main risk factors for developing this condition include the presence of a large amount of pleural effusion or pneumothorax, the persistence of this effusion for more than 3 days, the application of negative pressure suction, and the rapid evacuation of the effusion.

When the pleural effusion or pneumothorax is extensive, it can exert significant pressure on the lungs. If this fluid is suddenly evacuated, it can cause rapid lung expansion, triggering an inflammatory response and leading to pulmonary edema [4]. RPE should be suspected in cases where respiratory parameters deteriorate or fail to improve after drainage of the pleural cavity. Typically occurring within an hour, patients may present with coughing, dyspnea, and occasionally frothy sputum [8]. Clinicians then examine for moist rales at the drained lung (rarely bilaterally) and perform follow-up chest X-rays, the preferred diagnostic tool for “a vacuo” edema [5]. Once RPE is diagnosed, prompt treatment is essential, primarily relying on oxygen therapy and non-invasive positive pressure ventilation such as CPAP; severe cases may necessitate invasive ventilation with endotracheal intubation. Loop diuretics may also be employed. Some authors suggest corticosteroids or non-steroid anti-inflammatory drugs, but their efficacy remains unproven and thus not recommended [5]. While most patients recover within a week, mortality rates can be as high as 20% in those experiencing cardio circulatory collapse [9]. The primary emphasis should be placed on preventing the occurrence of RPE.

When performing tube thoracostomy for spontaneous pneumothorax or pleural effusion, it is recommended to initially connect the tubes to an underwater-seal drainage system. If re-expansion of the

lung does not occur within 24–48 hours using underwater-seal drainage alone, then negative pressure (preferably <20 cm H₂O) can be applied to the pleural space. If a patient develops chest tightness or coughing, the procedure should be halted [9]. Typically, it is recommended that the drainage volume of pleural effusion does not exceed 1–2 L every 2 h [10]. RPE should be considered as a potential diagnosis in any patient with a significant pneumothorax or pleural effusion who experiences worsening respiratory symptoms following tube thoracostomy or thoracentesis.

Conclusion

The importance of preventing re-expansion pulmonary edema cannot be overstated. By implementing proactive measures such as careful management during tube thoracostomy, monitoring fluid drainage volumes, and promptly recognizing symptoms during drainage procedures, we can significantly mitigate the risk of this potentially life-threatening complication. Prioritizing preventive strategies not only enhances patient safety but also ensures better outcomes and reduces the burden on healthcare resources.

Credit Statement

Ilyass Hmadate: Corresponding author, Writing – original draft, review & editing, Mohamed beaouiss: Writing – review & editing. Mohamed Benani: Writing – review & editing. Youssef Aarjouni: Writing – review & editing. Brahim Chikhi: Writing – review & editing. Abderrahmane Elwali: Writing – review & editing. Mustapha bensghir: Writing – review & editing, validation of the final manuscript.

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Ethics Declarations

Ethics Approval and Consent to Participate

Mohammed 5 Military training hospital ethical committee approved the study.

Consent for Publication

Written informed consent was obtained from the patient's family to publish this case report. A copy of the written consent is available for review by the Editor-in-Chief of this journal if requested.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work the author used ChatGPT to translate and improve the writing language. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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