



Case Report

Severe Systemic Subcutaneous Emphysema Associated with Tracheal Tear after Intubation

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SUMMARY

Tracheal tear or laceration during intubation is rare. We report a geriatric female developing extensive subcutaneous emphysema after urgent endotracheal intubation. Computed tomography showed tracheal rupture. Under the assistance of extracorporeal membrane oxygenation, primary repair of the rupture through video thoracotomy was done smoothly. Extensive subcutaneous emphysema but without pneumothorax may be a warning sign of tracheobronchial injury after intubation. Early diagnosis and treatment of tracheal rupture is essential for quality of critical care.

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1. Background

Tracheal rupture after intubation is seldom happened, but it causes severe and critical sequel.^{1–4} Early diagnosis and treatment may preserve patient's life. In emergency department, endotracheal intubation is essential for building adequate oxygenation but it may cause serious complications.^{1,3,5,6} We reported a case presented with severe extensive subcutaneous emphysema after urgent endotracheal intubation.

2. Case presentation

An 84-year-old female presented to the emergency department with acute respiratory distress and consciousness change. She had multiple morbid history of hypertension, coronary arterial disease, gastric ulcer, old stroke with independent functioning recovery, tuberculosis with pericardial effusion and dementia. She had short neck with height 150 cm and weight 55 kg. Her arterial blood gas values dropped while receiving cannula oxygen support to pH 7.498, PaCO₂ 22.1 mmHg, PaO₂ 48.1 mmHg and SaO₂ 88.1%. Emergent endotracheal intubation was done. A 7.0-mm endotracheal tube with stylet was placed at 20 cm initially at the first attempt. A follow-up chest X-ray film showed the tip of endotracheal tube was adjacent to carina, so the tube was pulled backwards and fixed at 19 cm. Her oxygenation got improved, then she was transferred to intensive unit for further care. However, neck subcutaneous crepitus was noted after one hour of intubation and progressively to the whole trunk. The initial ventilator was set at pressure control ventilation mode and the airway pressure was 35 cm H₂O. Breathing sound was coarse rales. Then the ventilator was switched to pressure control mode with airway pressure 18 cm H₂O. Subcutaneous emphysema

still progressed without reaching adequate oxygenation even with high-flow ventilation. Computed tomography (CT) was arranged and revealed massive extensive subcutaneous emphysema (Figure 1) along with pneumomediastinum, bilateral neck, arms, chest and abdominal wall emphysema. The endotracheal tube and nasogastric tube were in place. No pneumothorax was noted in the CT report. A tracheal perforation was impressed (Figure 2). Emergent diagnostic thoracotomy was arranged. Since double lumen intubation was impossible after evaluation by anesthesiology consultation, a venovenous Extracorporeal Membrane Oxygenation (ECMO) was sug-

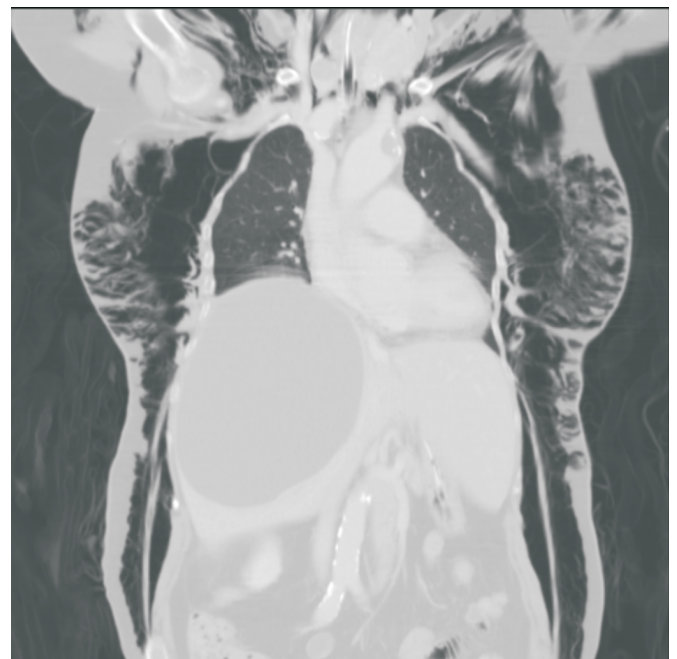


Figure 1. Coronal view of chest CT with lung windows showed the massive subcutaneous emphysema.

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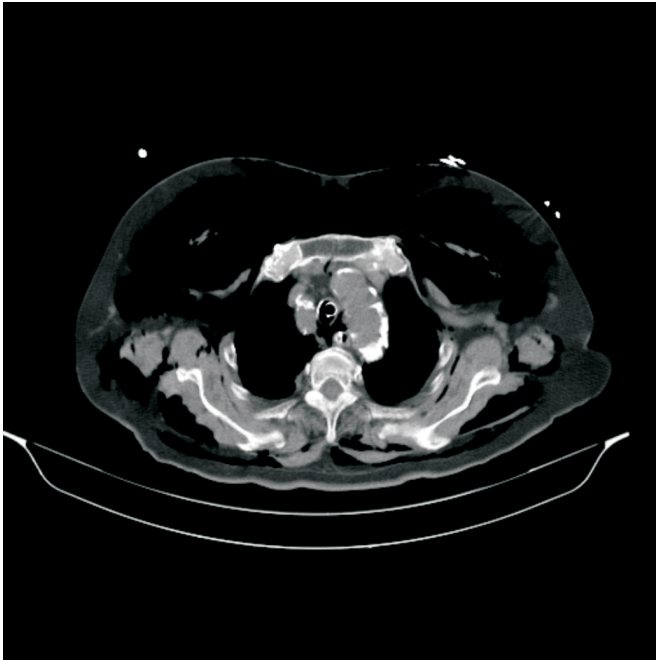


Figure 2. Transverse view CT of chest showed the tracheal perforation.

gested and set before video-assisted thoracoscopic surgical exploration. The operative findings (Figure 3) showed a 5-cm linear tracheal perforation over the membranous part just above the carina. Primary sutures were done smoothly. Subcutaneous emphysema resolved gradually. Following bronchoscopy of the patient, after one week of surgery, showed complete healed scars over the perforation site.

3. Discussion

When air is not in the proper position or area of the body may cause emphysema.^{7,8} A progressive subcutaneous emphysema with crepitus is a warning sign of air leakage from the malfunction or position of endotracheal tube. Management of endotracheal air leakage could be conservative or surgical.^{9–11} Conservative management requires intensive monitoring. When adequate oxygenation cannot be reached, surgical management is indicated.^{5,9,11} When double lumen intubation is impossible, cardiopulmonary bypass (extracorporeal membrane oxygenation, ECMO) is feasible in recent 5 years for setting adequate oxygenation before tracheal repairing surgery.^{9,11–13}

Risk factors for tracheal rupture after intubation could be solely from anatomical or mechanical, or both.^{3,4,11} The anatomical factors include congenital tracheal abnormalities, large mediastinal collections, lymph nodes, or tumors causing distortion of the trachea, weakness of the membranous trachea from gender (female predominant), ageing, previous esophageal surgery, chronic obstructive pulmonary disease, inflammatory lesions of tracheobronchial tree and use of corticosteroid. The mechanical factors include multiple vigorous attempts, inexperienced physicians, inappropriate use of stylets, over-inflation, rapid inflation, rupture of the cuff, eccentric inflation of tracheal cuff (double-lumen tubes), malpositioning the tip of the tube, tube repositioning without cuff deflation, patient moved with bronchial cuff inflated, inadequate tube size, vigorous coughing, abrupt head and neck movement, and nitrous oxide diffusion in the cuff.^{3,4} The most frequently injured site is located at the posterior membranous wall without cartilaginous support.¹⁴

The case in our report was a short stature,^{4,5} weakened octo-

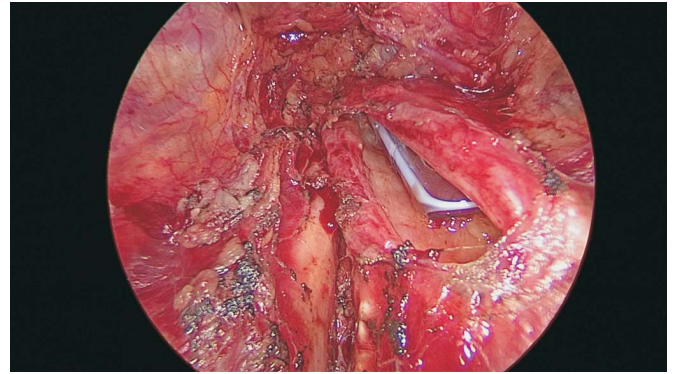


Figure 3. The tip of endotracheal tube was exposed through the laceration of trachea.

genarian female with previous tuberculosis treatment and multiple medication for hypertension and gastric ulcer could predispose the risks of tracheal injury¹⁴ when she was facing the indication for emergent endotracheal intubation. However, no pathological tissue from the thoracoscopic repair to confirm of our postulation. A follow-up bronchoscopy showed completely healed scars of the tracheal laceration.

Dyspnea, cyanosis, irritating cough, hemoptysis, pneumothorax, subcutaneous or mediastinal emphysema are signs of tracheobronchial injury.^{4,9} However, signs of tracheal rupture after intubation are hardly diagnosed early without high index of suspicion. Because of its rareness, it is frequently misdiagnosed as barotrauma.^{5,6} Most instances of subcutaneous emphysema are not clinically or physiologically important, but massive subcutaneous emphysema can be life-threatening if it involves the thoracic outlet, chest, and abdominal wall.⁵ Progressive compression of the thoracic outlet could obstruct airflow, block venous return to the heart, and perfusion to the head and neck.⁵ Our patient was intubated in the emergent department, then transferred to intensive care and profound extensive subcutaneous emphysema but no pneumothorax raised the suspicion of tracheal rupture. When a patient presented with progressive subcutaneous emphysema without adequate oxygenation after emergent endotracheal intubation, tracheal rupture should be ruled out to get early diagnosis.

Bronchoscopy and CT imaging are the major tools to make definite diagnosis.^{2,9} Bronchoscopy helps in defining the exact location and size of the injury and in treatment plans of the injury.^{2,11} Although bronchoscopy is considered as the “gold standard” for the diagnosis,¹¹ rapid CT scans could do the imaging diagnosis to prevent delay diagnosis⁵ when the patient is unstable for endoscopic procedure. More than fifty percent of the CT scans showed the characteristic pictures of tracheal rupture of gas dispersion around the broken ends, bronchial lumen stenosis or blockage, and bronchial displacement or angular deformity.⁹ More than seventy percent of the CT scans identify the direct sign of rupture with discontinuity of the tracheal wall or deformation of its length.² Even multiplanar reconstruction of CT scans has been postulated for positive detection rate up to 100% in diagnosing tracheobronchial injury.¹⁵ Our patient had the CT scans to reveal rupture at membranous part of the trachea and provide information of difficult double lumen anesthesia for planning surgical repair.

The first use of ECMO for respiratory failure was done for a trauma in 1972.¹⁶ The major concern for complications with ECMO initiation is on the dysfunction of coagulation cascade.¹⁷ Based on the clinical consensus by the American Association for the Surgery of Trauma Critical Care Committee in 2019,¹⁸ in trauma patients, no

specific diagnoses are absolute indications or contraindications to ECMO therapy, and survival rates up to 75% have been reported in cases with blunt thoracic trauma; patients with only respiratory failure, or shock caused by severe hypoxia should be for veno-venous ECMO. In surgical repair of the tracheal injury, ECMO can provide not only adequate oxygenation for the acute respiratory failure during the surgery,^{12,13} but also benefits of survival.^{16,18} Our patient with the assistance of veno-venous ECMO had received successful repair of the tracheal injury.

4. Conclusion

Tracheal rupture after endotracheal intubation is rare but demanding urgent management. Applying ECMO could restore oxygenation in advance and assist a successful repair of rupture of trachea.

Ethic approval

The report was approved and exempted by institution review board of Chi Mei Medical Center (10905-E02).

Conflicts of interest

I declare that the manuscript 'Severe systemic subcutaneous emphysema associated with tracheal tear after intubation', is original work produced by myself. It has never been published in any other capacity prior to submission to this journal.

The authors declare that none of any potential financial and non-financial conflicts of interest was noted for this manuscript.

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