CASE REPORT

Treatment of recalcitrant subcutaneous emphysema using negative pressure wound therapy dressings

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SUMMARY

Subcutaneous emphysema frequently occurs after pulmonary resection, but is usually mild and self-limiting. Patients can, however, develop severe symptomatic subcutaneous emphysema despite adequate thoracic drainage. There is a paucity of efficacious treatments for subcutaneous emphysema that does not respond to chest tube drainage. Previous reports have suggested that thoracoscopy may be an efficacious treatment, but is unfavourable due to the risks associated with reoperation. We present a case of a patient who developed severe subcutaneous emphysema after pulmonary lobectomy that was quickly and effectively treated using a commercially available negative pressure wound therapy dressing.

BACKGROUND

Subcutaneous emphysema frequently occurs after pulmonary resection, but is usually mild and self-limiting. Patients can, however, develop severe symptomatic subcutaneous emphysema despite adequate thoracic drainage. There is a paucity of efficacious treatments for severe subcutaneous emphysema. Current management strategies include observational management, which may lead to persistence of symptoms and prolonged hospital stay, or reoperation, which is unfavourable due to associated operative risks. We present a case of a patient who developed subcutaneous emphysema after pulmonary resection that was quickly and effectively treated using a negative pressure wound therapy (NPWT) dressing.

CASE PRESENTATION

A 74-year-old man presented with an FDG-avid 1.2 cm nodule in the right middle lobe suspicious for neoplasm. The patient had a history of non-obstructive coronary artery disease. He did not have a history of chronic obstructive pulmonary disease or bullous emphysema. He underwent elective bronchoscopy and thorascopic right middle lobe lobectomy with mediastinal lymph node dissection, which was performed without intraoperative complications. Two 24Fr Blake drains (Ethicon, Somerville, New Jersey, USA) were left to decompress the chest postoperatively. On postoperative day (POD) 2, the patient had a small air leak, and crepitus became apparent in the right chest. By the fourth POD, despite continued evidence of subcutaneous emphysema, the air leak had resolved and the chest drains were removed. Overnight, the patient developed a right pneumothorax, and a chest tube was replaced. With the

chest tube in place, the right lung was fully expanded with no air leak observed. The patient developed progressive subcutaneous emphysema by POD 7 that included the chest wall, arms, neck and face, with complete obstruction of both eyes. Chest radiograph at that time showed massive subcutaneous emphysema without significant pneumothorax (figure 1A). The patient's primary symptoms were vision loss and emotional distress. He did not experience dyspnoea or respiratory insufficiency.

TREATMENT

The patient returned to the operating room on POD 8 for treatment of his subcutaneous emphysema. A 6 cm incision was made on the right anterior chest wall, 4 cm inferior to the clavicle and extended to the pectoral fascia. An NPWT dressing (VAC, Kinetic Concepts, Inc, San Antonio, Texas, USA) was placed in the subcutaneous tissue (figure 2A–D). Continuous vacuum therapy was initiated at 125 mm Hg, based on manufacturer's guidelines. The subcutaneous emphysema partially resolved within 4 h of NPWT initiation. Although subcutaneous emphysema and his vision had improved, the emphysema had not completely resolved. The NPWT dressing frequently obstructed, losing suction. Two days later (POD 10/2), the patient was brought back to the operating room. The dressing was replaced, and the VAC sponge was placed flat in the wound (without folding), against the chest wall to improve the surface area for the dressing. A contralateral left-sided incision and NPWT dressing was also inserted at that time.

OUTCOME AND FOLLOW-UP

Within 24 h of the second NPWT dressing placement, the patient's subcutaneous emphysema and associated symptoms had completely resolved. The chest tube was removed, and subcutaneous emphysema did not recur (figure 1B). The patient experienced minimal discomfort due to the NPWT dressing. The NPWT was discontinued 6 days later (POD 16/8/6), and the wounds closed primarily. The patient was discharged the following day with complete resolution of subcutaneous emphysema (figure 3). He was subsequently seen in follow-up and has no clinical or radiographic evidence of subcutaneous emphysema or pneumothorax, and experienced no complications due to NPWT implementation.

DISCUSSION

Severe subcutaneous emphysema remains as a difficult condition with cosmetic and functional effects.

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Figure 1 Chest radiographs. (A) Upright chest radiograph of the patient prior to negative pressure wound therapy (NPWT) dressing placement showing a large amount of subcutaneous emphysema despite tube thoracostomy. (B) After placement of NPWT dressing, chest radiograph documents improvement in subcutaneous emphysema despite tube thoracostomy removal.

Subcutaneous emphysema is created by air that escapes the pleural space and enters the subcutaneous tissues. It can spread throughout the chest, arms, neck and face, which can result in obstructed vision. It can cause temporary disfigurement and psychological stress for patients and their family. Rarely, it may lead to more physiological problems including pneumomediastinum, pneumopericardium and respiratory arrest.^{1 2} Subcutaneous emphysema that persists despite adequate thoracic drainage has been described as recalcitrant (recalcitrant subcutaneous emphysema, RSE). In retrospective series, RSE is commonly associated with larger pulmonary resections (ie, in lobectomy vs wedge resection), and reoperations. Patients with forced expiratory volume in 1 s >50% of predicted and patients with diffusion capacity >50% of predicted have lower rates of subcutaneous emphysema.¹

Although most subcutaneous emphysema is relieved by the placement of a chest tube, treatment of RSE is challenging. Several strategies have been attempted including increased

intrathoracic chest tube suction, the insertion of a second pleural chest tube, insertion of an angiocatheter into the subcutaneous space, the creation of 'blowhole' incisions and surgical pneumolysis.^{1 3-6} Once the pleural air leak is addressed, observation alone typically results in gradual reabsorption of air from the subcutaneous tissues, but often requires a prolonged time period to achieve complete resolution. Insertion of subcutaneous catheters (such as angiocatheters) may aid in the resolution of RSE, but the insertion site may act as a source of infection and catheters obstruct frequently.^{4 6 7} The creation of 'blowhole' incisions also serves as an opening in the epidermal barrier, allowing passive egress of air from tissue contiguous to the incision. This procedure can be performed with local anaesthesia, but frequently fails due to wound closure and tissue coagulation.^{4 7} Placement of an NPWT is an extension of the 'blowhole' technique, with the sponge maintaining incisional patency and the continuous suction improving egress of trapped air.

Figure 2 The patient and negative pressure wound therapy (NPWT) dressing. (A) The patient with recalcitrant subcutaneous emphysema prior to surgery. (B) Right NPWT dressing in place. (C) Subcutaneous emphysema had resolved after 5 days of bilateral NPWT. (D) Dressings prior to removal. The skin was subsequently closed in a layered fashion.

Figure 3 Photographs of the patient throughout his hospitalisation. Severe subcutaneous emphysema increased in severity after chest tube removal. Right negative pressure wound therapy (NPWT) was initiated on postoperative day (POD) 8. Right NPWT was associated with partial improvement in subcutaneous emphysema. A second (left-sided) dressing was placed on POD 10/2, with resolution of the patient's symptoms.

Cerfolio *et al*¹ suggested thoracoscopic pneumolysis and placement of a new pleural tube as the preferred treatment for patients with RSE. This study showed that ~66% of patients demonstrated improved subcutaneous emphysema by increasing chest tube suction. Among the 85 patients (34%) with RSE, thoracoscopic pneumolysis and placement of a new chest tube led to resolution of subcutaneous emphysema in all but 1 patient.¹ While effective, this method involves intrathoracic surgery, general anaesthesia, and single lung ventilation, thereby exposing the patient to attendant operative risks.

The use of NPWT dressings has been described in a variety of clinical settings, including wound healing and reconstructive surgery. The system creates a negative pressure gradient at the wound, which removes air and fluid, reduces bacterial load, and accelerates healing by reducing tissue oedema and stimulating fibroblast recruitment.⁸ There are very few complications associated with NPWT dressing, but cases of wound infection secondary to retained dressing material and bleeding have been reported.

Limited reports have described the use of NPWT devices to treat RSE. They hypothesise that the negative gradient in the wound facilitates evacuation of trapped air from the subcutaneous tissues and promotes resolution of the underlying air leak.⁷ Byun *et al*⁴ described the use of unilateral NPWT dressings to treat RSE in four patients. Each required NPWT for 2–4 days to allow for the complete resolution of subcutaneous emphysema. The treatment was successful in all four patients with no recurrence or complications reported. In this case, we used clinical judgement to determine the appropriate duration of the NPWT dressings based on these previously reported cases.⁴ While

shorter durations may be appropriate for some cases, we believe that this patient's severe symptoms mandated a longer course.

To the best of our knowledge, this is the first report of bilateral NPWT dressings for the treatment of RSE. We hypothesise that bilateral dressings were necessary because of the patient's severe symptoms, and we also recommend placement of a second dressing for patients who do not respond to unilateral NPWT. Bilateral NPWT resulted in rapid resolution of subcutaneous emphysema from the chest, arms, neck and face. We describe this novel treatment for RSE as an alternative approach that hastens the resolution of symptoms and does not require intrathoracic operation. The strengths of this technique are that it does not require general anaesthesia, single lung ventilation and re-entry into the pleural space. It is also a clean, comfortable and closed drainage system with minimal infectious risk.

Learning points

- ▶ Severe subcutaneous emphysema can occur despite adequate thoracic drainage.
- ▶ Negative pressure wound therapy dressings can provide rapid resolution of subcutaneous emphysema.
- ▶ Bilateral negative pressure dressings may be necessary in cases of extensive subcutaneous emphysema.
- ▶ Negative pressure wound therapy dressing should be considered in patients with recalcitrant subcutaneous emphysema in whom reoperative intrathoracic surgery is contraindicated or unfavourable.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Cerfolio RJ, Bass CS, Pask AH, *et al.* Predictors and treatment of persistent air leaks. *Ann Thorac Surg* 2002;73:1727–30.
- 2 Abu-Omar Y, Catarino PA. Progressive subcutaneous emphysema and respiratory arrest. *J R Soc Med* 2002;95:90–1.
- 3 Herlan DB, Landreneau RJ, Ferson PF. Massive spontaneous subcutaneous emphysema. Acute management with infraclavicular “blow holes”. *Chest* 1992;102:503–5.
- 4 Byun CS, Choi JH, Hwang JJ, *et al.* Vacuum-assisted closure therapy as an alternative treatment of subcutaneous emphysema. *Korean J Thorac Cardiovasc Surg* 2013;46:383–7.
- 5 Sherif HM, Ott DA. The use of subcutaneous drains to manage subcutaneous emphysema. *Tex Heart Inst J* 1999;26:129–31.
- 6 Cesario A, Margaritora S, Porziella V, *et al.* Microdrainage via open technique in severe subcutaneous emphysema. *Chest* 2003;123:2161–2.
- 7 Sciortino CM, Munding GS, Kuwayama DP, *et al.* Case report: treatment of severe subcutaneous emphysema with a negative pressure wound therapy dressing. *Eplasty* 2009;9:e1.
- 8 Argenta LC, Morykwas MJ, Marks MW, *et al.* Vacuum-assisted closure: state of clinic art. *Plast Reconstr Surg* 2006;117(7 Suppl):127S–42S.

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