



# Computed tomography-guided tube thoracostomy for massive subcutaneous emphysema following lung resection: a case report

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**Abstract:** A 70-year-old man underwent right-sided pulmonary bilobectomy (removal of the middle and lower lobes) for stage IIIA non-small-cell lung carcinoma. Following the operation, there was minor air leakage through the intercostal drain from postoperative day 0 to 2, which stopped completely by postoperative day 3. The subsequent postoperative course was uneventful, and the patient was discharged on postoperative day 7 after removal of the chest tube. On postoperative day 9, the patient returned to the hospital with complaints of nasal speech and bulging of the skin over his right breast region. He was diagnosed with postoperative subcutaneous emphysema. A chest computed tomography (CT) scan revealed that the emphysema was not associated with a collapsed lung, and the patient's relatively small-sized thoracic cavity left limited space for the placement of a chest tube. We performed a CT-guided tube thoracostomy with proper insertion and placement of an intercostal drain at the site of the air leakage, within the compact thoracic cavity. The procedure was effective in draining the trapped air, thus resolving the subcutaneous emphysema successfully.

**Keywords:** Chest drainage; computed tomography guided (CT guided); subcutaneous emphysema; thoracic drainage; tube thoracostomy; video-assisted thoracic surgery

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## Introduction

Subcutaneous emphysema is not an uncommon complication following thoracic surgery. In almost all postoperative cases, subcutaneous emphysema is caused by air leakage through a pulmonary fistula. Therefore, chest drainage with an intercostal drain, also known as a tube thoracostomy, is usually an effective treatment modality. However, in a patient with a relatively small-sized thoracic cavity, it is sometimes difficult to insert and position the drainage tube properly. Such cases are usually managed with the insertion of a subcutaneous drain or by making a skin incision to drain the affected subcutaneous area (1-3). Alternatively, the development of interventional radiology has enabled computed tomography (CT)-guided thoracic drainage. A tube thoracostomy can be performed under CT

guidance among patients in whom a traditional approach for positioning the chest tube in the thoracic cavity is difficult (4). There is no previously published report on the use of CT-guided chest-tube placement for the management of a patient with postoperative subcutaneous emphysema. Here, we present a case of successful application of this technique.

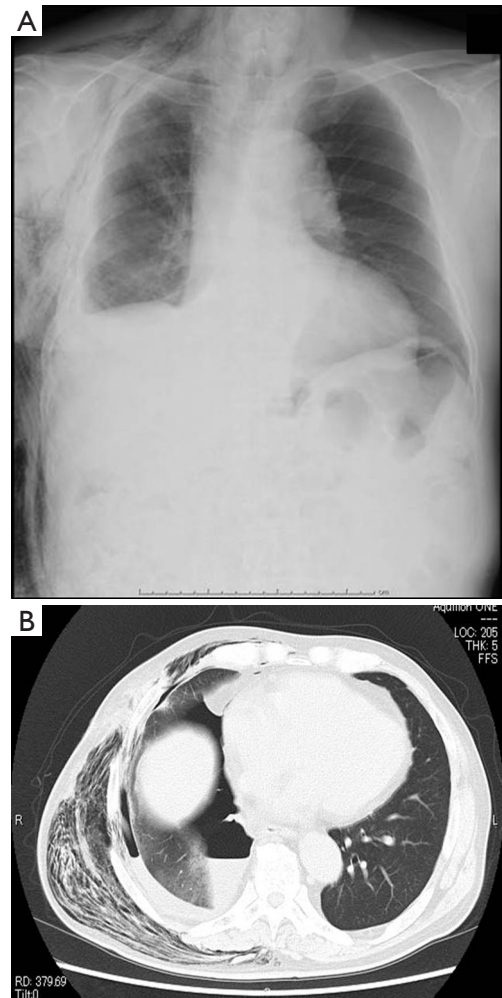
## Case presentation

A 70-year-old man was admitted to our hospital for the surgical treatment of a T3N1M0, Stage IIIA right lung adenocarcinoma. The patient had a medical history of hypertension and hyperuricemia, along with a 2.5 pack-year history of smoking. His preoperative pulmonary function test result was normal, with a vital capacity (VC)



**Figure 1** Imaging on postoperative day 7. Chest X-ray image on postoperative day 7 showing right-sided subcutaneous emphysema without right lung collapse.

of 3.25 L (%VC, 107.6%) and a forced expiratory volume (FEV1) of 2.39 L (%FEV1, 75.16%). We performed pulmonary bilobectomy with removal of the right middle and lower lobes, along with lymph node dissection (level ND1b+α). The surgical duration was 4 hours 1 min, and total intraoperative blood loss was minimal. A small amount of air leakage was observed from the chest tube from postoperative day (POD) 0 to day 2. However, the leakage stopped on POD 3. Subsequently, the postoperative course was uneventful. The chest tube was removed on POD 4, and the patient was discharged from the hospital on POD 7. A chest X-ray image obtained at that point showed mild right-sided subcutaneous emphysema (*Figure 1*). On POD 9, the patient presented again to the hospital with complaints of nasal speech and bulging of the skin over the right breast region. A chest X-ray image revealed right-sided massive subcutaneous emphysema without right lung collapse (*Figure 2A*). The chest CT scan also confirmed the presence of massive subcutaneous emphysema involving the right chest wall, along with adequate expansion of the right upper lobe, which left limited, accessible space for drainage within the patient's relatively small-sized right thoracic cavity (*Figure 2B*). He was re-admitted and kept under observation for a day. However, the emphysema did not show any signs of resolution. We determined that the site of



**Figure 2** Imaging on postoperative day 9. (A) Chest X-ray image on postoperative day 9 showing right-sided massive subcutaneous emphysema without right lung collapse compared with the finding on postoperative day 7; (B) chest computed tomography image on postoperative day 9 showing right-sided massive subcutaneous emphysema, with limited space in the right thoracic cavity.

air leakage was the caudalis of the right upper lobe, but we could not insert a chest tube into the compact right thoracic cavity via a conventional approach. Therefore, on POD 10, we performed a CT-guided tube thoracostomy with the insertion of a chest tube into the patient's right lower thoracic cavity (*Figure 3*). The thoracostomy was effective with successful evacuation of the leaked and trapped air through the drainage tube. We performed subsequent chemical pleurodesis, inserting picibanil (OK-432) and minocycline through the same drain. The air leakage was



**Figure 3** Computed tomography-guided insertion of a chest tube into the right lower thoracic cavity was performed on postoperative day 10.



**Figure 4** Chest X-ray image on postoperative day 16 showing resolution of the subcutaneous emphysema.

thus completely blocked, leading to an improvement in the subcutaneous emphysema. The chest drainage tube was removed on POD 15, and the patient was discharged in a stable condition on POD 16 (*Figure 4*).

## Discussion

The occurrence of subcutaneous emphysema following thoracic surgery is not uncommon. However, this complication could sometimes be difficult to manage if a significant amount of air leakage occurs. Once a large

amount of leaked air enters the subcutaneous space within the chest wall, it dissects into the soft tissues of the face, neck, upper chest, shoulders, and arms (5). Although considered a non-lethal condition, massive subcutaneous emphysema could be a serious complication, causing respiratory or circulatory obstruction, and it might require re-intubation, tracheostomy, or even re-operation (1,5-7). If pneumothorax is diagnosed or even suspected, chest tube insertion is the first choice of treatment. The subcutaneous emphysema usually resolves once the pneumothorax is drained (1,2,5,6). We also perform tube thoracostomy in cases of subcutaneous emphysema associated with lung collapse. This therapeutic modality has been effective in almost all treated cases, as the large amount of escaped air observed in patients with intrathoracic collapse of the lung due to an intrathoracic pulmonary fistula, a bronchial fistula, or lung injury, is also typically associated with exacerbation of subcutaneous emphysema (1,2,6). However, in patients who have a small-sized thoracic cavity with good lung expansion or in those with emphysema, insertion of a chest drain is difficult to perform successfully. Reportedly, in such cases, infraclavicular skin incision or subcutaneous drain insertion has been effectively performed for the resolution of the emphysema (3,5,7-9). There are earlier reported cases wherein single-incision video-assisted thoracic surgery has been performed for the proper placement of a chest tube (5), but the indication for this procedure is limited. However, the interventional radiological technique of CT-guided chest tube placement can be carried out effectively among patients in whom the conventional approach to the site of leakage within a compact thoracic cavity is difficult (4). CT-guided thoracic drainage has been reportedly performed in patients with pleural effusion and empyema (4). Up to now, there is no published report on the use of CT-guided tube thoracostomy for the treatment of postoperative massive subcutaneous emphysema. However, we surmise that this method can be safely utilized to perform evacuation of trapped air from the site of leakage within the thoracic cavity, even when the space for tube placement is limited. The basis of management of postoperative subcutaneous emphysema following lung resection is the drainage of the site of air leakage. We reported our experience, and we consider that the CT-guided tube thoracostomy technique for the management of massive subcutaneous emphysema, especially in patients with a compact thoracic cavity wherein chest-tube insertion is not possible via a conventional approach, is one of the options for treatment.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

*Informed Consent:* Written informed consent was obtained from the patients for publication of this manuscript.

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