

## Airway Lesions in Children: How to Deal with These Emergency Medical Situations?

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### Abstract

**Background:** Lesions of the airway are quite rare, but always serious injuries. Since their real trauma impact is often hardly visible on site, or hidden behind more sinister trauma conditions, the victim might mimic a stable condition, until he or she suddenly deteriorates.

However, since significant compromise of the airway has to be considered anytime in this group of patients, a proper airway management is of key importance to save either patient's life or to prevent life-long sequelae.

Treatment could be surgical or non-surgical, but specialist expertise is of key importance.

**Keywords:** Larynx trauma; Burn inhalation trauma; Trachea surgery

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### Introduction

Therefore why even life-threatening conditions are easily overlooked on scene or during patient's medevac operations. The majority of victims are transported unwittingly from scene to a rural hospital first, instead of rushing them directly to a specialized pediatric trauma center. In addition, mechanisms of accident and etiologies vary, making recognition of the leading clinical signs and key symptoms sometimes nearly impossible.

For final diagnosis plane x-ray, CT scans and tracheo-bronchoscopy is of key importance, and it has to be kept in mind that in regard to human anatomy the "airway" is located inside both, the neck and the chest compartment. According to the type of lesion non-surgical (i.e. lesion intubation) or surgical (i.e. direct suture) therapy will be recommended.

In the following paragraphs an illustrated case series on tracheal rupture lesions and their sequelae are presented in regard to their management and in front of a short literature review.

### Case Series

In the first section, examples of more simple airway lesions at the level of the larynx are presented.

Like for example, a cystic lesion (**Figure 1**), an edema after a posttraumatic manipulation (**Figure 2**), respectively a larynx after a burn inhalation trauma (**Figure 3**) [1].



**Figure 1:** Cystic lesion of the larynx.



**Figure 2:** Edematous larynx after posttraumatic manipulation.

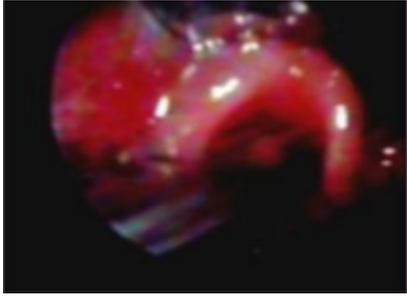


Figure 3: Larynx after burn inhalation trauma.

In contrast to these pure internal larynx trauma another two examples of external injuries are discussed. In the first one a slight right-sided exterior larynx hematoma (Figure 4), in the second one nothing abnormal could be visualized at first examination at the pediatric A&E unit; neither in x-ray nor in ultrasound scans (Figure 5).



Figure 4: X-ray ≡ US scan: Slight right-sided exterior larynx hematoma.



Figure 5: X-ray ≡ US scan: NAD.



Figure 6: Girl, 6 yrs. Skiing accident with femur fracture. Skin marks after a strangulation injury by the cord string of her skiing suit.

In the second series we present 2 airway lesions at the level of the neck [2].

The first child was injured in a skiing incident and had sustained a femur fracture. Striking injury was the femur fracture. A fact, bearing the high risk for the external neck injury to be easily overlooked, despite such clearly visible skin lesions (Figure 6).

Second, after scuffling with classmates a scholar presented himself with neck emphysema in the ER (Figures 7a and 7b). Despite its obvious presence, this important clinical finding was missed by the junior doctor on call during his first clinical examination. Then, in contrast to the mild clinical symptoms, massive “air echos” in the ultrasound scans could be visualized (Figure 7c). However, during endoscopy nothing abnormal could be detected (Figure 7d) [3].

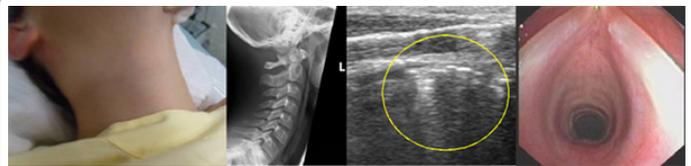


Figure 7: (a-d) Boy, 10 yrs. Scuffling with classmates. Neck emphysema in clinical presentation and x-ray. Heavy “air echos” in the US scans NAD in tracheobronchoscopy.

Close observation has been the successful treatment for both of these patients. A disabled child, dependant on a home ventilator, was rushed into the ER with a traumatic dislocation of his tracheostoma (Figure 8). In due course, the tracheoscopic-assisted change of the tracheostoma solved the problem. The aspirated foreign body (Figure 9a) in our fourth case example, a pin wall pin, could be removed successfully by tracheobronchoscopy (Figure 9b) after x-ray diagnosis as well. Some of the following scenarios might appear as “simplistic” airway lesions in the first instance, but for several reasons, finally a much more complex management was required.

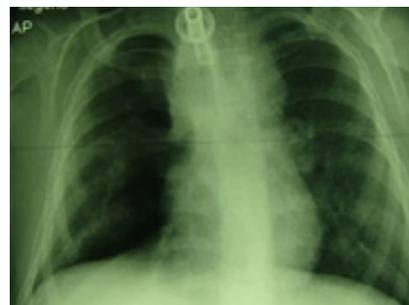
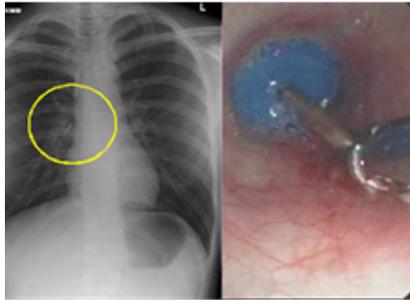


Figure 8: Disabled child, dependent on tracheostoma and home ventilator. Suspected stenosis, finally dislocated tracheostoma.



**Figure 9:** (a,b) Infant, aspirated pin wall pin. Successfully removed by tracheobronchoscopy.

Like in this strangler attack by a class mate. No external trauma marks were visible on the skin; but hoarseness, inability to speak and shock were present. In the lateral x-ray the “air column” seems to be interrupted (**Figure 10 a**), and during tracheoscopy a superficial mucosal lesion could be visualized (**Figure 10b**).



**Figure 10:** (a,b) Girl, 12 yrs. Chocked by a (originating from abroad) class mate-no external bruises, but hoarseness-shocked, unable to speak-first aid by the GP-normal saturation-no emphysema, but “air column” seems to be interrupted in lateral x-ray.

However, considering her “real” diagnosis this girl could be discharged only very hesitantly. Because in due course, she was admitted again and again with abdominal pain (= suspected appendicitis), indicating a PostTraumaticStress Disorder (PTSD) syndrome. The perpetrator was precondemned and mobbed and school day routine reassembled only very slowly. Finally, significant sickness leave from school has been the result. So in addition to the physical wounds “cultural issues”, “migration background”, “precondemnation” and “mobbing” among others, need to be addressed too. Another girl presented with heavy scratches, strangulation and punch marks on her neck (**Figure 11**) [4].



**Figure 11:** Girl, 10 yrs. Attempted murder by a teenager of the same village, strangled by the perpetrator, head beaten on a big rock, suspected sexual abuse, the perpetrator only left off his victim after a bystander (ex-policeman) interfered.

Attempted murder by a teenager of the same village. The physical wounds have been nothing against the psychological ones. And, we were facing a crime A Syrian teenage girl committed suicide by strangulating herself in the shower cabin. Clinical findings were strangulation mark and mediastinal emphysema. Asked by the psychiatrist, why she did this, her answer was, that” the ISIS has told her to do so”. Please note, that the triage officer classified her as “yellow” meaning 30 minutes waiting time before you see a doctor? In the CT scans only a very small pneumomediastinum around the aortic arch could be visualized (**Figure 12**), in her -scopic investigations nothing abnormal was detected. In our management we have to consider the Islamic culture, the language barrier, and her accompanying psychiatric disorder. And, last but not least aspects of “terrorism”. This Libyan scholar boy suffered a road traffic accident (**Figure 13a**). He was a referral from a rural



**Figure 12:** Girl, 16 yrs. Committed suicide by strangulating herself in the shower cabin. Clinical findings were a strangulation mark and a mediastinal emphysema. In the CT scan air bubbles around the aortic arch indicating a pneumomediastinum.

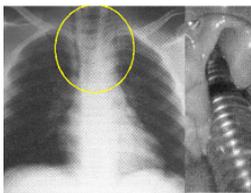


**Figure 13:** (a-c) Boy, 10 yrs. Road traffic accident. Referral from a rural hospital. Communication breakdown after the suspected neck emphysema was considered to be the esophagus.

hospital diagnosed as “suspected free air in the mediastinum”. Main problem was the communication breakdown, after we considered the “suspected neck emphysema” to be the esophagus (**Figures 13b and 13c**). Thus, in our management we have to consider Libyan doctors association’s code of conduct, the doctor’s attitude and the patient’s individual body knowledge as well.

In the final section our focus will be on complex airway lesions. Last but not least, their management and therapy will be described in detail.

A scholar boy underwent surgery for an ulnar condyle fracture in a rural hospital, starting with breathing difficulties and chest pain after extubation. Transfer to the Level I Trauma Center by air rescue after developing a severe neck emphysema (**Figure 14a**). An intubation trauma was diagnosed resulting in a small transmural lesion on the dorsal trachea wall; 2 to 3 cm distal of the larynx. Treatment has been successful non-surgical by lesion intubation (**Figure 14b**).



**Figure 14:** (a) Boy, 10 yrs. Neck emphysema (b) Intubation trauma resulting in a small transmural lesion on the dorsal trachea wall; 2 to 3 cm distal of the larynx Lesion intubation has been the treatment of choice.

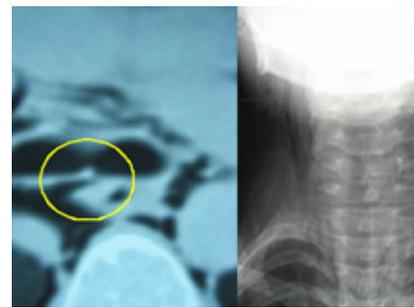
After an accidental fall on a trailer coupling, a preschooler suffered an open neck wound (**Figure 15**), dyspnea and neck emphysema. Immediate transfer to the Level I Trauma Center by air rescue. The 1.5 cm longitudinal tear originated in the pars membranacea distal of the cricoid extending to the 4th tracheal cartilage. Successful treatment consisted out of lesion intubation and suture of the skin.

No real history of trauma, just bending of his neck in the swimming pool, caused a small, hardly visible lesion at the level of the carina (**Figure 16a**) in this scholar boy. He presented with difficulties to swallow, mild coughing and an (isolated) neck emphysema (**Figure 16b**), but no cardio-respiratory compromise. Lesion intubation has been the successful treatment again, after his transfer from the rural hospital to the Level I Trauma Center by ground ambulance, diagnosed "s/o esophagus rupture". Another preschooler suffered a serious bicycle accident after collision with the rear wheels of a truck.

He walked back home alone before he got first aid in a rural hospital (**Figure 17a**). The initial diagnoses comprised a left-sided clavicular fracture, bilateral pneumothorax and a huge emphysema (**Figure 17b**). The child was intubated and a chest drain inserted, before he was rushed into our Level I Trauma Center by ground ambulance. After arrival the most impressive



**Figure 15:** Boy, 6 yrs. Farmland accident. Neck wound (already sutured), dyspnea and neck emphysema.



**Figure 16:** Boy, 8 yrs. (a) Small, hardly visible lesion at the level of the carina in the CT scan (b) (Isolated) Neck emphysema in the X-ray.

diagnosis was revealed in CT scan and tracheobronchoscopy: A complete transverse trachea rupture with displacement at the level of the 10<sup>th</sup>-11<sup>th</sup> cartilage ring, the endo-tracheal tube ending just in line with the proximal fragment (**Figure 17c**). Immediately the ruptured trachea was splinted tracheoscopically, the dislocated chest drain re-placed and a contralateral one inserted [5]. In due course open trachea surgery was successfully performed (**Figure 17d**). Tracheoscopic view of the uneventful healing (**Figure 17e**).



**Figure 17:** (a) Boy, 6 yrs. First clinical impression of the child (b) X-ray showing a left-sided clavicular fracture, bilateral pneumothorax and a huge emphysema (c) CT scan revealed a complete transverse trachea rupture with displacement at the level of the 10th-11th cartilage ring, the endo-tracheal tube ending just in line with the proximal fragment (d) Intraoperative view on the rupture side (e) Tracheoscopic view on the healing suture line.

## Conclusion

Finally, we revisited the files of 12 children (Mean age 8 yrs, m:f=7:5) in regard to the management and therapy of their airway lesions. We have to learn, that these injuries are rare, but always complex and life-threatening. Since they present with various mechanisms of accidents or incidents, respectively different clinical findings and special circumstances, a high level of suspicion is needed by every doctor in charge to establish the accurate diagnosis.

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