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CASE REPORT

Tracheal fistula in a patient after esophageal surgery confirmed by lung ultrasound: A new bedside tool for thoracic surgeons

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Abstract

Tracheal fistula is a rare but severe complication following esophageal surgery. Here, we report the case of a tracheal fistula in a patient after esophageal surgery suggested by pneumothorax and confirmed by fiberoptic bronchoscopy, and introduce lung ultrasound as a new bedside tool to sensitively detect pneumothorax.

Introduction

Tracheal fistula is a rare but severe complication of esophageal surgery that may cause a poor prognosis.[1] Detection of pneumothorax and/or subcutaneous emphysema within 1–7 days after surgery is strongly suggestive of the presence of a tracheal fistula.[2] However, volume of air in the lung may be very low so detection of pneumothorax is difficult. Chest X-ray is not sensitive enough, and chest computed tomography (CT) is costly and radioactive. Lung ultrasound[3] is a new tool now commonly used in ICU to detect lesions in the lung. It can be performed by the patient's bedside, is non-radioactive, less costly and convenient, and considered to be more sensitive than chest X-ray in detecting pneumothorax.[4] Here, we report a case of tracheal fistula following esophageal surgery soon after the surgery suggested by the pneumothorax that was detected with bedside lung ultrasound.

Case report

A 70-year-old male was admitted to our hospital with a history of gastric intestinal metaplasia for five years and subcostal dull pain for more than one month. He was diagnosed with esophagocardial adenocarcinoma and surgery for esophageal carcinoma was performed with the assistance of video-assisted thoracoscopic surgery (VATS) through an upper abdominal and right thorax incision. The patient was transferred to ICU after the surgery in the evening.

When admitted to ICU, subcutaneous emphysema in the right cervical and right anterior chest was detected on physical examination. However, fiberoptic bronchoscopy showed only obvious congestion of tracheal and bronchial mucosa. Chest X-ray showed no pneumothorax in the lung (Fig 1a). The following day, the patient's subcutaneous emphysema seemed to be more obvious, but chest X-ray

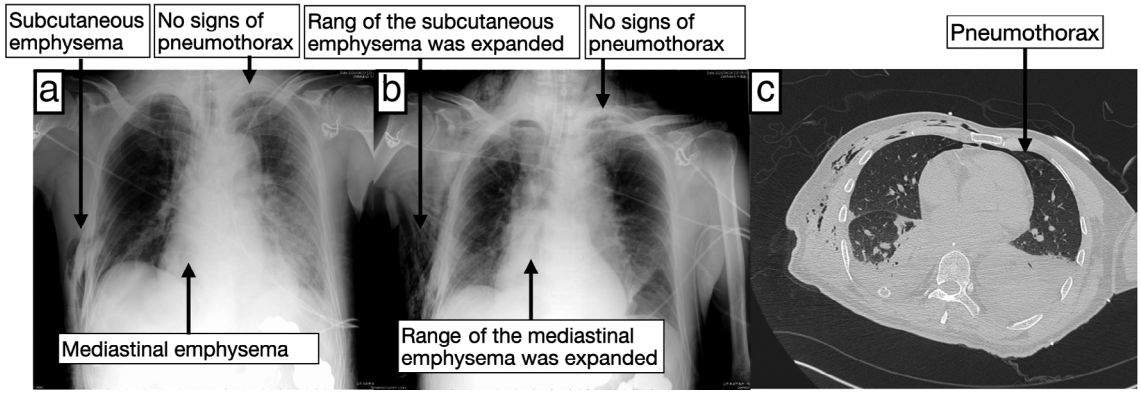

Figure 1 Chest X-ray and computed tomography (CT) scan of the patient. Chest X-ray showed no signs of pneumothorax both (**a**) on admission to ICU and (**b**) on the second day after surgery. (**c**) A CT scan verified the existence of a low volume left pneumothorax.

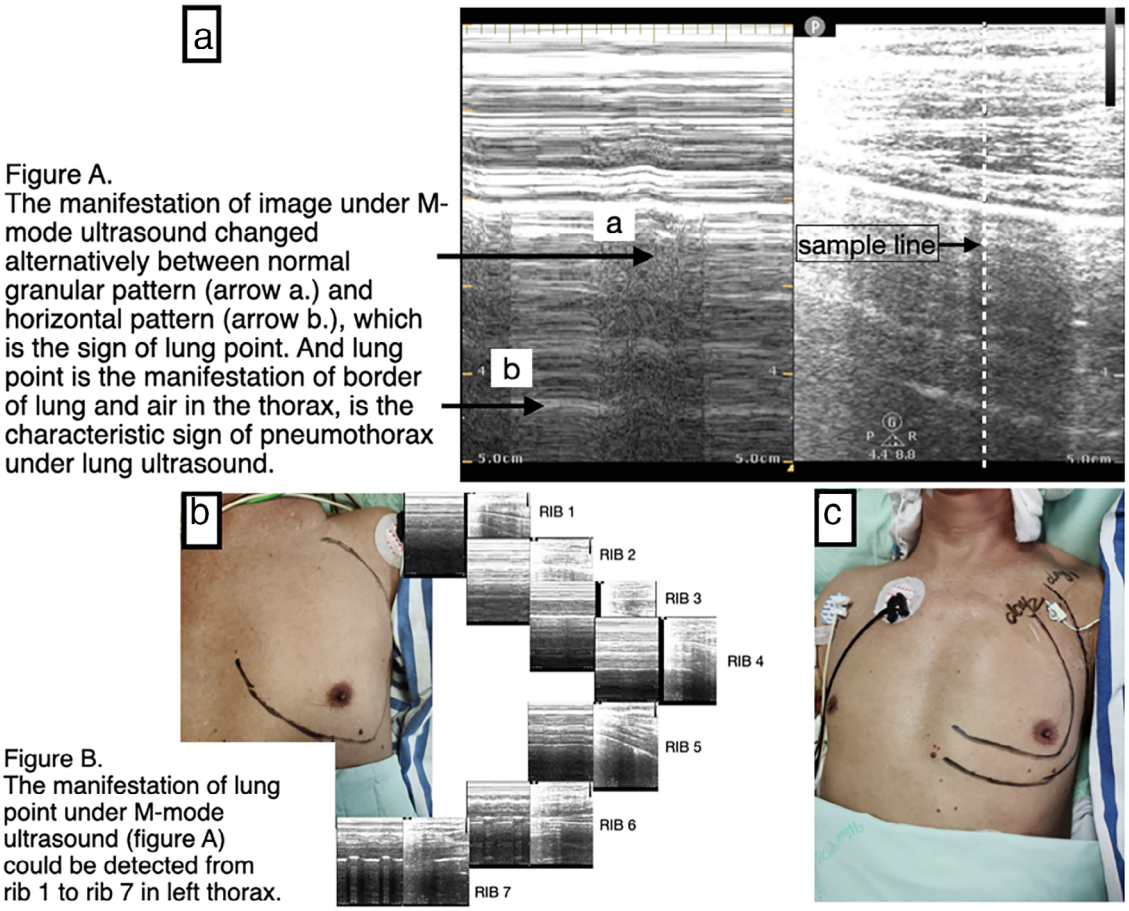

Figure 2 Lung ultrasound revealed the presence of a left pneumothorax. (**a**) In the time-motion mode of lung point sign, we could see the manifestation of image changed alternately between normal granular pattern (arrow a.) and horizontal pattern (arrow b.) at the defined location according to the respiratory cycle, which is a characteristic sign of pneumothorax. (**b**) Manifestation of lung point sign under M-mode was detected from the left first to seventh ribs. (**c**) Scope of left pneumothorax was diminished under monitoring with lung ultrasound. Video of the lung point sign from the first to the seventh ribs was also acquired. (see Appendix S1)

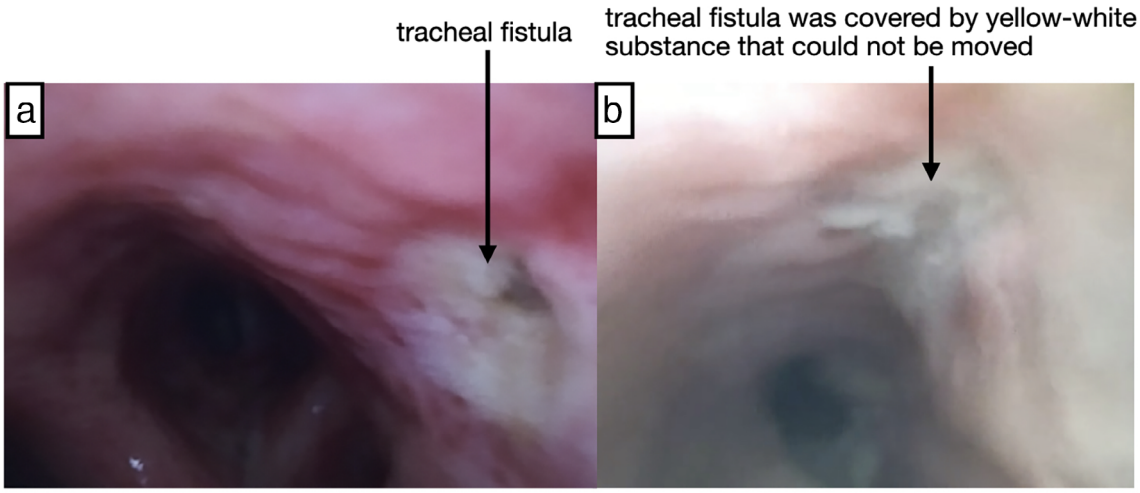

Figure 3 (**a**) A fiberoptic bronchoscopy revealed a 1 × 0.7 cm size tracheal fistula in the left principal bronchus. (**b**) Two days later the fistula was found covered by a yellow-white substance that could not be moved.

was also negative (Fig 1b). However, a routine lung ultrasound of the patient detected signs of A line, absence of pleural sliding and existence of a lung point (Fig 2a,b) in the left lung from the first to the seventh ribs, which definitely confirmed the presence of pneumothorax. This was subsequently verified by CT scan (Fig 1c).

A tracheal fistula was suspected and fiberoptic bronchoscopy was again performed, and a tracheal fistula of about 1 × 0.7 cm in size was detected 1 cm under the opening of the left principal bronchus (Fig 3a). A 1 × 1.5 cm ulcer near the anastomotic astium was detected on gastroenterological endoscope examination, but there were no signs of esophagotracheal fistula formulation. We assessed the possibility of insertion of an endotracheal stent or surgery. However, fortunately for the patient, two days later the fistula was found covered by yellow-white substance that could not be moved (Fig 3b) under fiberoptic bronchoscopy. Scope of left pneumothorax was also diminished under monitoring with lung ultrasound (Fig 2c). The patient was successfully weaned off mechanical ventilation and transferred back to the department of thoracic surgery.

Discussion

Tracheal fistula formation is a rare complication after esophageal surgery, and can cause pulmonary infection, mediastinal emphysema and pneumothorax, which could affect a patient's prognosis and even be mortal when severe.[5] Timely detection of the fistula in the case reported here enabled us to monitor the condition and form a therapeutic plan. Once a fistula has been diagnosed, the ventilation setting on the ventilator should be changed to support fistula closure and the setting should be kept as low as possible under the premise of providing enough respiratory support, and extubation of the tracheal tube should be performed as soon as possible so that the fistula might recover on its own accord.

However, most tracheal fistula are occult and difficult to discover if severe consequences arise. Detection of both subcutaneous emphysema and pneumothorax, especially its progressive increase, is rare after esophageal surgery and therefore to some extent strongly suggests the possibility of the existence of a tracheal fistula. Subcutaneous emphysema is easily detected on physical examination, but pneumothorax may be difficult to diagnose due to its low volume since chest X-ray is not sensitive enough to detect occult pneumothorax, and CT should be carefully considered due to its relatively high radiation exposure and cost.

The advantages of lung ultrasound include that it is non-radioactive, can be used bedside, is convenient, can be used in real-time and rapidly, is low cost with a good level of accuracy, and its development[3] as a new tool has accelerated in recent years and it now plays an important role in daily lung assessment and monitoring. It is now used extensively in ICU. Absence of pleural sliding on lung ultrasound examination suggests the possibility of pneumothorax. Detection of a lung point, a characteristic sign of movement of the border of air and the lung in ultrasonography, also assists in diagnosis.[6]

The motion mode (M-mode) of ultrasound is the motion of manifestation of echoes in the sample line along with time. If it is the lung in the sample line, M-mode ultrasound present a granular pattern (arrow a. in Fig 2a); and if it is the air in the sample line, M-mode ultrasound present a horizontal pattern (arrow b. in Fig 2a). Therefore, M-mode ultrasound of a lung point (Fig 2a) is the alternate

manifestation of the granular and horizontal pattern according to the respiratory cycle. In the lung ultrasound examination of the patient reported here, manifestation of a lung point under M-mode ultrasound was detected, which assisted us in arriving at a diagnosis of pneumothorax.

Lung ultrasound is not only able to detect but also to monitor the volume changes of pneumothorax. It is considered to have a greater degree of sensitivity in the diagnosis of pneumothorax than chest X-ray.[4] In a meta-analysis by Alrajab *et al.*[4] 13 studies were analyzed comparing lung ultrasound with chest X-ray in detecting pneumothorax; the pooled sensitivity was 78.6% and 39.8% and the pooled specificity was 98.4% and 99.3%, respectively. Lung ultrasound is clearly a superior method for the detection of pneumothorax.

In the case reported here, we investigated the reason why lung ultrasound is more sensitive compared with chest X-ray. When the volume of the air is very low in pneumothorax, air is restricted in the anterior chest. The boundary of the air and lung may be overlapped by other tissue images on chest X-ray making a pneumothorax difficult to distinguish. As in the patient reported here, there was very little air, and the air and lung boundaries were just on the margin of the lateral chest. We were unable to distinguish the air and lung boundaries as they were covered by an image of the ribs on chest X-ray. However, when the boundary was in the anterior chest, even laterally, it was easily distinguishable through a lung point on ultrasound. Therefore, lung ultrasound is more sensitive and useful than chest X-ray in the screening of pneumothorax, especially in low-volume pneumothorax, in which situation symptoms are occult and easily neglected.

Chest X-ray is now a routine examination usually performed the second day after esophageal surgery. Most patients return to the department of thoracic surgery instead of ICU. Lung ultrasound is rarely used in these kinds of patients. Since occult esophagotracheal fistula is rare and severe, the enhancement of application of lung ultrasound in such patients could assist with its early discovery. In addition, not only pneumothorax but also lung pathophysiology can be detected by lung ultrasound. We therefore suggest that routine monitoring of pneumothorax by lung ultrasound is performed within 14 days in patients following esophageal surgery before their discharge. However, it will be necessary for thoracic surgeons to master this new tool.

In conclusion, there are few reports in the literature using lung ultrasound to screen and monitor pneumothorax suggestive of the existence of a tracheal fistula. The case reported here may help to provide a new approach to monitor this rare complication after esophageal surgery.

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Disclosure

The authors declare that they have no competing interests.

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Supporting Information

Additional Supporting Informationmay be found in the online version of this article at the publisher's website:

Appendix S1: Supplementary Information.

