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Review Article

Hold your horses: A comparison of human laryngomalacia with analogous equine airway pathology

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ABSTRACT

Objectives: Laryngomalacia is the most common cause of stridor in infants. Dynamic airway collapse is also a well-recognised entity in horses and an important cause of surgical veterinary intervention. We compare the aetiology, clinical features and management of human laryngomalacia with equine dynamic airway collapse.
Methods: A structured review of the PubMed, the Ovid Medline and the Cochrane Collaboration databases (Cochrane Central Register of Controlled Trials, Cochrane Database of Systemic Reviews).
Results: There are numerous equine conditions that cause dynamic airway collapse defined specifically by the anatomical structures involved. Axial Deviation of the Aryepiglottic Folds (ADAF) is the condition most clinically analogous to laryngomalacia in humans, and is likewise most prevalent in the immature equine airway. Both conditions are managed either conservatively, or if symptoms require it, with surgical intervention. The operative procedures performed for ADAF and laryngomalacia are technically comparable.
Conclusion: Dynamic collapse of the equine larynx, especially ADAF, is clinically similar to human laryngomalacia, and both are treated in a similar fashion.

1. Introduction

The term laryngomalacia was coined in 1942 [1], and describes the inward collapse of supraglottic structures on inspiration. It is the most common cause of stridor in neonates and infants, accounting for between 45 and 75% of cases [2]. Late-onset laryngomalacia is also described in the literature and is reported to affect a subgroup of older children who present with exercise-induced airway symptoms.

In horses, dynamic airway collapse is a group of disorders that cause transient, usually exercise induced, obstruction of the equine pharynx, larynx or both. One condition in particular, Axial Deviation of the Aryepiglottic Folds (ADAF), has clinical symptoms and endoscopic findings analogous to human laryngomalacia. Dynamic airway collapse is a collection of upper respiratory tract (URT) disorders in horses. It is a well-recognised and researched entity, with clinical identification driven by Owners and Trainers investigating poor performance in competition horses characterised by inspiratory stridor and prolonged recovery times.

In this article, we compare and contrast the aetiology, clinical features and management of human laryngomalacia and equine dynamic airway collapse.

2. Methods

A structured review of the PubMed, the Ovid Medline and the Cochrane Collaboration databases (Cochrane Central Register of Controlled Trials, Cochrane Database of Systemic Reviews) was undertaken. In this review, we focus on the aetiology, diagnosis and management of human laryngomalacia and compare and contrast this with conditions accounting for equine dynamic airway collapse.

3. Results

3.1. Clinical features: human laryngomalacia

Symptoms develop within the first few weeks of life, the most common of which is inspiratory stridor that typically worsens with feeding and crying. Other associated symptoms include cough, choking, regurgitation, slow feeding and failure to thrive. Apnoea and cyanosis are symptoms of severe disease, and along with failure to thrive, are indications for surgical intervention. However, most infants have mild symptoms that can be managed conservatively until symptom resolution, typically by the age of 12–24 months.

The diagnosis is often clear on clinical history taking, especially

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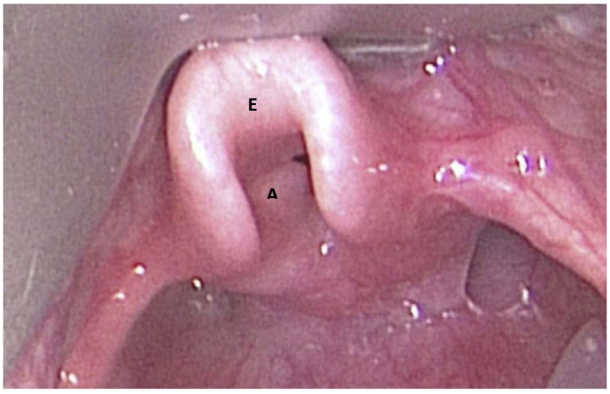

Fig. 1. An image taken during an airway endoscopy of a human paediatric patient with laryngomalacia. Anterior prolapse of bulky mucosa overlying the left arytenoid mucosa (A) and an elongated and tubular epiglottis (E) are characteristic features of laryngomalacia.

when other features that may suggest an alternative diagnosis (e.g. history of previous airway intubation) are absent, and can be confirmed by flexible laryngoscopy in an awake infant. Olney et al., 1999 categorised laryngomalacia into three types based upon the three characteristic anatomical abnormalities of the condition [3,4]. In type 1 laryngomalacia there is anterior prolapse of bulky and redundant mucosa overlying the arytenoid cartilages. Type 2 involves medial collapse of short aryepiglottic folds. Type 3 patients have an elongated and tubular epiglottis that collapses inward and posteriorly on inspiration. Fig. 1 demonstrates a human paediatric larynx affected by laryngomalacia.

Laryngomalacia has developed into a ubiquitous term used to describe a floppy-appearing larynx, regardless of the age of the patient. However, when the anatomical abnormalities of the condition are identified in older patients, the symptom complex is often different from that of patients with congenital laryngomalacia. Richter et al., 2008 reviewed a cohort of seventeen children diagnosed as having laryngomalacia when older than two years [5]. Patients with late-onset laryngomalacia were classified into three categories according to their symptom complex; those presenting with feeding-disordered laryngomalacia (n = 7; mean age at onset, 3.3 years), sleep-disordered laryngomalacia (n = 7; mean age at onset, 6.3 years), and exercise-induced laryngomalacia (n = 3; mean age at onset, 15 years). Stridor was rarely present except in patients with exercise-induced laryngomalacia during strenuous activity. Profound arytenoid redundancy and prolapse was discovered in all three groups during nasolaryngeal endoscopy, however in the case of exercise-induced laryngomalacia the features were only apparent on endoscopy during exercise treadmill testing with a normal laryngeal examination at rest. Laryngomalacia has also been identified in even older children (mean age 13 years) presenting with exertional dyspnoea as the main symptom [6].

3.2. Equine dynamic airway collapse

As in human laryngomalacia, dynamic airway collapse in horses is characterised by transient obstruction within the pharynx, larynx or both. Rigid endoscopy to examine the equine airway was first used in late 19th century Austria, but it wasn't until the advent of flexible fibreoptic endoscopy in the 1970's that airway endoscopy was widely adopted into equine clinical practice. Examination of the larynx during exercise on a high-speed treadmill has enabled the diagnosis of a range of disorders causing dynamic airway collapse in horses [7,8] (Table 1). More recently, high-speed exercise endoscopy has been replaced by overground endoscopy whereby an endoscope is attached to the tack of the horse and captures video images of the larynx and associated URT structures whilst the horse is undergoing ridden exercise, which is subsequently downloaded and analysed. This technique has been adopted to reduce musculoskeletal injury on treadmills and more closely mimic normal ridden exercise [9,10].

In a study of Thoroughbred racehorses (mean age 5.5 years) referred for investigation of poor performance, Lane et al. identified dynamic collapse within the nasopharynx and larynx in 471 of the 600 horses investigated. The most common cause was intermittent dorsal displacement of soft palate [DDSP], found as the sole abnormality in 177 horses and a contributing factor in further 60 [7].

Interestingly, arytenoid cartilage collapse shares characteristics with human type 1 laryngomalacia. Movement of the corniculate process of the arytenoid cartilage towards the midline during inspiration results in airway compromise akin to that in type 1 laryngomalcia. However, arytenoid cartilage collapse is invariably associated with ipsilateral vocal cord collapse, which is not a feature of type 1 laryngomalacia [7]. ADAF appears to be analogous to type 2 laryngomalacia due to exhibiting medial displacement and inspiratory collapse of the aryepiglottic folds. Retroversion of the epiglottis in horses is reported to be rare yet is similar to type 3 laryngomalacia in which there is inspiratory collapse of the epiglottis inwards and posteriorly.

Poor performance is a typical presentation of dynamic airway collapse in horses, with other features including abnormal upper respiratory noise during inspiration, coughing and dysphagia.

In comparison with human laryngomalacia, symptoms of breathlessness and noisy breathing worse on exertion (feeding in man, racing in horses) are thus similar, but there is a clear difference in the age groups affected. Human laryngomalacia predominanly affects infants, but in horses it is not the foals (horses aged under one year) that are affected, instead it is the older horses that are usually in the peak of their racing performance. Thus, equine airway obstruction may be more akin to late-onset laryngomalacia in man, particularly exercise-induced laryngomalacia.

Unlike human infant laryngomalacia that is easily diagnosed at rest, equine airway obstruction requires examination on exertion, again more akin to exercise-induced laryngomalacia in man. Other than idiopathic laryngeal hemiplegia (ILH), the conditions associated with dynamic airway collapse are only found on exercise visualisation of the equine larynx and are associated with support muscle fatigue.

3.3. Axial Deviation of the Aryepiglottic Folds (ADAF)

Axial Deviation of the Aryepiglottic Folds (ADAF) deserves further consideration and discussion as this appears to be the type of equine airway collapse that is the most similar to human laryngomalacia. As previously mentioned, equine retroversion of the epiglottis is also similar to laryngomalacia (specifically type 3) however it is rarely described in the literature hence we concentrate on ADAF as a comparison for human laryngomalacia. Like in laryngomalacia, immaturity is a known predisposing factor for this equine condition. ADAF is most prevalent in younger horses, most commonly in 2–3 year olds (horses are usually as considered an adult when aged 4 years and older). However, the condition sometimes occurs at an earlier age when training commences at 18 months in order to race as a 2 year old. In ADAF, there is axial deviation of the membranous portion of the aryepiglottic folds that extend between the corniculate process of the arytenoid cartilage and the lateral edge of the epiglottis [11].

Similar to laryngomalacia (specifically type 2) there is medial displacement and inward collapse of the aryepiglottic folds. The degree of deviation of the equine aryepiglottic folds varies with and is exacerbated by inspiration and during strenuous exercise, again displaying similarities to laryngomalacia where there is a worsening of symptoms with the effort of feeding in younger children and exercise in those with late-onset laryngomalacia. Unlike in laryngomalacia however, ADAF is not specifically characterised by redundant mucosa overlying the arytenoid cartilages, but redundant mucosa is known to