



POST-INTUBATION TRACHEAL INJURY - LESSONS TO BE LEARNT

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ABSTRACT

Complications following traumatic intubations are devastating and could prove fatal. Extremely demanding, they necessitate that the intensivists' team possess the adequate skill and presence of mind to tackle such complications. We discuss our experience with one such case and review the literature discerning the probable causes and prevention strategies. A 62 yr old female presented with endotracheal (ET) tube in-situ from another center where she was intubated and mechanically ventilated for 5 days for severe shortness of breath and altered sensorium secondary to gastrointestinal sepsis and right lower lobe-pneumonia. Upon admission she was hemodynamically stable and mechanical ventilatory support was continued. Her electrolyte disturbances and metabolic acidosis were corrected, along with adequate broad spectrum antibiotic coverage. There was a past history of bronchial asthma and inhaled and occasional oral corticosteroid use. Over the next 2 days she responded well and was weaned off the ventilator whilst continuing continuous positive airway pressure (CPAP) support. The next day post-extubation she developed respiratory distress that was refractory to CPAP warranting invasive ventilation again. During intubation, a 7.5mm endotracheal tube with a stylet, was advanced. Air entry was equal in bilateral apices but feeble which was interpreted as secondary to thick (obese) chest wall. Auscultation of abdomen over gastric fundus did not reflect the ambu-bag ventilation. Patient began developing rapid subcutaneous swelling beginning from the neck to face upwards and chest and trunk downwards including both the upper limbs. Due to the swelling and protrusion of tongue it was virtually impossible to advance the laryngoscope to re-guide the ET tube. Emergency tracheostomy was planned but before the procedure could start, patient developed cardiac arrest necessitating advanced cardiac-life-support protocol of cardiopulmonary resuscitation (CPR). Due to massive subcutaneous emphysema, the tracheostomy procedure failed and the patient could not be revived despite aggressive CPR. Post-humous fiberoptic bronchoscopy confirmed the tracheal tear (level II degree as per classification described below).



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Post-intubation tracheal injury is a rare but potentially fatal complication, occurring in about 1 in 20,000 intubations.^[1] Double-lumen intubations, emergency intubation (and/or repeated attempts), lack of intensivist experience, improper use of a stylet (protrusion beyond the tube), cuff over-inflation, older age (>50 yrs), female gender (because of the smaller size of airways) and associated tracheomalacia or tracheal stenosis are the factors that heighten the chances of tracheal injury. Malpositioned tube, repositioning of the ET tube without deflating the cuff, improper tube size, patient actions such as sudden movements, excessive coughing etc, underlying medical morbidity such as chronic obstructive pulmonary disease, bronchial asthma (in our case) etc, longer duration of ET tube insitu (5 +2=7 days in this case) short stature, and the use of corticosteroids (chronic use may weaken membranes) have all been associated with higher risk of tracheal injury.^[2, 3, 4] Presence of kyphosis, and the use of nitrous oxide may also have a bearing on tracheal injuries. Higher preponderance in females may be due to their shorter necks and tracheal diameters which are at higher risk for damage at the 'usual' ET tube sizes and cuff pressures. Laceration of the soft tissues of the pharynx, hypopharynx and the trachea can occur during traumatic intubation. The posterior part of the trachea lacks cartilaginous support and is thus more prone to ruptures than the anterior wall. Most lacerations occur as linear lesions in the pars membranacea of the cervicothoracic trachea, whereas tracheal injuries caused by high-pressure or -volume ventilation occur in the pars membranacea and in the pars cartilaginea of the tracheal bifurcation and tracheobronchial region (may be the case in our patient).^[5] The clinical manifestations of tracheal injury usually result from a major leak into the mediastinum and include pneumomediastinum, subcutaneous emphysema, bilateral pneumothorax and the resultant respiratory distress. Occasionally pneumoperitoneum and hemopneumothorax may also be found.

A systematic review and meta-analysis of 182 cases of postintubation tracheal rupture showed an overall mortality of 22%. Increasing patient age, delayed diagnosis and emergency intubation, the presence of subcutaneous emphysema and need for surgical treatment were associated with an increased mortality. Emergency intubation was associated with a threefold increased risk of death compared to elective intubation.^[6] Causes for tracheal laceration and false-passage creation in our case are previous and current vigorous attempts at intubation (Class 4 modified Mallampati scoring) and active abrupt movements by the patient. Various risk factors in our patient such as short neck, stylet related ET injury, older age, female sex, steroid use, comorbid ventilator associated pneumonia and sepsis may have compounded the degree of tracheal injury. Rapidly progressive subcutaneous emphysema leading to restrictive chest wall movement, probable pneumothorax/pneumomediastinum, absence of appropriate tracheobronchial and pulmonary ventilation due to false-tracking of ambu-ventilation may have resulted in cyanosis and cardiac arrest in our case. The definitive diagnosis can be established by fibre-optic tracheobronchoscopy^[7] which gauges the degree of severity of the trauma. Computerized tomography and Xray of chest may quantify the complications such as pneumothorax and pneumomediastinum and may also reveal useful information about the size and position of the tear. A classification of postintubation tracheobronchial lacerations was proposed. Level I — mucosal or submucosal tracheal involvement without mediastinal emphysema and without oesophageal injury; Level II — tracheal lesion up to the muscular wall with subcutaneous or mediastinal emphysema without oesophageal injury or mediastinitis; Level IIIA — complete laceration of the tracheal wall with oesophageal or mediastinal soft-tissue hernia without oesophageal injury or mediastinitis; Level IIIB — any laceration of the tracheal wall with oesophageal injury or mediastinitis. A study reported that while Level

IIIA and IIIB require surgical repair, the other levels can be conservatively treated (endoscopic instillation of fibrin glue, etc).^[4] In emergency cases a tracheal silicon stent has shown benefit via securing the airway and minimizing the air leak and associated complications.^[8] A case of tracheal rupture which was managed with bilateral bronchial intubation with success has also been described.^[9] The conservative repair discussed in literature mostly applies to elective situations unlike our case. The emergency nature of our case with rapidly worsening emphysema and other discussed complications occurring in less than a minute precluded the tracheostomy procedure. Retrospectively analyzing, the use of soft bougie instead of a stylet may have had a bearing on the outcome. Also immediately after noticing emphysema, deflating the cuff and then advancing the tube deeper even in to right bronchus (single lung ventilation being better than no ventilation) may have had a better outcome.

Preventive measures remain the mainstay in tracheal rupture post-intubation especially in desperate settings where the intensivists may not have the necessary skills for performing an emergency tracheostomy. Avoiding

forceful/repeated attempts to introduce the tube through the trachea, the use of a satin slip intubating stylet/soft bougie, withdrawing the stylet as the tube is advanced through the vocal cords, avoiding hyperextension of the head and neck, minimizing abrupt movements by the patient (via adequate sedation and paralysis), avoiding cuff over-inflation (by a manometer where available), and appropriate selection of size of ET tube are some of the ways of minimizing tracheal injury. In tracheobronchial injuries extending up to the carina, selective main stem bronchus intubation may be of substantial benefit. The need to take precautions to avoid tracheobronchial injury is as paramount as the necessity to secure an airway in an emergency. Simple measures such as those discussed may thus make a life-saving difference in patient care.

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