CHEST

A Man in His 60s With Sudden Decompensation After Percutaneous Tracheostomy

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VIDEO

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A cachectic man in his 60s presented to the ED with progressive fatigue, dyspnea on exertion, and weight loss over 1 year. Information later provided by the patient's family revealed progressive proximal muscle weakness over the past few years. His initial evaluation revealed a non-ST-segment elevation myocardial infarction that was medically managed. The patient underwent CT and MRI scanning to rule out malignancy given his weight loss and overall chronically ill appearance, but all findings were nondiagnostic. Results of an HIV test were also negative.

One week into his hospitalization, the patient was intubated secondary to acute hypercarbic respiratory failure. Three attempts at extubation failed, and given the patient's ventilator dependence, he underwent bedside percutaneous tracheostomy placement in the medical ICU. The tracheostomy placement was complicated by an off-vector dilator placement that was subsequently corrected with successful insertion of the tracheostomy tube. As the final step in verification, the patient was connected to the ventilator but developed elevated peak airway pressures > 55 cm H_20 with minimal tidal volume delivered. The patient became acutely and progressively severely hypoxemic, tachycardic, and hypotensive. Immediate bedside lung ultrasonography was performed to evaluate the patient's rapid deterioration. Absence of lung sliding on the right hemithorax, along with lung point, was observed; diagnosis of a tension pneumothorax was made, with immediate performance of needle decompression and chest tube placement. The patient's cardiorespiratory status improved with evidence of lung sliding on the right anterior chest via lung ultrasound (Video 1, Video Set 1). Ten minutes later, the patient was again noted to be tachycardic, hypotensive, and hypoxemic. Lung ultrasonography was once more used emergently to elucidate the reason for recurrent patient decompensation (Videos 2 and 3, Video Set 1).

Question: *Based on the repeat bedside lung ultrasound findings, what was the reason for the patient's recurrent deterioration?*

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Answer: The right lung demonstrated lung sliding, excluding residual pneumothorax and confirming proper chest tube function (Video Set 1, Video 1). The patient now had a left-sided tension pneumothorax, seen by the absence of lung sliding (Video Set 1, Video 2) and the presence of lung point (Video Set 1, Video 3), requiring emergent needle decompression with subsequent placement of a second 14-F pigtail catheter in the second anterior intercostal space. Return of lung sliding at the location of the previously visualized lung point should be seen on repeat ultrasonography.

Discussion

The patient had an uncommon complication after percutaneous tracheostomy placement: bilateral pneumothoraces. The reported incidence of posttracheostomy pneumothorax is varied and most likely underreported.[1,2] The suspected mechanism is the inadvertent puncture of the posterior tracheal membrane secondary to an incorrect dilator vector leading to pneumomediastinum and subsequent lung collapse.[3-5] Recently, percutaneous tracheostomies have become a common bedside procedure in the medical ICU. Bedside ultrasound may enhance the safety of the procedure by identifying aberrant neck vasculature (ie, high-riding innominate artery) that can lead to uncontrollable bleeding. These patients can then be referred for a standard surgical tracheostomy performed in the operating room.

In the present case, the use of bedside ultrasonography allowed for the immediate identification of the pneumothoraces, prompting the use of life-saving interventions that led to a favorable patient outcome. Traditionally, chest radiographs are used to identify pneumothoraces. However, thoracic ultrasound has been proven to be as specific and more sensitive in the identification of pneumothorax with the advantage of immediate bedside availability.[6]

The identification of lung sliding rules out the presence of pneumothorax with 100% certainty in the area being scanned (Discussion Video Set, Video 1). Lung sliding was originally described in 1995 by Lichtenstein and Menu as an "interface between the soft tissues of the chest wall and aerated lung."[7] Lung sliding is appreciated as movement at the pleural line with respiration and can be assessed at any point on the chest wall. If lung sliding is present, there is direct apposition between the parietal and visceral pleurae, excluding the presence of a pneumothorax. It is therefore essential to identify and establish the presence of lung sliding prior to any thoracic procedures. The absence of lung sliding (Discussion Video Set, Video 2) raises the possibility of a pneumothorax but can also be seen in other conditions that may cause the adherence of the visceral and parietal pleurae (such as in ARDS), complete atelectasis (as in right mainstem intubation), or iatrogenic pleurodesis (as in patients with treated malignant pleural effusions). In these situations, other sonographic findings can help to rule out a pneumothorax. These findings include lung pulse and "B" lines. Lung pulse represents transmitted cardiac pulsation appreciated at the pleural line when visceral and parietal pleurae are opposed (Discussion Video Set, Video 4).[8] B lines represent vertical reflection artifacts consistent with alveolar-interstitial syndromes, as the source of B lines is within the lung parenchyma, and their presence rules out intrapleural air. Absence of lung sliding with the presence of lung point (Discussion Video Set, Video 3) verifies the presence of a pneumothorax.[9] Lung point represents the interface between the pneumothorax and the aerated lung. During inspiration, the collapsed lung may expand to reach the chest wall, allowing visualization of lung sliding intermittently, until expiration, when the lung is once again removed from the chest wall. Both low- and high-frequency transducers have the ability to visualize the pleural line, and there have been no studies comparing which transducer is better for the diagnosis of a pneumothorax. The high-frequency transducer allows closer inspection of the pleural line and is frequently used when ambiguity exists regarding lung sliding or lung pulse.

After bilateral chest tube placement, the patient improved and was eventually discharged to a rehabilitation facility. This case illustrates the importance of using a standard algorithm for the quick and accurate assessment of acute respiratory failure, as previously described by Lichtenstein and Mezière in 2008.[10] The ability to accurately and quickly rule in or out a pneumothorax in a patient with respiratory failure has obvious life-saving benefit; ultrasound assessment for pneumothorax is arguably the best modality in the ICU. It is therefore the opinion of these authors that all intensivists should gain proficiency in lung ultrasound. It is easy to learn, highly accurate, requires no patient transport, uses no ionizing radiation, and is repeatable as often as needed.

Reverberations

1. *Thoracic ultrasound is the best imaging modality for the diagnosis of pneumothorax in the ICU, with a higher sensitivity than standard chest radiography.*
2. *The presence of lung sliding rules out a pneumothorax. The absence of lung sliding suggests pneumothorax as one of many etiologies, and further confirmatory tests should be undertaken. Finding a lung point in this circumstance would confirm the presence of a pneumothorax.*

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Additional information: To analyze this case with the videos, see the online version of this article.

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