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# Successful non-operative management of a contained tracheal tear following iatrogenic endotracheal tube injury<sup>☆</sup>



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## ABSTRACT

We describe the case of a 5-year-old girl who was intubated in the field and sustained a severe tracheal injury resulting in a pneumothorax and extensive subcutaneous emphysema. She was treated without operative intervention and this tracheal tear was observed by serial bronchoscopy. After 6 weeks the trachea was well healed; in select cases non-operative management is a safe and effective strategy for contained tracheal injuries.

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Iatrogenic tracheal injury following endotracheal intubation is a rare but serious complication with an incidence of 0.005%–0.12% [1,2]. While much data exist regarding the management of adult and neonatal acute tracheal injury, pediatric cases are not well documented and there is no consensus regarding treatment. We report a case of iatrogenic tracheal injury in a child with favorable response to non-operative management.

## 1. Case report

A 5-year-old female with a history of global developmental delay became unresponsive after an episode of emesis at home in the context of gastroenteritis. In the ambulance to a local hospital, the patient had a second episode of emesis with subsequent respiratory compromise and seizure. The patient was intubated in the ambulance. Chest x-ray (CXR) upon arrival to the Emergency Room showed right main stem bronchus intubation with left lobar atelectasis (Fig. 1A). In addition, the balloon appeared overinflated. The decision was made to move the endotracheal tube 3 cm cephalad; however, the balloon was not deflated in that process.

Repeat CXR showed appropriate positioning of the endotracheal tube with overinflated balloon. The endotracheal tube manipulation

resulted in a tracheal injury, as subsequent CXR showed a ventilated left lung, but subcutaneous emphysema (Fig. 1B).

The decision was made to transfer the patient to a children's hospital for ventilator management. CXR on arrival demonstrated a large pneumothorax and an increase in subcutaneous emphysema (Fig. 1C) that worsened over the next few hours. A pigtail chest tube was placed on the right side to correct the pneumothorax. Additional imaging included a computed tomography (CT) scan (Fig. 2). Axial views show a tracheal tear with evidence of bilateral pneumothoraces and significant subcutaneous emphysema. This was felt to be a contained leak, as at the time of the CT scan the air leak on the chest tube had stopped and the lungs remained stably inflated.

On the second hospital day, bronchoscopy was performed (Fig. 3A). The surgeon evaluated the trachea through the existing endotracheal tube under fiberoptic guidance and discovered a contained tear along the posterior aspect of the trachea spanning five tracheal rings to the level of the carina. Our team decided to observe the injury. The patient was weaned on the ventilator and extubated uneventfully on hospital day two; our feeling was that attempts to minimize positive pressure on the airway would be favorable for airway wound healing. Her subcutaneous emphysema slowly resolved and her chest tube was removed on hospital day three. She was maintained on prophylactic Clindamycin for five days.

Follow up bronchoscopy six weeks later showed a well-healed trachea without sign of posterior rupture (Fig. 3B).

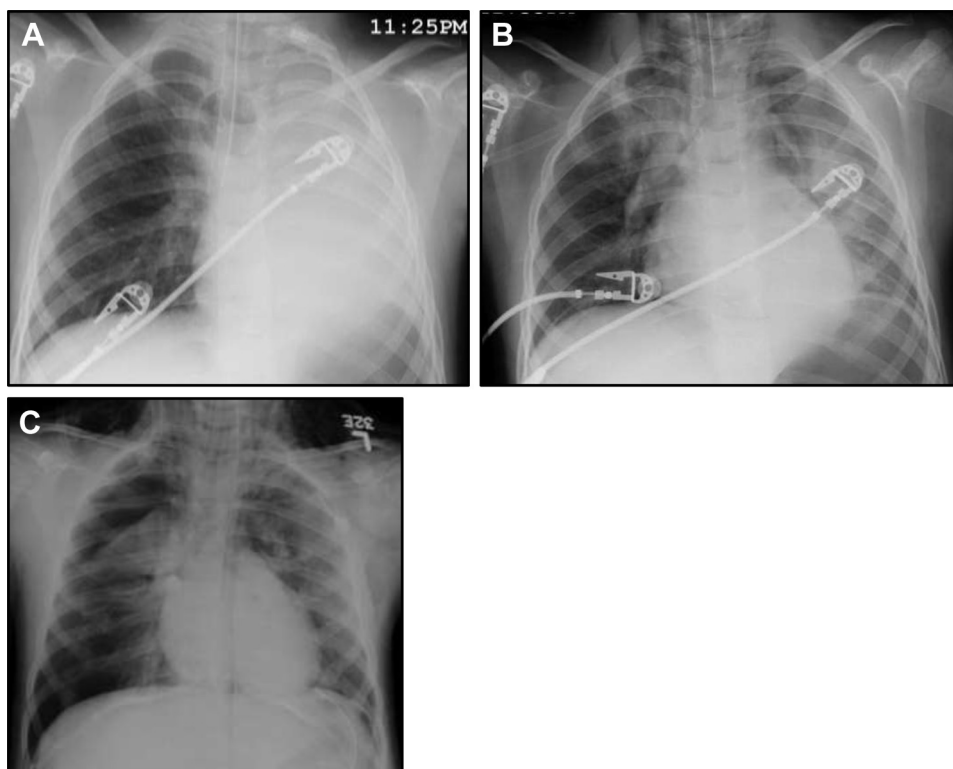
## 2. Discussion

Tracheal rupture is a rare event that can occur after trauma to the chest or neck [3] or, less commonly, as a complication of

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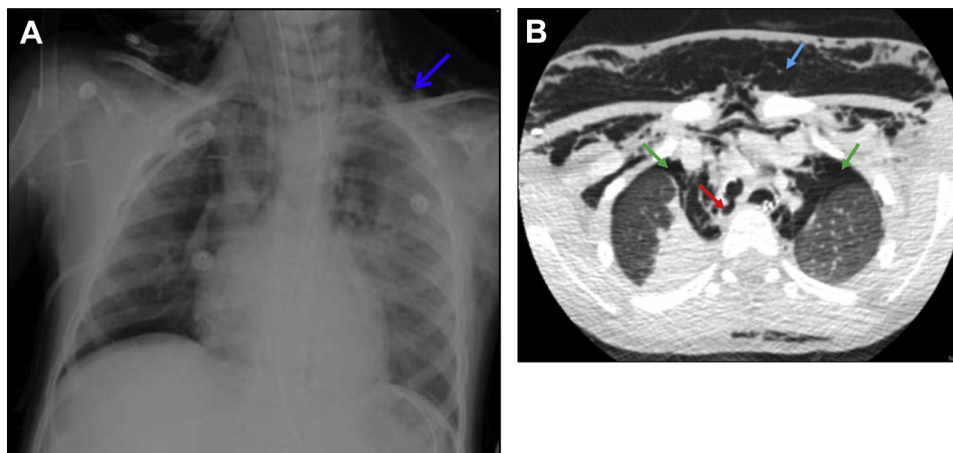
**Fig. 1.** (A) Initial CXR showing right mainstem bronchus intubation causing atelectasis of the left lung and endotracheal cuff over-inflation. (B) CXR with the endotracheal tube pulled back above the carina with some subcutaneous emphysema. (C) CXR with extensive subcutaneous emphysema and right pneumothorax.

endotracheal intubation. Tracheal tears can also occur, albeit much less commonly, after severe vomiting [4] or coughing [5], although these are typically mucosal, rather than full-thickness tears. The importance of early diagnosis of these injuries has been detailed previously, as morbidity and mortality increase proportional to time between diagnosis and treatment. Many cases of tracheal injury are not diagnosed until autopsy [6], probably leading to a slight misrepresentation of case incidence, especially in the pediatric population. In all patient populations, the incidence rate of tracheal injury following endotracheal intubation has been reported between 0.005 and 0.12% [1,2].

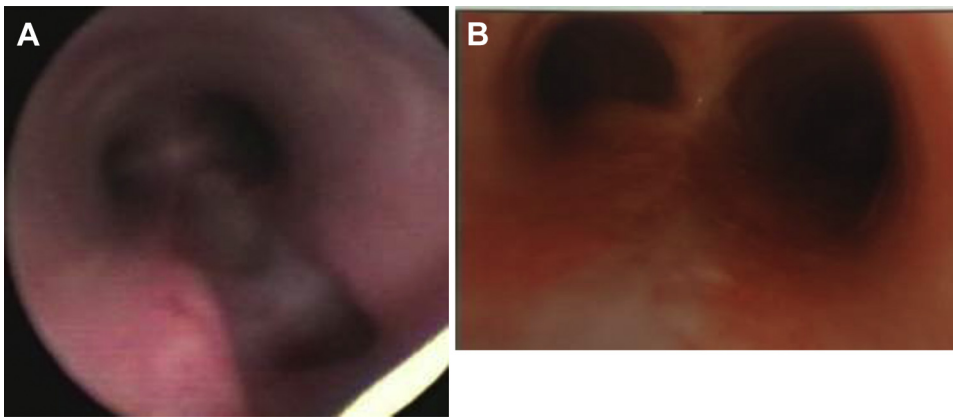
Many predisposing factors have been described for injury after endotracheal intubation. Among these, intubation in emergency

situations, especially in emergency response vehicles and other unstable environments, is associated with higher mortality [7–10]. Furthermore, over-inflation of the endotracheal tube cuff has been reported as the cause of up to 71% of tracheal tears [3,8,10]. Other reported risk factors in all patient populations include short stature [10], female gender [1,2,8,9], and age over 60 [1,2]. These factors suggest that smaller and more fragile tracheas are more susceptible to injury caused by intubation. In the pediatric population, there is no significant difference in incidence between genders [11]. There is however a higher incidence in neonates [12], perhaps indicating that a shorter trachea makes traumatic intubation, and right main-stem intubation, more likely.

As early diagnosis is critical to the management of these cases, a high level of suspicion is required with the onset of signs and



**Fig. 2.** (A) CXR with right lung re-expansion after pigtail placement. (B) CT scan of chest showing: tracheal defect (red arrow); pneumothorax (green arrows); sub-cutaneous emphysema (blue arrows).



**Fig. 3.** (A) Bronchoscopy on hospital day 1 after tracheal injury showing contained defect along the posterior wall of the trachea. (B) Bronchoscopy six weeks after the injury showing a well healed posterior trachea.

symptoms [7]. The hallmark clinical presentation of tracheal tear is subcutaneous emphysema, appearing in almost every reported case [2,3,7,9]. Other commonly appearing findings include pneumothorax, pneumomediastinum, and/or respiratory distress [7,9].

Early detection of tracheal tears necessitates appropriate imaging studies to diagnose the injury. CXR has been demonstrated to have a false negative rate of 5–10% when used alone to diagnose tracheal disruption [2,12]. As such, a normal radiograph does not exclude diagnosis. Even CT, which has been used more frequently in the visualization of location and extent of tracheal injury, has been shown to be only 85% sensitive for detecting tracheal injury, especially with smaller defects [3]. Previous studies agree that confirmation of suspicion of tracheal injury requires direct visualization via bronchoscopy [2,9,11]. Tracheal tears usually occur within 2–5 cm of the carina [13] along the membranous posterior aspect of the trachea [8]. This patient had evident subcutaneous emphysema and pneumothorax evident on both CXR and CT. The posterior tear was demonstrated on CT and confirmed to be contained by bronchoscopy.

Treatment is aimed at restoring the airway without increased trauma to the trachea [5]. Treatment options are surgical restoration or non-surgical, conservative treatment. Historically, surgical repair has been the mainstay of treatment if the airway is unstable, the tear is greater than 2 cm in length, or the tear is in the distal trachea or into the bronchus [7,9,14]; however, there is no consensus regarding treatment within the pediatric patient population. Conservative treatment involves broad-spectrum prophylactic antibiotics, mechanical ventilation, and frequent monitoring of the trachea by bronchoscopy [1,12]. A study of conservative treatment in neonates showed that bridging the tracheal tear with a carefully placed endotracheal tube allowed stress-free healing of the injury while maintaining ventilation.

### 3. Conclusions

In this study, the patient had a symptomatic tracheal tear larger than 2 cm that was visible on CT scan and initial bronchoscopy. Clinically, there was extensive subcutaneous emphysema and a

pneumothorax that resolved without persistent air leak after initial drainage. By bronchoscopy, in this case, the injury healed spontaneously after 6 weeks. A conservative approach can be considered a safe approach to a pediatric patient in stable condition even with a large tracheal tear.

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