Fenestrated Angiocatheter: Role as a Therapeutic Intervention

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ABSTRACT

Extensive subcutaneous emphysema (ESE) is accompanied by marked discomfort related to the body deformity, which impedes eye opening, speaking and impairs respiration. It can rarely be associated with upper airway obstruction, airway compromise, respiratory failure and death. Subcutaneous emphysema is commonly observed with bronchopleural fistula but development of subcutaneous emphysema secondary to tracheocutaneous fistula is rare in patients with pulmonary tuberculosis. There are case reports of pulmonary tuberculosis reported with subcutaneous emphysema with and without pnemomediastimun, and pneumothorax secondary to miliary tuberculosis or secondary to communication of pulmonary cavity to the subcutaneous tissue (caverno–pleuro–soft tissue fistula). Most of the interventions to drain subcutaneous emphysema are too invasive and need surgical expertise. We report fenestrated angiocatheter to be the least invasive, effective and convenient ,method to manage cases of subcutaneous emphysema before referral to thoracic surgeons. We report our experience with fenestrated angiocatheter and compressive massage to drain subcutaneous emphysema.

INTRODUCTION

Subcutaneous emphysema (SE) with pneumothorax and pneumomediastinum is a common complication with traumatic and infective etiology which are commonly reported to surgeons.The causes of subcutaneous emphysema can be broadly divided into three categories: traumatic (including iatrogenic), infectious, and spontaneous.

Iatrogenic subcutaneous emphysema is a recognised complication of several common procedures, particularly chest tube drainage 1.It can also be secondary to dental procedures such as tooth extraction [2] .Endotracheal intubation or bronchoscopy may rupture the mucosal surface of the proximal airways, leading to subcutaneous emphysema. Endoscopic procedures can cause perforation of the oesophagus, causing pneumomediastinum and subsequently subcutaneous emphysema. Similarly, positive pressure ventilation can cause alveolar rupture, allowing air to enter the interstitial tissues and track subcutaneously.

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Some soft tissue infections, such as cellulitis and fasciitis, may be associated with subcutaneous emphysema, in which case the affected areas are tender, warm, and erythematous.

Spontaneous pneumomediastinum and subcutaneous emphysema is defined as pneumomediastinum that occurs without surgical or medical procedures, chest trauma, or mechanical ventilation [3]. Spontaneous pneumomediastinum is unusual, occurring in 1 in about 30 000 hospital admissions[4,5]. The accepted explanation is alveolar rupture into the pulmonary vascular sheaths as a result of intra-alveolar pressure rising above perivascular interstitial pressure, though in many cases the source of air is not found[6,7].

A trigger event can often be elicited from the patient's history. Triggers cause alveolar rupture by raising the intra-alveolar pressure (for example, the Valsalva manoeuvre) and/or decreasing the interstitial pressure (for example, forceful breathing)[8].Reported precipitants of spontaneous pneumomediastinum are obstructed airflow in asthma and exacerbations of chronic

obstructive pulmonary disease,viral bronchiolitis in infants, straining during childbirth, coughing or sneezing,vomiting, defecation and inflating party balloons [9]. Management of extensive subcutaneous emphysema secondary to tracheocutaneous and bronchopleural fistula requires combined approach by CVTS and ENT surgeons. It is managed by variety of procedures such as placing chest tubes, inflaclavicular blow holes, tracheostomy, subcutaneous pig tail or large –bore drains, and trocar type drains with suction. However these procedures are too invasive and skill requiring.We report insertion of fenestrated angiocatheter with compressive massage as a least invasive and covenient method for drainage of subcutaneous emphysema**.**

CASE REPORT

A 60 years old male patient was reported to emergency department with history of cough with expectoration since 3 days and swelling around neck , especially around left angle of mandible since 2 days. He was non smoker and non alcoholic. There was no history of any instrumentation, endotracheal intubation, dental surgeries and trauma to chest. Two years before, patient was diagnosed to be a case of pulmonary Koch's and was prescribed anti Tubercular drugs by practitioner from his town. However, he had stopped anti TB therapy after receiving for 3 months. On examination, patient was tachypneic, had cyanosis, clubbing, and crepitus around the neck and chest. Percussion note was hyperresonant on left side with decreased tactile vocal fremitus. Auscultation revealed decreased intensity of breath sounds on left side with decreased vocal resonance. Rest of the examination was unremarkable. Chest radiograph revealed extensive subcutaneous emphysema and pneumothorax on left side. Computed Tomography of thorax revealed left sided fibrosis, pleural thickening and calcification ,lung destruction and chronic hydropneumothorax. **Bronchopleural fistula** was noted communicating left bronchus with loculated pleural space. **A small fistular track from left postero-lateral wall of trachea at cervico-thoracic junction level seen communicating with subcutaneous emphysema and pneumomediastinum** was noted. Nodular infiltrates were noted in right lung field predominant in upper lobe suggestive of active infective lesions. Patient was started empirically on intravenous Ceftriaxone and Metronidazole . Patient also received intravenous fluids and oxygen inhalation 2 lit/min as supportive therapy. The subcutaneous emphysema progressed over next 24 hours causing dysphonia, puffiness of face and periorbital edema. However he did not develop respiratory failure. In view of progressing subcutaneous causing marked respiratory discomfort General surgeons and ENT surgeons consultation was sought. However, as the fistula was located near the cervicothoracic junction, CVTS surgeon and the facilities for Cardiothoracic surgery were essential ,which are presently not available at our institute.

As the subcutaneous emphysema was increasing and surgical intervention was not possible , it was thought what intervention could be performed in emergency, to prevent airway compromise and to drain subcutaneous emphysema. Literature was searched and it was found that fenestrated angiocatheterisation ,a procedure described by Beck et al,[10] is a simplest method to drain subcutaneous emphysema which is least invasive, and can be performed in absence of surgical expertise.Secondary infections are also less common and angiocatheter is relatively less expensive. Hence it was decided to drain subcutaneous emphysema by fenestrated angiocatheterisation as an emergency measure.

Fenestrations were created with a scalpel blade in a spiral fashion over the 16 G intravenous catheter by keeping the stylette inside it. Skin was prepared with 5 % povidone – iodine and local anaesthesia was given with 2% lignocaine subcutaneously. Fenestrated angiocatheter was inserted 2-3 cm lateral to the mid-clavicular line over the third rib at 45^{o}angle until the tip of catheter lies 0.5- 1 cm deep to skin. The angle was then decreased and the catheter was then progressed so that it completely lies into the subcutaneous space. The catheter was then secured by adhesive tape and attached to an under water seal. Minimal drainage of gas was observed due to low pressure difference across the the system. Compressive massage was given face downwards and arm downwards to facilitate gas drainage. Dramatic bubbling and significant resolution of subcutaneous emphysema was observed after the massage. Subcutaneous emphysema resolved in next few hours which relieved the patient's respiratory

discomfort. The catheter was kept in-situ for 24 hours and removed. Category 2 anti-TB drugs were started after consulting RNTCP experts. Patient was subsequently referred to thoracic surgeons for management.

DISCUSSION

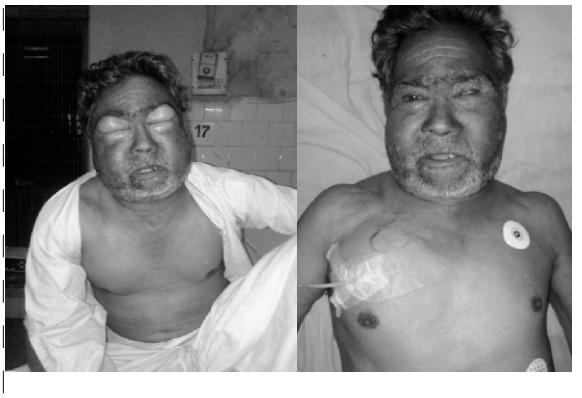
Alveolar rupture leads to aberrant alveolar air escape into the pulmonary interstitium. This air follow the perivascular plane to escape into the mediastinum and subcutaneous tissue[11]. Air leaking through the tracheocutaneous fistula escape directly into the subcutaneous tissue to cause subcutaneous emphysema. Mediastinal may rupture to cause pneumothorax.

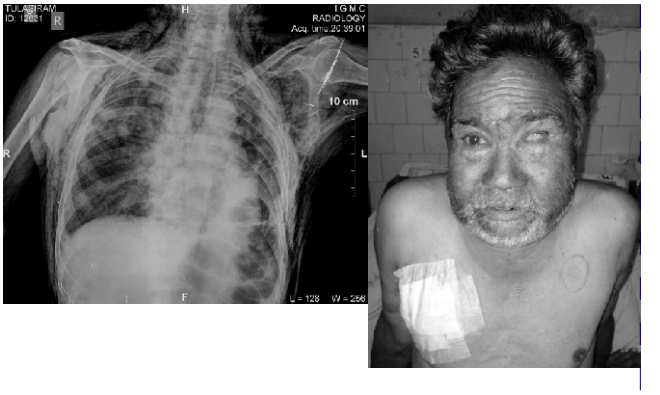
When the leakage of air is greater than absorption it will lead to progressive accumulation of air into subcutaneous tissue. Any Subcutaneous emphysema causing palpable cutaneous tension, palpabral closure, dysphagia and dysphonia or associated with pneumoperitoneum, airway compromise, "tension phenomenon "and respiratory failure is labelled extensive subcutaneous emphysema[10,12]". It can lead to upper airway obstruction[13],respiratory failure[14], pacemaker dysfunction[15] and systemic embolisation[16].

Many surgical techniques are mentioned to manage subcutaneous emphysema including chest tube insertion[17], inflaclavicular blow holes[18], tracheostomy, subcutaneous pig tail insertion[19], large bore drains[20], trochar type drains with suction[21] and fenestrated angiocathetors[10,23,24]. Inflaclavicular blow holes is limted by scab formation and secondary infection. Other procedures are also limited by secondary infection and need surgical expertise and time consuming. Fenestrated angiocatheters are modified catheters which are simple to insert, minimally invasive and less liable to secondary infection. It can be inserted by a phycisian and does not require surgical expertise.

The only disadvantage of this procedure is inadequate drainage of air due to low pressure gradient across the system. This can be solved by compressive massage face downwards, arm upwards and lower limb upwards towards the catheter to increase interstitial pressure. Bubbling of air through the underwater seal can be taken as endpoint for adequate compressive massage. Time for complete resolution was 12 hours which was much less than median time required for absorption of air naturally (median 3.7 days)[12].Supportive management in form of adequate analgesia, supplemental O_2 therapy and cough suppressant is helpful.

We found rare association of bronchopleural fistula and tracheoctaneous fistula with subcutaneous emphysema. Subcutaneous emphysema reporting to medicine ward is rare and managing it without surgical assistance is difficult. Our patient had tracheacutaneous fistula and bronchopleural fistula which was situated lower down near carina. This tracheocutaneous fistula is difficult to access by ENT and general surgeon. This requires assistance by CVTS surgeon which was not available to us. Thus we report a novel method to drain subcutaneous emphysema with a fenestrated angiocatheter with compressive massage to relieve respiratory obstruction which can be inserted by a physician before referral to CVTS.





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