

Tracheal Injury After Endotracheal Intubation: Experience with Conservative Treatment in Two Infants

Endotrakeal Entübasyon Sonrası Trakeal Yaralanma: İki Süt Çocuğunda Konservatif Tedavi Deneyimi

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ABSTRACT Iatrogenic tracheal injury is unusual, but a challenging complication in pediatric age group. Delayed diagnosis may result in increased morbidity and even mortality. There is no consensus between surgical and conservative management as treatment options in pediatric patients. Although surgery is still a life-saving procedure, conservative treatment has recently become an alternative to surgery in selected patients. In this paper, we present our experience with conservative management in 2 infants with tracheal injury after endotracheal intubation. Both patients presented with subcutaneous emphysema. The chest and neck roentgenogram and computed tomography showed findings highly suggestive of tracheal injury such as subcutaneous emphysema, pneumomediastinum and air leak around the trachea. The patients were followed-up conservatively, and clinical and radiological resolution of subcutaneous emphysema and pneumomediastinum was gradually observed. Finally, successful outcomes were achieved in both of the patients.

Keywords: Child; endotracheal intubation; trachea; injuries; conservative treatment

ÖZET İyatrojenik trakeal yaralanma pediyatrik yaş grubunda nadir görülen, fakat zorlu bir komplikasyondur. Gecikmiş tanı artmış morbidite ve hatta morbidite ile sonuçlanabilir. Çocuklarda tedavi seçeneği olarak cerrahi ve konservatif tedavi arasında bir fikir birliği yoktur. Cerrahi tedavi hala hayat kurtarıcı bir yöntem olsa da konservatif tedavi son zamanlarda seçilmiş hastalarda cerrahinin bir alternatifi haline gelmiştir. Bu yazıda endotrakeal entübasyon sonrası trakeal yaralanması olan 2 süt çocuğunda konservatif tedavi konusundaki tecrübelerimizi sunuyoruz. Her iki hastada da ilk bulgu cilt altında amfizemdi. Göğüs ve boyun grafilerinde ve bilgisayarlı tomografide trakeal yaralanmayı önemli ölçüde düşündüren cilt altı amfizem, pnömomediastinum ve trakeanın etrafında hava kaçağı gibi bulgular mevcuttu. Hastalar konservatif olarak takip edildi ve cilt altı amfizem ve pnömomediastinumun klinik ve radyolojik rezolüsyonu yavaş yavaş gözlemlendi. Sonuçta, her iki hastada da başarılı sonuçlar elde edildi.

Anahtar Kelimeler: Çocuk; endotrakeal entübasyon; trakea; yaralanmalar; konservatif tedavi

Iatrogenic tracheal injury is an unusual, but life-threatening complication in children. Early recognition and prompt treatment are essential for successful management. Although the management of iatrogenic tracheal injury is usually straightforward in adults, there is no pediatric consensus. Here, we present our experiences with two infants with tracheal injury after endotracheal intubation.

CASE REPORTS

CASE 1

A 3-month-old male infant was operated due to right inguinal hernia. Endotracheal intubation was performed with difficulty using a stylet after multiple attempts. After the operation, he was extubated in the operating theatre. Subcutaneous emphysema of the neck was realized at postoperative visit without any respiratory failure. The chest and neck roentgenogram showed pneumomediastinum, subcutaneous emphysema of the neck and no pneumothorax (Figure 1a), and thoracic computed tomography (CT) also demonstrated air leak around the trachea (Figure 1b). Enteral feeding was initially stopped due to possible esophageal injury until ruled out by contrast esophagography, and then enteral feeding was restarted with a nasogastric tube. The patient was followed-up conservatively with broad spectrum antibiotics and chest roentgenograms to follow up the progression of pneumomediastinum. Clinical and radiological resolution of subcutaneous emphysema and pneumomediastinum was observed after 1-week uneventful follow-up, and then the patient was discharged.

CASE 2

A 5-month-old female infant was referred to our hospital due to varicella pneumonia. Respiratory

distress requiring mechanical ventilation was observed one day later. Chest roentgenogram demonstrated right pneumothorax, so the patient was intubated, and chest tube was placed. On second day, respiratory failure and respiratory acidosis with bradycardia and oxygen desaturation occurred, and finally cardiac arrest developed. The endotracheal tube was changed promptly using a stylet. After 6 minutes of cardiopulmonary resuscitation, the return of spontaneous circulation was achieved. Subcutaneous emphysema involving the right chest and neck was observed subsequently. However, there was no air leak through the chest tube. The chest roentgenogram showed pneumomediastinum and diffuse subcutaneous emphysema of the chest and neck and no pneumothorax (Figure 2a), and thoracic CT also demonstrated a small posterior tracheal defect just superior the carina (Figure 2b). Because of the pneumonia and poor general condition, bronchoscopy could not be performed. Fortunately, significant reduction in oxygen saturations was not observed. The patient was followed-up conservatively with broad spectrum antibiotics, antiviral medication, sedation, and chest roentgenograms. Subcutaneous emphysema progressed significantly into whole chest, neck and back of the patient on the next day, so a few small skin incisions were made to evacuate air manually and low tidal volumes were used in order to minimize air leak. After that, subcutaneous

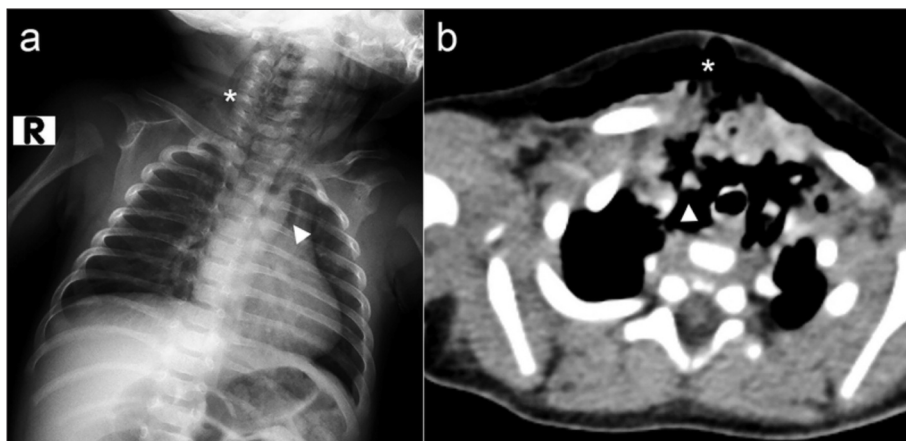


FIGURE 1: (a) The chest and neck roentgenogram showing pneumomediastinum (arrow head) and subcutaneous emphysema of the neck (asterix). (b) Thoracic CT showing air leak around the trachea (arrow head) and subcutaneous emphysema (asterix).

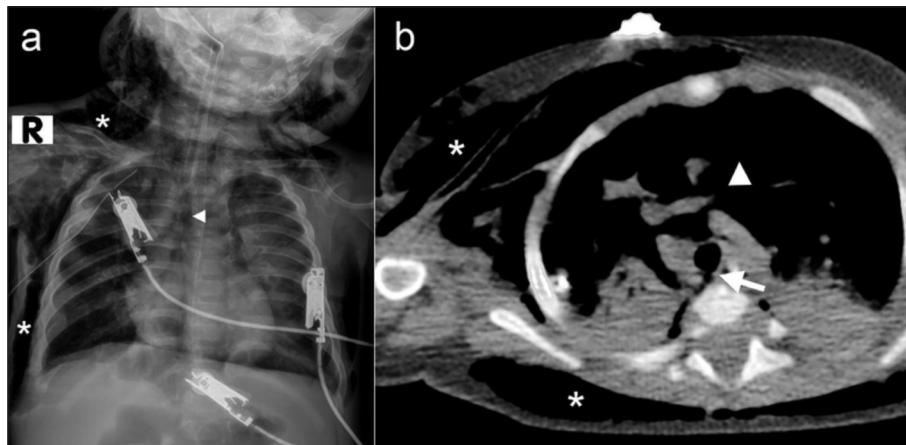


FIGURE 2: (a) The chest roentgenogram showing pneumomediastinum (arrow head) and diffuse subcutaneous emphysema of the chest and the neck (asterix). (b) Thoracic CT showing subcutaneous emphysema (asterix) and pneumomediastinum (arrow head), and a small posterior tracheal defect just superior the carina (arrow).

emphysema and pneumomediastinum dramatically regressed within a week, and the patient was successfully extubated on hospital day 8, and the next day chest tube was removed. Treatment of the pneumonia was continued until hospital day 14, and then the patient was discharged.

DISCUSSION

Endotracheal intubation can lead to some life-threatening complications. Of these, tracheal rupture is a rare and challenging complication with an incidence of 1: 75000 in adults.¹ It is an extremely rare complication in children, and its exact incidence is unknown, because most published papers about children consist of only case reports or small case series.

The leading cause of tracheal injury during intubation is direct mechanical trauma caused by endotracheal tube or improper positioning of the stylet as in our patients.² The procedure-related factors include inexperience of physician, emergency intubation, multiple vigorous attempts, poor positioning, excessive external laryngeal pressure, inadequate muscle relaxation, tube repositioning without cuff deflation and over-inflation of the cuff.^{2,3} However, the structural differences such as the higher cartilage elasticity and weaker intercartilaginous membranes of the pediatric airway may be the contributing factors.⁴

Awareness of these predisposing factors is important to prevent this unwanted complication.

Early recognition of tracheal injury is important, because a delayed diagnosis could cause mediastinitis which is a serious complication leading to morbidity and mortality.⁵ The most common clinical manifestation of tracheal injury is subcutaneous emphysema of the neck and thorax, which was the presenting symptom of our patients. It may be considered as a favorable sign, because its presence facilitates early diagnosis and treatment.^{3,4} Other clinical symptoms are respiratory distress, cough, hemoptysis, hypoxemia and rarely hypotension and shock, and radiological findings include pneumomediastinum, subcutaneous air, and less commonly pneumothorax.^{3,5} Roentgenograms of the chest and neck should be taken as the priority in any case of suspected tracheal perforation. Thoracic CT is mostly helpful for detailed evaluation of airway injury and demonstration of complications. Additionally, esophagogram may be necessary to rule out concomitant esophageal injury. Bronchoscopy is the gold standard in order to confirm the diagnosis, as well as to determine precise localization and extension of the injury.³⁻⁵ Good general condition without respiratory distress in the first case, critical illness due to varicella pneumonia in the second case, and above all, thoracic CT findings highly

suggestive of tracheal injury in both of the cases were the main reasons why we did not perform bronchoscopic evaluation.

Current knowledge about treatment modalities of tracheal injury are mainly based on the adult experiences. Therefore, the management of this eventful complication in children is still controversial. While surgical exploration and immediate repair was the traditional treatment method that first came to mind, conservative treatment has recently become an alternative to surgery in selected patients. Ross et al.⁶ proposed following clinical settings for conservative management of intubation-related tracheal injury: stable vital signs, easy ventilation while intubated, absence of respiratory distress while extubated, no evidence of esophageal injury, minimal mediastinal fluid collection, nonprogressive pneumomediastinum or subcutaneous emphysema, and absence of sepsis. In this respect, conservative treatment was appropriate for the first case, but it was controversial in the second case who had progressive subcutaneous emphysema which is a criterion for surgical treatment.⁷ On the other hand, other studies suggest that poor physical condition in severely ill patients is an indication for conservative treatment that is associated with a better outcome.³ Moreover, surgical repair in critically ill patients is a high-risk procedure with a mortality that can reach 62%.⁸ We managed the patient conservatively, because she was critically ill due to the pneumonia, but she had stable respiratory status with no sign of mediastinitis, and progression of subcutaneous emphysema was also controlled by skin incisions and ventilation with low tidal volumes.

Conservative management starts with broad-spectrum antibiotic prophylaxis to prevent mediastinitis. Oral feedings should also be stopped. Sedation is also useful to decrease movement of the tube. Close monitoring of vital signs and serial radiologic evaluation of subcutaneous emphysema and pneumomediastinum are important measures. The placement of endotracheal tube distal to the injury is mainly recommended to minimize or

eliminate any air leak through the perforation site.⁵ Injuries close to the carina represent a unique challenge, because it is difficult to advance the tube distal to the injury. Although surgical repair is the recommended modality in this situation, successful outcome was achieved in the second case by ventilation with low tidal volumes which avoided deterioration of the condition.

In conclusion, problems during endotracheal intubation may cause tracheal injury. A prompt diagnosis requires a high clinical suspicion. Although surgery still maintains its significance in the treatment, recent trends have changed towards the conservative management in selected patients. In this respect, this paper presents two new pediatric cases and demonstrates that distal tracheal injury with progressive subcutaneous emphysema can be managed with conservative measures in children.

Informed Consent

Informed consent was taken from one of the parents.

Source of Finance

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Levent Duman; **Design:** Levent Duman; **Control/Supervision:** Levent Duman, Ebru Yılmaz Keskin; **Data Collection and/or Processing:** Levent Duman, Özkan Cesur; **Analysis and/or Interpretation:** Levent Duman, Mustafa Çağrı Savaş; **Literature Review:** Levent Duman, Özkan Cesur; **Writing the Article:** Levent Duman, Mustafa Çağrı Savaş; **Critical Review:** Mustafa Çağrı Savaş, Ebru Yılmaz Keskin; **References and Fundings:** Levent Duman; **Materials:** Levent Duman.

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