



(CASE REPORT)



## Post traumatic disruption of the trachea: About three adolescents' cases with literature review

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### Abstract

**Introduction:** Tracheal lesions are rare but potentially serious and can cause significant morbidity and mortality. Early diagnosis is essential for optimal management. We report 3 cases of adolescents who were victims of external cervicothoracic trauma. All three patients presented with neck pain, inspiratory dyspnea, and polypnea with subcutaneous cervical emphysema in clinical examination. Nasofibroscope showed normal appearance and mobility of the vocal cords. Cervical and thoracic CT scan with contrast enhancement was carried out in all our patients that showed tracheal breach in various localizations.

The first patient underwent surgical exploration of the penetrating wound in the cervical area. The surgical exploration revealed no damage to the anterior and lateral faces of the trachea. In this case, a sagittal discontinuity on the posterior wall of the trachea was revealed using a rigid bronchoscope. All patients were admitted to the intensive care unit for monitoring and follow-up for 24 to 72 hours and received antibiotics and corticosteroids for 10 days. The patient's symptoms improved throughout the evolution.

**Conclusion:** Early diagnosis is necessary to prevent complications. The gold standard for diagnosis is bronchoscopy. Conservative management is recently considered the best therapeutic choice which also allows the morbidity of surgical treatment to be avoided.

**Keywords:** Tracheal disruptions; Adolescents; Cervico-thoracic trauma; Subcutaneous cervical emphysema

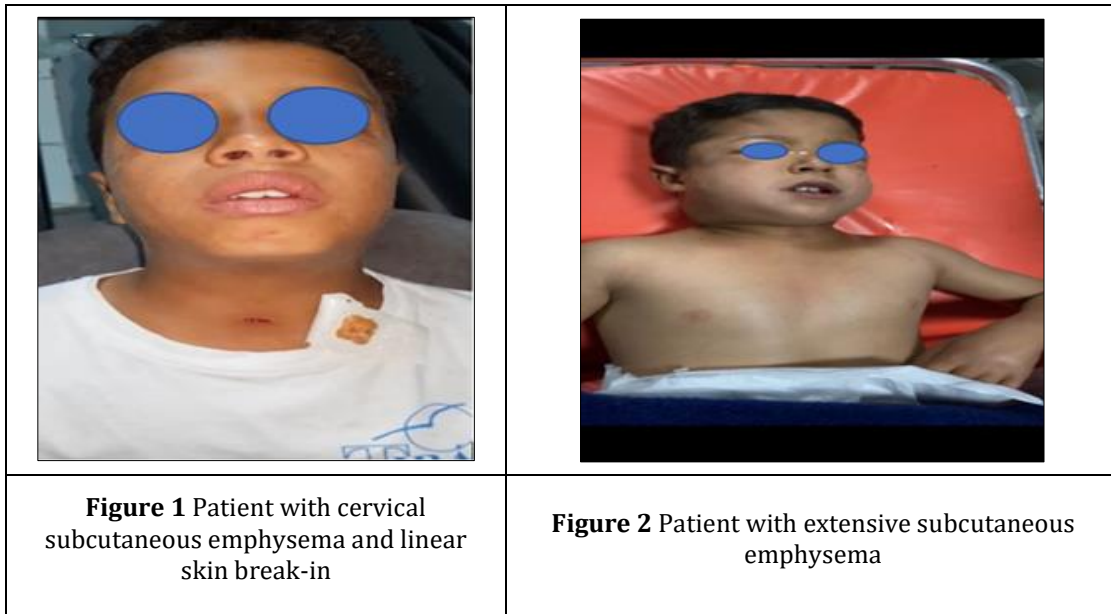
### 1. Introduction

Tracheal injuries caused by blunt or penetrating trauma are uncommon and more scarce in children. However, due to their mortality and potential complications, they require rapid and appropriate management [1,2]. Clinical signs may vary from mild respiratory discomfort or subcutaneous emphysema to acute respiratory failure. An appropriate radiological examination can assist in diagnosis. The management of tracheal injuries remains controversial with no consensus. Therapeutic options range from conservative to surgical means. While early surgical repair was once considered the cornerstone of therapeutic management, currently, evidence in favor of conservative treatment continues to strengthen [3]. Understanding the symptoms, diagnostic modalities, therapeutic options and early detection of these lesions is essential for a better prognosis.

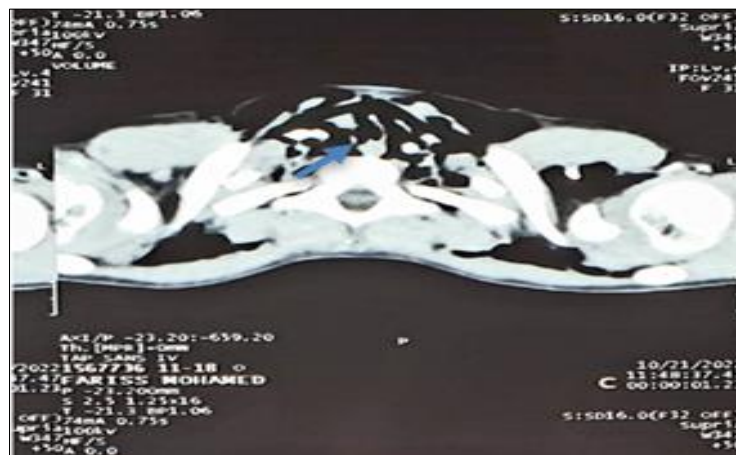
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## 2. Case report

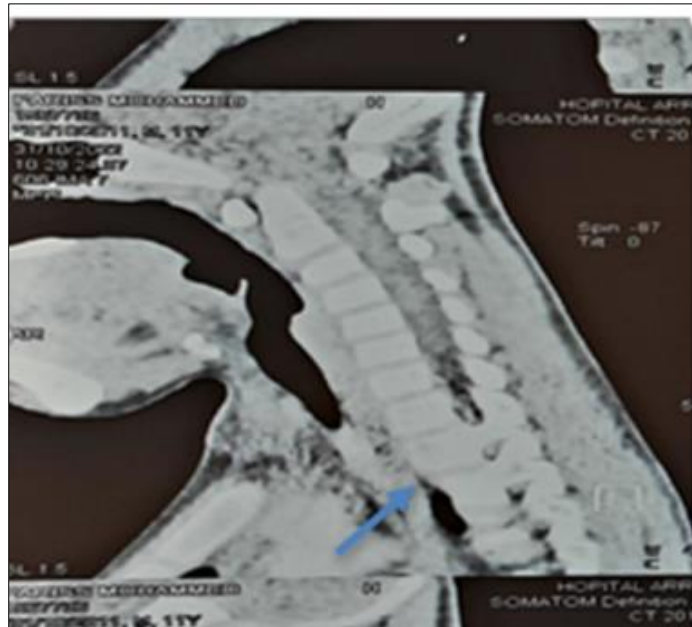
This report presents three cases of 3 adolescents, aged 10, 11, and 16 years, who were admitted to the emergency department with external cervicothoracic trauma. The first case was due to a fall from a bicycle onto the handlebars resulting in a cervical impact point, the second case was a craniofacial impact point due to a road traffic accident and the third case was a cervicothoracic impact point due to a crushing by a heavy object. On admission, all three patients presented with neck pain, inspiratory dyspnea, and polypnea. However, they were neurologically and hemodynamically stable, with no cyanosis. Clinical examination revealed subcutaneous cervical emphysema in all three patients, which extended to the face, chest wall, abdomen, and upper limbs in one patient. No pain or deformity of the laryngeal relief was observed during the cervical examination. Nasofibroscope showed normal appearance and mobility of the vocal cords in all patients. The examination of the lungs and pleura revealed no abnormalities or signs of pleural effusion syndrome.



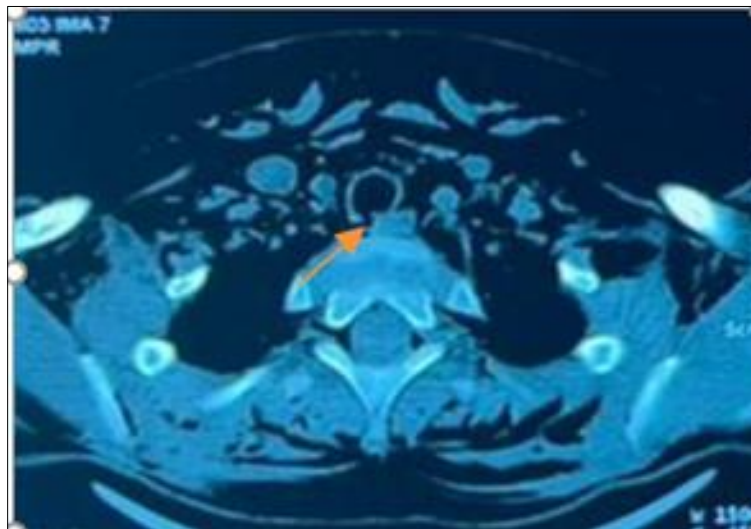
No standard cervicothoracic X-ray was performed on any patient. A cervical and thoracic CT scan with contrast enhancement was carried out in all our patients. In the first case CT scan showed a posterior tracheal breach at the same level as the eighth cervical vertebra (C8) measuring 2.5mm extending over 5.5mm. in the second case, the breach was localized in the right lateral wall of the trachea at the level of the dorsal vertebra (D2-D3) measuring 3.5 mm and extended over 3 mm while in the third case, the tracheal breach was located at the level of the C5



**Figure 3** Axial section of the CT showing the tracheal breach in the 1st patient



**Figure 4** Sagittal section of the CT showing the tracheal breach in the 1st patient



**Figure 5** Axial section of the CT of the breach in the right lateral tracheal wall in the 2nd patient

The first patient underwent surgical exploration of the penetrating wound in the cervical area. The surgical exploration revealed no damage to the anterior and lateral faces of the trachea. In this case, a sagittal discontinuity on the posterior wall of the trachea was revealed using a rigid bronchoscope. The discontinuity extended over 2 cm of the mucosa, and there was uncertainty regarding the involvement of the muscularis, but the breach was sealed by the cervical esophagus, and no surgical repair was deemed necessary. No tracheostomy was needed. In the second case, bronchoscopy was necessary due to extensive emphysema. The bronchoscopy was normal, but surgical exploration revealed a lateral rupture between the tracheal rings less than 1 cm. This rupture required filling with a small muscular flap patch of the sub hyoid muscles. In the third case, we have opted for a conservative treatment with strict monitoring.

All patients were admitted to the intensive care unit for monitoring and follow-up for 24 to 72 hours without intubation or assisted ventilation. One patient was transferred to our department for monitoring for ten days, and the other three patients were transferred to the thoracic surgery department for monitoring. All patients received antibiotics and corticosteroids for ten days. The patient's symptoms improved throughout the evolution. Two months after discharge, a control cervico-thoracic CT scan was performed and found to be normal in all cases.

### 3. Discussion

Tracheobronchial lesions in children are very rare and different authors have cited incidences between 0.7% and 2.8% after trauma at the cervicothoracic impact point, as the main etiology with a mortality incidence of 30% [6, 7], and between 0.04% and 0.12% caused by endotracheal intubation [8], but we can have other iatrogenic causes such as during thoracic surgery, bronchoscopy, tracheal dilatation or tracheotomy. The mechanisms of tracheobronchial injury in cases of cervicothoracic trauma are either crushing of the thorax following high-energy trauma with compression of the tracheobronchial tree between the sternum and the spine. Either a shearing effect caused by rapid deceleration or tracheal hyperpressure with a closed glottis [6]. tracheobronchial lesions are rare since the trachea is quite flexible and protected by the sternum, clavicles, and spine. Thus, tracheal lesions caused by cervical trauma are often horizontal or irregular in shape, this is explained by the compression of the trachea against the cervical spine. On the other hand, the lesions caused by endotracheal intubation are often longitudinal at the level of the posterolateral tracheal wall, or even a rupture of the posterior wall [2,3]. 80% of tracheobronchial lesions occur less than 2.5 cm from the carina (80% affect the main bronchi, 15% affect the trachea, and 5% the distal bronchi). [6.16]

The clinical manifestations are diverse and complex, which poses diagnostic and management difficulties. The most common symptoms are dyspnea, cyanosis, cough, hemoptysis, hoarse voice, dysphonia, odynophagia, and neck pain. Physical examination reveals subcutaneous emphysema and skin bruising, cyanosis, pneumothorax, and vocal cord paralysis. Patients with a partial rupture of the trachea, which remains normally positioned, may form a false passage through the traumatized tissue. Tracheal injury may not be obvious due to the absence of an open wound in the neck, and there may not be immediate dyspnea. Studies have shown that the following clinical manifestations are highly suspicious for blunt injury to the cervical trachea after neck trauma, firstly pain exacerbated by swallowing or rotation of the neck, second, cervical skin bruising, dry cough, cyanosis, hemoptysis, cervical subcutaneous emphysema and pneumomediastinum and third, significant worsening of dyspnea when the neck is extended; and lastly a hoarse voice [2.14]. Therapeutic management requires early diagnosis for adequate treatment to avoid the most serious complications such as stenosis or atresia of the trachea which can endanger the patient's vital prognosis. The rate of delayed diagnosis is reported to be between 35 to 68% [15].

Although rare, tracheal injuries can cause significant sequelae in terms of morbidity and mortality [4]. The development of pneumomediastinum, pneumothorax, and mediastinitis leads to high mortality rates. Rupture of the trachea can lead to the creation of a false passage and therefore, obstruction of the airways leading quickly to death. Our case reported subcutaneous emphysema which led to suspicion of a tracheal lesion.

Regarding paraclinical examinations, chest X-rays and cervical profile X-rays can be carried out to highlight the progression of subcutaneous emphysema, pneumothorax, and pneumomediastinum. In addition, CT scanning is often requested to identify lesions, their location, and their extent. a barium enema may be used to rule out esophageal damage. Flexible or rigid laryngoscopy and bronchoscopy remain the gold standard for diagnosis; they allow visualization of the respiratory tract and localize the site of the lesion and its extent [1.2].

Although surgical management of tracheobronchial lesions was once considered the first therapeutic choice, recent publications, particularly in the adult literature, have shown increasing evidence in favor of conservative management [3,9].

Therapeutic management of tracheal lesions switches between conservative and surgical treatment. It responds to immediate vital and secondary functional requirements, aimed at preventing the risk of tracheal stenosis and maintaining phonation. The endoscopic and radiological lesion assessment makes it possible to distinguish trauma requiring medical treatment from trauma requiring surgical treatment which aims to reduce the risk of stenosis.

Conservative management of the trachea is used most often under the following criteria: stable vital signs, effective ventilation, absence of respiratory distress, stability of pneumomediastinum or subcutaneous emphysema and absence of sepsis [ 3.10]. Some authors report that lacerations >1 cm require surgical intervention, while others state that the length of the lesion has no impact on the method of treatment [3,13]. Surgical airway opening procedures carry significant risks. Meyers reported a mortality rate of up to 70% in patients undergoing open surgical repair [11]. In patients who meet the above criteria for conservative management, the risks inherent in surgery are avoided and long-term morbidity is reduced.

The surgical means described are diverse; endotracheal calibration using a Montgomery tube may be necessary to maintain the patency of the respiratory tract. It is especially indicated in cases of significant mucosal damage,

laryngotracheal disinsertion, or fracture of the cervical trachea and it is maintained for a period which should not exceed 15 days, even if some authors maintain them for 3 to 6 weeks.[17]

Surgical management differs depending on the degree of tracheal injury, in the event of complete tracheal rupture, a suture is made with a tractor wire to the skin to allow suitable ventilation with ideally an end-to-end suture and resection of one or two rings if necessary to obtain healthy extremities. In the case of incomplete tracheal ruptures, there are several scenarios: if a wound in the pars membranacea does not exceed 1 cm; biological glue can be used, otherwise a suture with an absorbable thread ( Vicryl type braided thread or PDS type monofilament ), if cartilage lesions (fracture, depression) The suture is made with absorbable braided thread with internal containment by a T tube of Montgomery for at least 2 months. If there is a loss of substance, different processes have been described for mucosal defects, a local plasty is performed but when the loss of substance is more significant, composite grafts, mucosa, and septal cartilage are used with systematic calibration by Montgomery tube or else as an alternative, the Friedman flap is used if the loss of substance is anterior or exceeds 30% of the tracheal circumference. In the absence of sufficient cartilaginous reinforcement, an anastomotic resection is carried out and if this is impossible (more than four rings or more than 6 cm of loss of substance), techniques for lowering the larynx can be used: the Dedo process which aims to free the larynx from the hyoid bone or the Lacourreye process which is less damaging and consists of freeing the posterior face of the sternocleidohyoid muscle as perfectly as possible, associating it with tracheal release. These techniques, which aim to lower the proximal end of the trachea, can be supplemented by freeing the distal end of the trachea by careful dissection. However, if the loss of substance cannot be filled, it is possible to prepare a two-stage repair, using a muscular flap of the sternohyoid muscle before the installation of a cartilaginous framework obtained by chondrocyte culture or by synthetic material. [18,19]

In our series of cases, we opted for conservative treatment as the first option, unless the clinical picture deteriorated, especially in cases of subcutaneous emphysema or a penetrating wound. In such cases, surgical exploration or tracheal repair may be necessary, The technique of direct suture of the breach with placement of a pedicled muscular patch of the subhyoid muscles yielded good postoperative results without morbidity.

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#### 4. Conclusion

Tracheal injuries are rare but potentially serious and can cause significant sequelae in terms of morbidity and mortality. Early diagnosis is necessary for optimal management to prevent complications, in the face of any suspicion of tracheal lesion, especially in the face of subcutaneous emphysema and cervical pain, an exploration must be carried out as quickly as possible. The gold standard for diagnosis is bronchoscopy. Conservative management is recently considered the best therapeutic choice which also allows the morbidity of surgical treatment to be avoided.

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#### Compliance with ethical standards

##### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

##### *Statement of ethical approval*

Our institution does not require ethical approval for reporting individual cases or case series

##### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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