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Management of extensive surgical emphysema with subcutaneous drain: A case report

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ABSTRACT

INTRODUCTION: Subcutaneous emphysema (SE) is a frequent and often self-limiting complication of tube thoracostomy or other cardiothoracic procedures. On rare occasions, severe and extensive surgical emphysema marked by palpable cutaneous tension, dysphagia, dysphonia, palpebral closure or associated with pneumoperitoneum, airway compromise, “tension phenomenon” and respiratory failure require treatment.

PRESENTATION OF CASE: A 67 year old lady presented with a large spontaneous pneumothorax on the background of end-stage chronic obstructive pulmonary disease (COPD) and newly diagnosed lung cancer, developed extensive surgical emphysema following insertion of a chest drain. Immediate improvement was observed after insertion of a large-bore, 26 French (Fr.) intercostal catheter, subcutaneous drain which was maintained under low suction ($-5\text{ cm H}_2\text{O}$) for a further 24 h.

DISCUSSION: Several methods have been described in the literature for the treatment of extensive subcutaneous emphysema, including: emergency tracheostomy, multisite subcutaneous drainage, infra-clavicular “blow holes” incisions and subcutaneous drains or simply increasing suction on an in situ chest drain. Here a large-bore, fenestrated, subcutaneous drain maintained on low negative pressure also provided the necessary decompression.

CONCLUSION: In the absence of a comparative study to identify the most effective method to manage extensive subcutaneous emphysema, this case highlights an effective, simple and safe management option.

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1. Introduction

Surgical emphysema (SE) complicating tube thoracostomy for pneumothorax is a common phenomenon. It usually follows a benign, self-limiting course to recovery requiring only conservative measures [1]. On occasions it can be extensive, rapidly increasing, disfiguring and life threatening which require intervention. As described by Srivanas et al., extensive surgical emphysema can be a debilitating form causing palpable cutaneous tension, dysphagia, dysphonia, palpebral closure or associated with pneumoperitoneum, airway compromise, “tension phenomenon” and respiratory failure [2,3]. Here a case of extensive surgical emphysema treated with subcutaneous drain is reported in line with the SCARE criteria [4].

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2. Case presentation

A 67 year old lady presented to the emergency department with sudden onset of shortness of breath with oxygen saturation of 71% on 4L of oxygen via nasal prongs. She had a history of severe COPD on home oxygen, was on chemotherapy for metastatic lung adenocarcinoma and anticoagulated with low molecular weight heparin subsequent to a recent diagnosis of pulmonary embolism. Arterial blood gas on admission demonstrated hypoxia with decompensated respiratory acidosis and chest X-ray showed a large right-sided pneumothorax (Fig. 1). Supplemental oxygen was given with Venturi mask, aiming to maintain oxygenation between 88% and 92%, in view of her carbon dioxide retaining form of COPD. A 14 Fr. intrapleural chest drain was inserted in the 5th intercostal space using the Seldinger technique and connected to an underwater seal system on gravity drainage. The patient's shortness of breath improved significantly but progressive surgical emphysema was noted in the ensuing 24 h to involve the torso, upper limbs, neck and face. A chest x-ray showed marked surgical emphysema and partial reinflation of the right lung. The intercostal

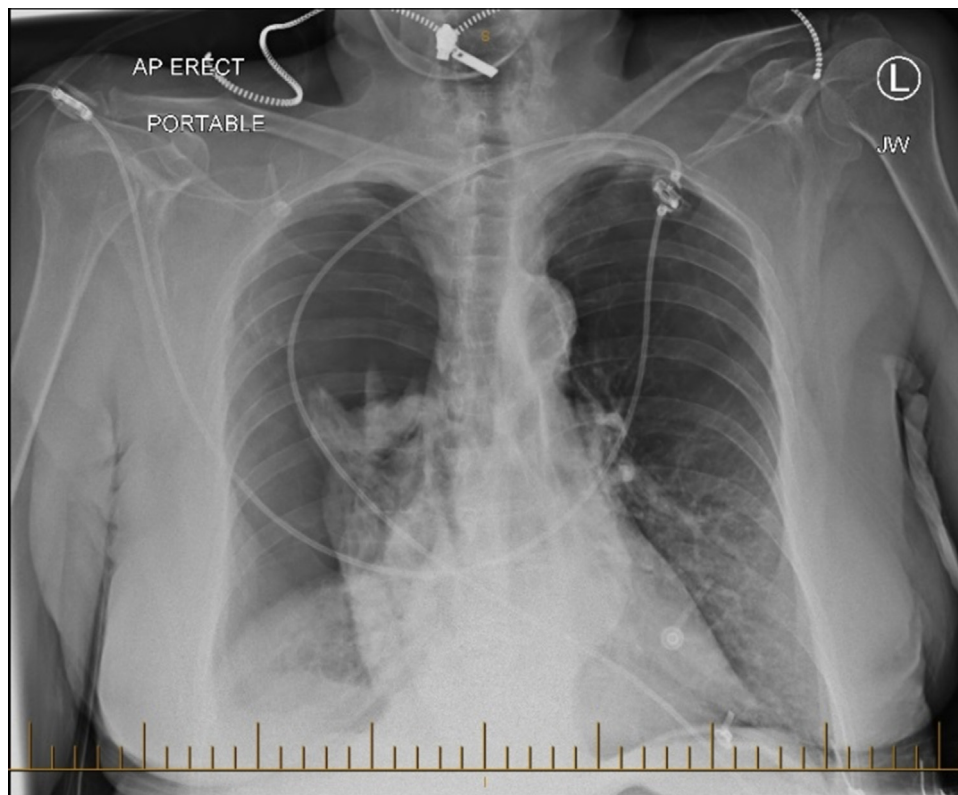


Fig. 1. Large right sided pneumothorax at presentation.

catheter's (ICC) perforators were intrathoracic but close to the chest wall and the drainage system was bubbling and swinging suggesting a patent functioning chest tube. The intercostal catheter was repositioned and high wall suction pressure (equivalent to -40 cm H_2O) was applied but the subcutaneous emphysema progressed causing palpable cutaneous tension around her neck, dysphonia, dysphagia and palpebral closure (Fig. 2). Due to the worsening of symptoms and the patient's increasing distress a decision was made to decompress the surgical emphysema with a subcutaneous drain. Approaches described by Sheriff et al. were used as general guides [5,6]. After local anaesthetic, a 2 cm transverse skin incision was made in the anterior mid-axillary line, approximately along the third intercostal space, superior to the existing intrapleural chest drain and at the site of maximal subcutaneous crepitus. A caudocranially oriented subcutaneous tract approximately 8 cm in length was created just superficial to the pectoral fascia using blunt dissection. A large-bore, 26 Fr. intercostal catheter was trimmed to size, gently inserted into the created tract, anchored with stay sutures and connected to an underwater seal drainage system placed on low suction of -5 cm H_2O . Rapid decompression was achieved within the hour with the patient then able to open her eyes.

The subcutaneous drain remained on low suction for 24 h. Her lung fully re-expanded after three days and a chest computed tomography (CT) confirmed resolution of her pneumothorax (Fig. 3). The ICC was removed on day three and the subcutaneous drain was removed after five days at which stage the patient has returned to baseline prior to discharge.

3. Discussion

Subcutaneous emphysema may be secondary to a pneumothorax or a complication of chest tube insertion. Approximately one in five tube thoracostomies for pneumothorax results in subcuta-

neous emphysema according to two retrospective studies by Ball et al. and Jones et al. [7,8]. Surgical emphysema complicating chest tube insertions for pneumothoraces are more commonly seen in trauma, large and bilateral pneumothoraces, bronchopleural fistulae and mechanical ventilation. Several avoidable causes such as poor tube placement, tube blockage, side port migration and greater number of chest tubes have been attributed to this phenomenon [8].

Air originating from the lung could cause subcutaneous emphysema by two mechanisms. Firstly, when the parietal pleura is pierced, air from a pneumothorax may pass directly into the chest wall and subcutaneous tissues [9]. Secondly, Macklin delineated an alternative route in 1939, where alveoli rupture at their bases can introduce air into the perivascular adventitia and this tends to dissect proximally within the bronchovascular sheath towards the mediastinum [10]. Because there is a continuity of visceral spaces between the soft tissue compartments of the neck, mediastinum and retroperitoneum, aberrant air from alveolar rupture can decompress from the mediastinum to these regions or pass superficial to the endothoracic fascia into the subcutaneous tissues [11]. Subcutaneous air from the neck can spread to the face and eyelid causing palpebral closure. Sometimes mediastinal pleura may rupture and cause pneumothorax [11]. It is believed that this mechanism may be responsible for spontaneous pneumothorax rather than rupture of subpleural blebs in the majority of cases [11].

The primary aim of treating severe subcutaneous emphysema is to decompress the thoracic inlet and the neck to maintain an airway, therefore emergency tracheostomy has often been advocated [5]. There have been various other successful methods described in the literature. Cerfolio et al. reported the practice of increasing suction on an in situ functioning chest tube on high suction (up to -40 cm H_2O) [12]. This would relieve SE in two third of the cases and if the surgical emphysema is still progressive with resultant palpebral closure then a second chest tube could be

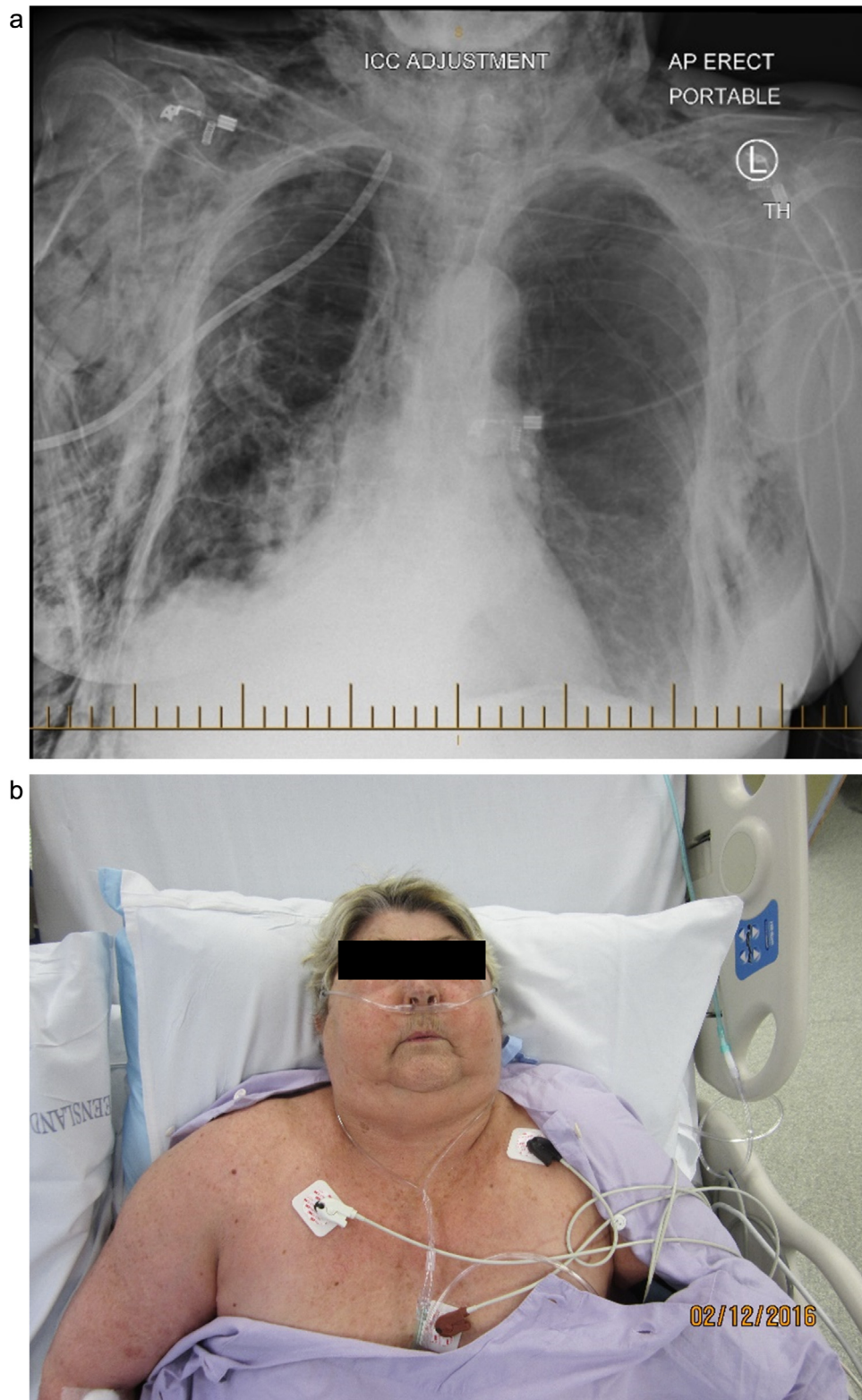


Fig. 2. a) Developing subcutaneous emphysema post ICC insertion. b) Severe, extensive subcutaneous emphysema causing palpebral closure and facial swelling.

inserted. Both supraclavicular and infraclavicular small skin incisions (approximately 2 cm, midclavicular line, halfway between nipple and clavicle) which serve as “blow holes” for repeated manual decompressive massage of subcutaneous air have been reported [12]. Byun et al. have applied vacuum-assisted closure (VAC) therapy to these “blow holes” with continuous suction at -150 mmHg

for ventilator associated massive subcutaneous emphysema [13]. A variety of large-bore semirigid tubings including Jackson-Pratt drains, regular chest drains to smaller luminal diameter angiocatheters, cannula with side holes and penrose-type drains placed subcutaneously, with or without the aid of manual decompressive massage have been described [14].



Fig. 3. Three days after insertion of subcutaneous drain A) Improvement of facial swelling B) CT head and neck showing extent of facial subcutaneous emphysema C) CT chest demonstrating lung re-inflation and positions of ICC and subcutaneous drain.

Johnson et al. and Ahmed et al. recently reviewed the various methods described in the literature – mostly small retrospective studies and case reports – to outline the advantages and disadvantages of each technique. Repeated manual decompression via “blow hole” incisions can be cumbersome, while VAC therapy would pose potential cosmetic defect [15]. Small-bore catheters may be prone to blockage and take longer to resolve. Ahmed et al. had combined these techniques using a 12 Fr. subcutaneous infraclavicular drain on continuous high suction at -150 mmHg aided by manual decompressive massage [3].

In the case presented here, a large-bore subcutaneous drain was placed in the anterior axillary line, rather than infraclavicular, due to consideration of cosmesis and presence of female breast tissue anteriorly. In addition, the maximal site of subcutaneous crepitus was located laterally and the absence of mediastinal air on x-ray suggesting the mechanism was more likely from direct infiltration of air into the subcutaneous tissues via a torn parietal pleura. Therefore, the drain placed in this position was deemed most appropriate. The existing separation of the tissue planes by

subcutaneous emphysema also facilitated the effortless insertion of the drain.

4. Conclusion

Subcutaneous emphysema often complicates tube thoracostomy but usually has a benign natural history. However, extensive SE can add significant morbidity and requires intervention. SE is a rare condition and standard management practices are not well defined, and as such there have been several reports in the literature with varying degrees of success. This case describes the use of a large-bore subcutaneous drain which provides a simple, cost-efficient approach that adds little risk to the patient and can provide rapid and sustained decompression of surgical emphysema.

Conflicts of interest

None.

Funding

None.

Ethical approval

Ethical approval is exempted for case reports at Caboolture Hospital and QLD Health Hospitals.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Quoc Tran contributed to data collection, data analysis and writing. Ryo Mizumoto contributed to data acquisition, revising critically for important intellectual content and final approval prior to submission. Dr Daniel Mehanna contributed to case conception, revising for important intellectual content and final approval of report, supervising surgeon.

Registration of research studies

Registered.

Guarantor

Quoc Tran.

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