Surgical repair of an iatrogenic tracheal injury in a very low birth weight infant

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A very low birth weight premature infant was found to have a tracheal perforation following multiple attempts at intubation. Worsening pneumomediastinum prompted surgical evaluation with a successful operative outcome.

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Tracheal perforation is a rare complication in difficult intubations with a reported incidence of 0.005–0.12% [1–3]. Premature babies in the neonatal intensive care unit (NICU) are at increased risk due to their smaller trachea and cricoid cartilage anatomy [4]. Tracheal wall tears can be the result of unknown sided intubations, cuff over-inflation, eccentric cuff inflation, tube removal without adequate cuff deflation, coughing against a closed tube, or suckling and swallowing movements [1,5]. Furthermore, prolonged or rough intubations can lead to mucosal laceration, fractured cartilage, ischemic pressure necrosis, perforation, laryngeal or subglottic stenosis, as well as subglottic cysts [4–7].

This case report focuses on a significantly premature neonate with a tracheal perforation secondary to a difficult intubation who required surgical repair.

1. Case history

The patient was born at 27 weeks gestation to a 22 year old Gravida1, para0, abortion0 female. His initial weight was 1010 g with Apgar scores of 5 and 7 at 1 and 5 min respectively. Although initially stable, the patient quickly developed respiratory distress and was intubated and given surfactant. Intubation with a 3.0 mm endotracheal tube (ETT) was uneventful. The patient was admitted to the neonatal intensive care unit. After a short course of positive pressure ventilation, the patient was considered stable and extubated. Within 24 h, he had increased work of breathing, poor aeration, and a profound metabolic acidosis that required emergent intubation. Five attempts were required before a 2.5 mm ETT could be placed. A post-intubation chest X-ray (CXR) did not show any pneumothorax or pneumomediastinum. Physical exam did not reveal any subcutaneous emphysema. A CXR performed one day later indicated mild accumulation of air in the superior mediastinum which progressed over the next week to a large pneumomediastinum with mediastinal shift (see Fig. 1). Several attempts at needle decompression were made by the neonatology staff with little resolution.

As the patient’s clinical status deteriorated, maximal ventilator and pressor support were initiated. Pediatric surgery, ENT, and cardiac surgery were consulted to manage the presumed tracheal injury. An emergent right thoracotomy was performed at the bedside. Upon entering the thoracic cavity, the pneumomediastinum was easily identified and opened. Saline instilled in the chest cavity showed a large air leak. Further dissection revealed an injury near the tracheal bifurcation, most likely due to traumatic intubation efforts. As the injury was presumably seven days old, there was significant inflammation and scarring around the area, making it difficult to clearly define the injury borders. Interrupted 6–0 Prolene sutures were used to buttress the defect with the surrounding pleural tissue in two layers. No residual air leak was visualized after instillation of saline into the chest cavity. A chest tube was left in place and the chest incision was closed primarily (Fig. 2).
To avoid barotrauma, the patient was ventilated with high flow jet ventilation (HFJV) for two weeks following the tracheal repair. The chest tube was left in place until conversion to conventional ventilation with low tidal volumes. There was no evidence of intrathoracic air leak on subsequent CXR's and the chest tube was removed. One month after surgery, patient was successfully extubated to CPAP for approximately 18 h at which point he was weaned to high flow O₂. Follow up endoscopy showed well-healed mucosa without tracheal narrowing.

2. Discussion

Neonatal airways are anatomically different from adults, which increases the risk of puncture during intubation attempts. The level of the cricoid is the smallest point of a pediatric airway as opposed to the vocal cords as seen in adults [4,5,7]. The smaller, completely encircled cricoid cartilage and smaller lumen increases the risk of injury because the trachea cannot safely accommodate most ET tubes [5]. Difficult airways increase the likelihood of requiring multiple attempts and thus increasing the risk of airway injury [7]. In addition, a “false passage” can be made by the perforation, further increasing the difficulty of intubation [7,8]. Tracheal injury following intubation severely increases morbidity and mortality; mortality has been reported as high as 75% in neonates [7].

Common presenting symptoms include subcutaneous emphysema, pneumomediastinum, pneumothorax, and respiratory distress [8]. Subcutaneous emphysema is an early sign and should raise suspicion for a tracheal injury particularly in recently intubated patients. Patients with suspected tracheal rupture should be diagnosed as soon as possible, ideally with radiographs or direct visualization [5,7,8]. Serial plain films can document progression of pneumothorax and pneumomediastinum, but carries a 5–10% false negative rate. Computed tomography, fiberoptic bronchoscopy, and/or esophagoscopy can aid in visualizing the airway and digestive tract to diagnose not only the site of injury, but also the extent of damage. However, this is oftentimes not possible in low birth weight infants.

There is currently little consensus regarding the management of tracheal injuries in premature infants, especially neonates with large tracheal injuries and airway compromise. Treatment must then be centered on patient- and incident-specific factors, including type of injury, location and size of injury, extent of spread into surrounding tissue, and overall patient status [7,9].

Conservative, less invasive treatment plans should only be applied to hemodynamically stable patients. One option is endoscopic application of fibrin sealant [10], allowing ventilation to be controlled in a non-invasive way. This approach has been shown to be effective in stable children, small tears less than 2 cm, and patients with significant comorbidities precluding surgical intervention [7,11]. Selective right or left main stem intubation has also been successful in treating neonates with lower airway laceration, but there is the risk of converting a small injury into a larger tear in a difficult location [12]. In very mild cases, close observation may be all that is necessary [11]. Surgical options include primary repair or use of a native tissue buttress, including pericardium or pleura. Surgery is generally reserved for clinically unstable patients. Overall, the goal of treatment is to minimize the risk of mediastinitis, provide effective ventilation, and to prevent complications such as scarring and tracheal stenosis [11].

Due to the small ETT, bronchoscopy was not felt to be possible in our patient. With worsening pneumomediastinum and hemodynamic instability, surgery was felt to be the best course of action. To date, our patient is the smallest child who has had a successful surgical repair for an iatrogenic tracheal injury.

3. Conclusion

Complications associated with endotracheal intubation are rare, but are associated with a significant risk of mortality [7,11]. Very few cases of low birth weight infants with tracheal perforation have been presented and most have been treated by conservative measures. Early recognition remains imperative for a successful treatment plan for these patients.
References