



# Novel management of extensive subcutaneous emphysema in cardiac surgery: cases presentation

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**Article Information:**

Received: 20 Apr 2022; Revised: 25 Feb 2023; Accepted: 04 Mar 2023

DOI: 10.18502/cbj.v2i2.12160

## Abstract

Subcutaneous emphysema occurs when air is trapped between subcutaneous tissues and manifests as sudden swelling, dysphonia, and sore throat. In many severe cases, subcutaneous emphysema causes dysphagia, pain, and breathing difficulty. The current study reports two cases of successful management of extensive subcutaneous emphysema after cardiac surgery.

The first patient was a 60-year-old man with a history of coronary artery disease who underwent coronary artery bypass graft (CABG) surgery with cardiopulmonary bypass. He was transferred to the intensive care unit (ICU) in good condition. Twelve hours after the surgery, he was extubated in a stable condition. On the second day after the surgery, his face, neck, and chest began to swell due to extensive subcutaneous emphysema, and he experienced decreased SPO<sub>2</sub> and severe respiratory distress.

The second patient was a 65-year-old woman with a history of myocardial infarction (MI) who had CABG off-pump surgery. After surgery, the patient was transferred to the ICU in a favorable and stable condition and was extubated 6 hours after the surgery. Her face, neck, and chest started swelling three days after the surgery, and she had severe respiratory distress and decreased blood saturation due to extensive subcutaneous emphysema.

In both cases, despite conventional treatment, the patient's symptoms escalated despite re-intubation and mechanical ventilation. In the operating room, the chest tubes were removed, two new chest tubes were inserted, and the area damaged by the old tubes was repaired. Shortly after the insertion of the chest tubes, the patient's emphysema symptoms decreased significantly.

**Keywords:** Cardiac surgery, Subcutaneous emphysema, Chest tube

## Introduction

Subcutaneous emphysema occurs when air is confined between subcutaneous tissues and manifests as sudden swelling, dysphasia, and sore throat. In many severe cases, it causes dysphagia, pain, and breathing difficulty (1). Subcutaneous emphysema is manifested clinically in 6.3% of patients who undergo thoracic surgery (2). Nevertheless, more patients have mild or asymptomatic local emphysema. Most

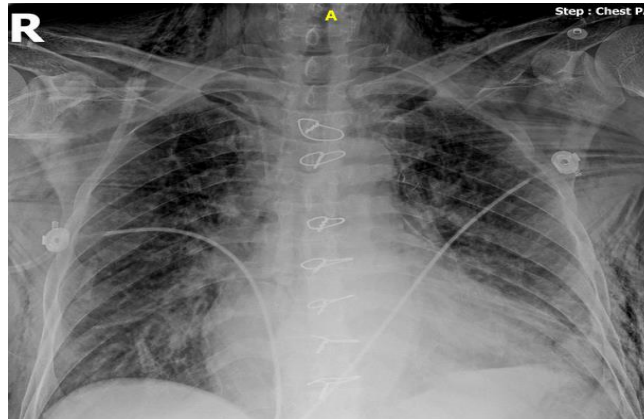
subcutaneous emphysema cases are self-limited, and the symptoms will improve if the chest is correctly drained (3). Subcutaneous emphysema can cause the face, neck, and chest to swell, leading to breathing difficulty. Especially in mechanically ventilated patients, extensive subcutaneous emphysema can cause tracheal compression, exacerbated ventilation, and decreased venous return to the head and neck. (3).

The mechanism of subcutaneous emphysema is similar to the one-way valve in the air that enters the subcutaneous space and cannot be removed. Although subcutaneous emphysema can be caused by blunt trauma, iatrogenic airway damage, or rarely by infection, pulmonary parenchymal damage is characteristic of thoracic surgery, and the nature of thoracic surgery requires a parietal pleural incision to access the thoracic cavity. Subcutaneous emphysema is not uncommon after thoracic surgery (1,2). We report two cases of successful management of extensive subcutaneous emphysema after cardiac surgery.

### Case presentation 1

A 60-year-old male with coronary artery disease was admitted to Madani Cardiovascular, Medical, and Research Center, Tabriz, Iran, in April 2022

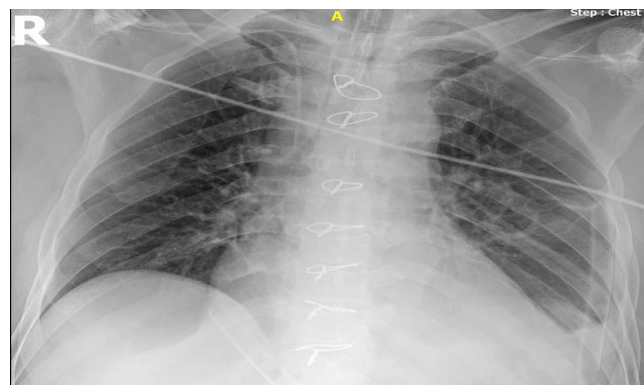
and underwent elective coronary artery bypass graft (CABG) and cardiopulmonary bypass surgery. The left internal mammary artery was grafted to the left anterior descending artery(LAD), and the three saphenous veins were grafted to the obtuse marginal, posterior descending, and diagonal arteries. Chest tubes were inserted into the left hemithorax and mediastinum, and the patient was transferred to the ICU in good condition. Twelve hours after surgery, the patient was in stable condition and was extubated. No abnormalities were found in the first chest X-ray after transferring to the ICU. Approximately two days after surgery, the patient's face, neck, and chest began to swell. His Oxygen saturation( SPO<sub>2</sub> )dropped, and he developed severe respiratory distress, while chest X-rays revealed severe subcutaneous emphysema Figure 1.



**Figure 1:** Severe subcutaneous emphysema two days after surgery (Case 1)

The patient was transferred to the operating room again, chest tubes were removed, and the previous chest tube wound site was repaired. Then two new chest tubes were placed in the fifth

intercostal space. After inserting the chest tubes, the symptoms of emphysema decreased significantly, and the patient's respiratory distress improved Figure 2.

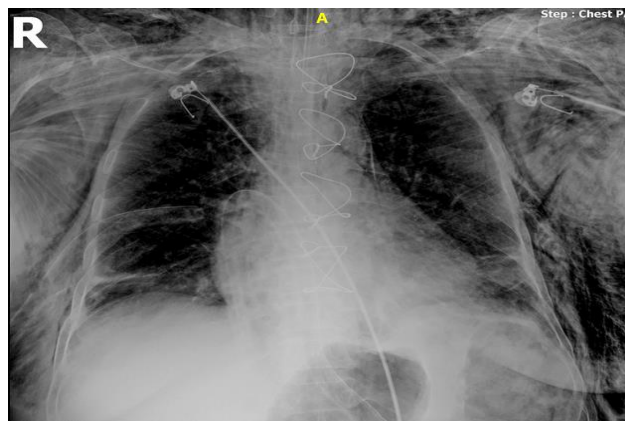


**Figure 2:** Decreased symptoms of emphysema and improve patient's respiratory after implant two new chest tubes (Case 1)

### Case presentation 2

A 65-year-old female with a history of MI was admitted to Madani Cardiovascular, Medical, and Research Center, Tabriz - Iran, and underwent off-pump CABG surgery. The left internal mammary artery was grafted to the LAD artery, and a saphenous vein was grafted to the posterior descending artery. We inserted two chest tubes in the right and left pleura and the chest tube in the mediastinum. The patient was transferred to the

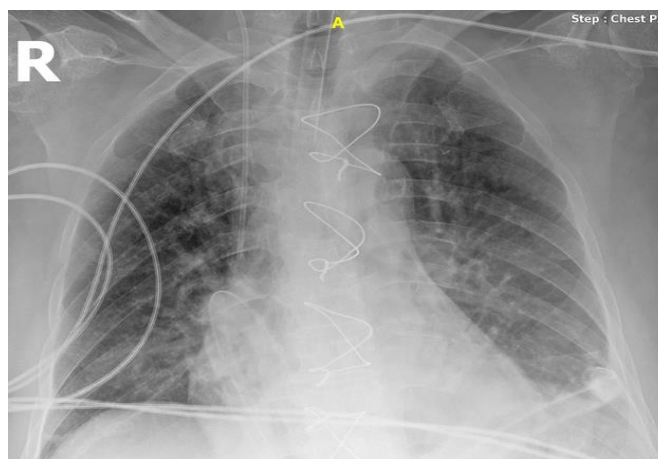
ICU in good and stable condition. After 6 hours of surgery, she was extubated in a stable condition. X-ray showing normal bones was done in the ICU, after she was transferred. Three days following the surgery, the patient's face, neck, and chest began to swell, and she developed severe respiratory distress and decreased SPO<sub>2</sub>. Chest X-ray findings indicated severe subcutaneous emphysema Figure 3.



**Figure 3:** Severe subcutaneous emphysema three days after surgery (Case 2)

The patient was transferred again to the operating room and intubated. The chest tubes were removed under general anesthesia, and the wound site of the previous chest tube was reformed. Two

new chest tubes were implanted on the left and right sides of the chest. The symptoms of emphysema and respiratory distress gradually improved after the implantation Figure 4.



**Figure 4:** Decreased symptoms of emphysema and improve patient's respiratory after implant two new chest tubes (Case 2)

Both patients were discharged in good general condition.

This study has fully observed all aspects of the Helsinki Declaration and the Code of Ethics of the

National Committee for Medical Ethics at Tabriz University of Medical Sciences, Tabriz, Iran. The information was recorded confidentially. The patient incurred no additional costs.

### Follow-up

After a month, both patients were followed up. They were both in good general condition.

### Discussion

In most cases, subcutaneous emphysema is self-limiting and can be treated by inducing proper chest drainage (3). In cases of extensive subcutaneous emphysema, the face, neck, and chest become swollen, which can cause respiratory failure (3). The extensive subcutaneous emphysema, especially in mechanically ventilated patients, can cause breathing to be exacerbated and to have impaired venous return from the head and neck (3). 95% of patients with air leaks typically require non-surgical treatment and intercostal drainage (4). Generally, subcutaneous emphysema is benign, but it can cause significant discomfort and, in rare cases, lead to high airway pressure, severe respiratory acidosis, and pacemaker dysfunction, resulting in life-threatening conditions (5). In acute conditions, the early placement of the chest drain is critical to prevent respiratory complications. There are reports of respiratory arrest and subsequent death in patients with subcutaneous emphysema (6). However, there are a few treatment methods for dealing with subcutaneous emphysema. These include immediate tracheostomy, multiple subcutaneous drainages, subclavian incision, negative pressure evacuation, chest drain, and cervical mediastinotomy (7). The mechanism of subcutaneous emphysema is similar to the one-way valve in that the air enters the subcutaneous space and cannot be removed (1, 2). Our treatment was based on the hypothesis that we turn this one-way valve into a two-way valve and evacuate it by transferring the accumulated air in the tissue to the pleural space by replacing the previous chest tube. The emphysema would have decreased if the air inside the tissue had an exit to the pleural space through the last tube chest. Secondly, air may have entered from around the previous chest tube, and the chest tube may have acted as a one-way valve, intensifying emphysema, so we

decided to replace the chest tube. Quoc et al. reported a rapid improvement in subcutaneous emphysema in a patient after inserting a chest drain and draining it under negative pressure to drain it (8). A multicenter study by Byun et al. of subcutaneous emphysema used negative pressure and sponges (9). This method is accompanied by risks such as bleeding and pain, especially when removing the subcutaneous sponge. In a similar study, Mihanović et al. reported the safety of the Negative Pressure Wound Therapy (NPWT) method for treating extensive, severe subcutaneous emphysema (3). Lloyd and Jankowski demonstrated a significant reduction of symptoms after one hour with a fenestrated catheter and suction device while treating life-threatening subcutaneous emphysema (-10).

### Conclusion

To sum up, based on the results of the current case study presentation, when severe subcutaneous emphysema after thoracic surgery does not respond to standard solutions, and the symptoms worsen, we recommend to remove all chest tubes and insert new ones and repair the site of the previous chest tubes.

### Authors' Contributions

All authors contributed to collecting data and writing the manuscript. All authors have read and approved the manuscript.

### Data Availability Statement

Data supporting this study's findings are available from the corresponding author upon reasonable request.

### Informed consent

Informed consent was obtained from the patient.

### Conflicts of Interest

None declared

### Acknowledgments

The authors express gratitude to the patients who helped them in this article.

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