Disorders of the Trachea in Horses

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Introduction
Primary tracheal diseases in horses are rare. Tracheal diseases mostly occur secondary to trauma or injury and produce airway obstruction. Injuries of the mucosal membrane of the trachea with an air leakage lead to regional or generalized subcutaneous emphysema (Fig. 1) including a subcutaneous, non-painful swelling which is easily indented, mobile, and crackling [1].

Figure 1. Subcutaneous emphysema (indented, mobile, crackling) after tracheal penetration. (see Fig. 2). - To view this image in full size go to the IVIS website at www.ivis.org.

To prevent this type of subcutaneous emphysema, open wound healing might be recommended in such cases. Obstruction to airflow may be caused by intraluminal space, occupying lesions, tracheal ring deformity, or peritracheal compressive lesions. The diagnosis of tracheal diseases is based on a complete clinical examination, endoscopy and radiography [2]. Additionally a computer-radiography could be helpful to detect tracheal disorders in the cervical part of the trachea. In the treatment of tracheal stenosis, numerous surgical procedures have been reported, including tracheal resection and anastomosis, extraluminal prostheses and multiple tracheal ring chondrotomies [3-8].

Tracheal Traumata
Tracheal traumas range from small puncture wounds to complete tracheal rupture [6,9] and can be induced by external injuries with or without disruption of the skin or by an internal insult, i.e., caused by foreign bodies. A special kind of trauma is the "contre coup" phenomenon, which occurs when a blow with a blunt object, i.e., a hoof on the ventral tracheal side, leads to a sudden and severe compression of the tracheal rings. In these cases the tip of the dorsal ends of the tracheal rings perforates the fibroelastic membrane in the airway (Fig. 2). In such a blunt-object injury, the diagnosis of tracheal trauma may not be recognized until subcutaneous emphysema develops. Small tears can be treated conservatively while large tears should be managed surgically [2,6,10].

Figure 2. Perforation of the dorsal fibroelastic membrane by dorsal ends of tracheal rings ("contre coup" phenomenon) (a), scheme of tracheal transverse section (b). - To view this image in full size go to the IVIS website at www.ivis.org.

Tracheal Granulomas
Spike-shaped granulomatous nodules are occasionally observed in the proximal tracheal lumen near the larynx (Fig. 3). The etiology of these spikes is unknown and they are usually not associated with clinical signs. The most common cause of tracheal airflow obstruction is tracheal stenosis after laryngoo- and tracheotomy [11,12]. The stenotic area may result from
granuloma formation within the tracheal lumen (Fig. 4) or tracheal ring collapse following loss of ventral support [12,13].

Transendoscopic neomydium-YAG laser surgery has been used to remove intraluminal granulomas [14]. Also granulomas can be removed transendoscopically using an electrosurgical wiresnare (Fig. 5). Tracheal penetration after laryngoplastic surgery requires the removal of the laryngeal prosthesis, which is possible with transendoscopic scissors, wiresnares and grasping forceps (Fig. 6).

Tracheal Collapse and Malformation
Congenital tracheal collapse has been described in horses, miniature horses and ponies (Fig. 7) [15-21], while tracheal collapse in large animals occurs most commonly as a result of direct trauma. Also a dynamic tracheal collapse is possible [16]. The cranial and midcervical portions of the trachea are the most susceptible areas, owing to their superficial location [16-18]. Tracheal collapse can critically limit athletic function by increasing airway impedance and turbulence, thereby increasing the effort of breathing [16]. Rigidity of the trachea is provided by hyaline cartilage rings, which are incomplete dorsally. The dorsal surface of the trachea is bridged by connective tissue and the trachealis muscle. Tracheal cartilage prevents collapse during inhalation when tracheal luminal pressure is lower than atmospheric pressure. Because the tracheal rings are incomplete dorsally, loss of ventral support results in overriding of the dorsal tips and resultant loss of airway diameter. Lateral radiographs show a narrow tracheal outline (Fig. 8).

Treatment of tracheal collapse depends on etiologic factors, the length of the trachea involved, and the accessibility of the affected tracheal segment [3]. Treatment options include complete replacement with prosthesis, placement of external prosthesis to stent collapsed rings, plication of the trachealis muscle, and tracheal resection and anastomosis [4,5,22,23]. In addition, chondrotomy allows remodeling of deformed tracheal rings, which can then be anchored to an extraluminal prosthesis.
Tracheal Foreign Bodies
Horses may occasionally inhale foreign objects that lodge in the trachea. Signs include a chronic cough, inspiratory dyspnea, audible stridor that can be localized to the trachea, extension of the head and neck, and salivation [24]. Other signs that can develop are fetid breath, intermittent bilateral purulent nasal discharge, epistaxis, hemoptysis and reduced exercise tolerance. Signs of severe pneumonia may also be evident [25].
Endoscopy and radiology are important aids to diagnosis. Foreign bodies often lodge near the tracheal bifurcation [24] and examination of this area in warmblood horses requires an endoscope longer than 130 cm. Some smaller objects may be retrieved by a wiresnare or grasping forceps passed through an endoscope in standing horses after suppression of the cough reflex by topical instillation of local anaesthetic (Fig. 9). Other foreign bodies may require tracheotomy. A complete recovery can be expected following successful removal of a tracheobronchial foreign body.

Tracheal Neoplasias
Tumors of the trachea are rare in mammals. A round-cell sarcoma has been described in the trachea of a 6 year old gelding as well as tracheal mastocytosis in a 21 year old gelding [26]. Figure 10 shows a rhabdomyoma extending from the trachealis muscle in the dorsal tracheal membrane. Clinical signs were severe respiratory noise at rest and complete exercise intolerance. The diagnosis was supported by radiography and computer radiography (Fig. 10), and treatment was performed under general anesthesia in dorsal recumbency (Fig. 11). After resection of the ventral part of two tracheal rings, the tumor was removed and the wound was closed with absorbable suture material. The horse developed a moderate subcutaneous emphysema of two weeks' duration. Six months after surgery no more respiratory noise was detectable (Fig. 12).

Tracheal Necrosis
Tracheal necrosis has been described following endotracheal intubation with ischemic necrosis of the mucosa and submucosa (Fig. 13), due to overinflation of endotracheal tube cuffs or disinfecting agents [27-29]. Although many of these lesions resolve without untoward sequelae, the disruption of the tracheal epithelium can cause rapid production of granulation and epithelial tissues, which may form a circumferential fibrous obstruction to airflow (Fig. 14).
External Compression of the Trachea

Tracheal stenosis caused by external compression of a space-occupying mass is also accompanied by respiratory stridor [30]. Contrary to the physiologic left-sided compression by the heart near the tracheal bifurcation (Fig. 15), a peritracheal abscess (Fig. 16), abscesses in the peritracheal mediastinal lymph nodes (Fig. 17) [21,30,31], lipomas [3], mediastinal masses and tumors (Fig. 18) and an esophageal diverticule (Fig. 19) can cause tracheal compression at the thoracic inlet [30]. Drainage of the abscess may resolve the compression and result in a normal trachea [30]. In chronic cases, however, the tracheal deformity may persist after drainage of the abscess [12].

References