Endoscopy in the Equine

Lawrence Daniels*

DEVICES

In the late 1600's, Christian Huggins evolved the wave theory of light, which gives an explanation of the laws of reflection and refraction, or bending. [1] These theories have been put to use to implement the physical transmission of light through glass fibers, which depends on internal reflection. The first practical application and patent of an instrument transmitting light through glass fiber bundles occurred in England in 1928. Since then, a wide range of instrumentation has evolved for endoscopy, the visualization of internal anatomical structures through natural or surgically acquired body orifices.

Endoscopic equipment can be categorized as hollow or fiberoptic, rigid or flexible, proximally or distally lighted, and hot or cold light endoscopes. Combinations of categories are available such as hollow, rigid, distal hot, light, or rigid, fiberoptic, preoximal cold light. Discussion will deal principally with the flexible, fiberoptic, proximal cold light endoscope, due to its inherent advantages for use in the equine upper respiratory tract.

The flexible fiberoptic endoscope is much superior to rigid endoscopes because of the advantages of flexibility and the disadvantages of rigidity. All fiberoptic scopes, rigid or flexible, have a proximal cold light source, the light bulb being located in a power source box removed from the viewing window-control head. A fiberoptic umbilical cord transmits light from the light bulb to the viewing window-control head via internal reflection through flexible bundles of noncoherent glass fibers and, by the same principle, from here on to the distal tip. A rather short umbilical cord (approximately 155 cm) is recommended because light is lost in direct proportion to the length of the fibers. Portability is therefore sacrificed for light conservation. The image is then transmitted back up the scope from the distal tip through a separate set of coherent glass fibers to the viewing window.

*Mr. Daniels is a fourth year student in the College of Veterinary Medicine, ISU.

The greatest advantages of the flexible firberoptic endoscope are its versatility, both in its range of application and field of visual capacity, and its safety to both patient and operator of the scope. The standard medical esophago-fiberscope, model E F Olympus, has a working length of 66.5 cms. and a maximum external diameter of 12.6 mm. The cone of vision is 60 degrees forward viewing and the angle of the distal bending section can be moved in one plane with a range over 180 degrees. In the horse and cow, this model may be used for exam of the nasal passages, pharnyx, gutteral pouches in the equine, larynx, esophagus and trachea down to the thoracic inlet, rectum, uterus, vagina, female bladder, and peritoneal cavity, all without significant iatrogenic trauma. The Olympus Gastro-intestincal Fiberscope, model GIF, type P (pediatric), has a wide, safe range of visual diagnostic applicability in a wide range of species, including small animals. This points out that a single fiberscope can be very useful in both large and small animals seen in a mixed practice.

In addition to its aforementioned capabilities, flexible fiberscopes have other advantages. The most useful is a water-jet flushing system of the distal tip to clear away mucous, exudate, etc., which prevents fogging of the image. An air pump to dry and blow debris away from the distal tip, as well as for insufflation of a hollow organ or cavity, is also very useful. Less essential options include suction, biopsy, cytology brush, cautery, snares, and photography. Some scopes have a dual purpose 3 mm diameter channel which extends the length of the tube. When the control box is connected to a vacuum pump, suction can be applied to internal cavities. This channel also allows the passage and utilization of various instruments such as flexible biopsy forceps, cytology brushes, diathermy wires, probes, swabs, guides, and catheters, thus increasing the potential for diagnosis and treatment.

Several of the flexible fiberscopes on the market work well on horses. They vary in size, price and capabilities. Flexible fiberscopes having an outside diameter of about 13 mm, a working length of 105-110 cm, and a forward viewing field of 75-80 degrees are best suited for equine use. Although two-way movement of the distal tip is adequate, four-way movement with a total deflection of 360 degrees is ideal. Movement of the distal tip is accomplished by small diameter cables which run from the control head to the distal tip of the working length.

The purchase of a used flexible fiberscope can result in considerable savings to the equine practitioner. The major factor to evaluate before purchase is the number of broken glass fibers in both the coherent and non-coherent bundles. Black dots in the viewing field represent broken fibers and can be accentuated by viewing a white sheet of paper. An acceptable percentage of broken fibers is hard to evaluate since a scope with an outside diameter of 12.5 mm may contain 20,000 fibers. Breakage of fibers is probably due to useage and not abuse if black dots are scattered throughout the field, whereas black dots in a line across the center of the field could indicate excessive bending at one point, or misuse.

Because the flexible glass bundles are susceptible to breakage and are expensive to replace, flexible fiberscopes require more care and maintenance than do rigid endoscopes. They should be used at or warmed to room temperature. The distal tip should not be bent as acutely as allowed by the controls unless absolutely necessary for an exam. Swinging of the working lengths should be avoided to preserve the glass bundles.

The flexible fiberscope should be cleaned by sponging with a providone iodine soap and water solution, not by immersion, to prevent the fiber bundles and cables moving the distal tip from getting wet due to leaky seals. All orifices should be flushed, cleaned, and dried immediately after use to prevent fogging. Drying is especially important since liquid might penetrate the seals, collect on the fiber bundles resulting in reduced light and image transmission, or corrode the cables. If sterilization is required, it can be done by ethylene oxide gas sterilization or, more quickly, by swabbing the outside sheath twice and flushing the inside channel twice with a 0.1% benzalkonium chloride solution, followed by rinsing each surface with sterile water.

The best method of storage is to suspend the fiberscope by the viewing head at room temperature in a relatively dust-free, limited-traffic room. The next best place for storage is in the manufacturer's padded case.

USES

The equine has evolved speed as a defense mechanism. Speed requires a natural airway which allows movement of great volumes of air during exertion. The larynx serves as a valve which can allow movement of large volumes of air, as well as divert food and water to the esophagus. The arytenoids, pharynx, anterior turbinates and nostrils are capable of a large degree of dilation to allow passage of large volumes of air. Any pathological process which interferes with normal air flow is a potential impairment of the horse's soundness for use and is a common cause of decreased work tolerance. Because the presenting signs are many and varied, endoscopy is an essential part of a complete diagnostic work-up when confronted with clinical signs of upper respiratory disease. Diagnosis is thus based on history, physical exam, functional exam, and endoscopic exam.

Obstructions of the airway are divided anatomically by means of history and external exam at rest and at work into the following: 1.) pre-pharyngeal, in which case endoscopic exam is more difficult and less conclusive, and 2.) pharyngeal, post-pharyngeal.[2] Pre-pharyngeal obstructions may be differentiated by audible characteristics at work. If false nostrils are present, one might expect a loud, expiratory snorting flutter. Nares and turbinate obstructions have a biphasic, less stridorous sound because the lesion is consistently present and mechanically interferes with air passage.

In the preliminary physical exam, airflow through each nostril should be compared after exercise, each nostril occluded separately by hand. Asymmetrical airflow indicates a pre-pharyngeal lesion; obstructive lesions of the nasopharynx, pharynx, and adjacent structures do not cause asymmetrical airflow. Passage of a stomach tube may also provide location of a lesion. If it can only be passed up one nostril, or if the tube strikes an object, a lesion could be present provided the tube is positively in the ventral meatus.

The upper respiratory exam with a flexible fiberoptic endoscope can be easily performed in the conscious patient. Initially, the horse's temperment should be evaluated. If the horse will stand for a stomach tube, he will stand for passage of the fiberscope. The exam should be performed in well constructed stocks with a padded floor to protect the horse and the endoscope. With horses that accept a stomach tube, two assistants are required, one to hold the head and the other to handle the twitch. If the horse is fractious, he should be "rompunized" or put down under general anesthesia. Rompun works very well in conjunction with a padded crutch used to hold up the head.[3] Since the first ten centimeters of the nasal passages are the most sensitive, initial entrance of the fiberscope is usually when a horse will object the most. If necessary, sensation in this area may be alleviated by application of a topical anesthetic.

The size of the horse's head should be compared with the length of the endoscope to predetermine positioning of the distal tip to facilitate location of specific anatomical structures. For instance, the distance from the gutteral pouch orifice to the external nares can be gauged by measuring the external distance from the medial canthus of the eye, along the side of the head, to the external nares. This distance corresponds to the internal distance from the external nares to the gutteral pouch orifice. The next step is to set the angle control to "free" to provide minimal discomfort to the horse and greater flexibility. The operator then passes the working length, much as one passes a stomach tube. The first ten centimeters are passed rapidly, securing the working length in the ventral meatus with the left hand. If the distal tip strikes a firm obstruction, is is most likely the ethmoid turbinate. If that happens, the tip should be withdrawn slightly and re-directed ventrally since trauma to the highly vascular ethmoid turbinate can cause severe epistaxis.

Several of the common pathologies of the upper respiratory tract presenting signs of obstruction, epistaxis, or nasal discharge are easily diagnosed with the fiberoptic endoscope. Rhinitis, nasal polyps, fracture or neoplasia of the nasal septum or turbinates, rhinitis or sinusitis secondary to alveolar periostitis, and progressive hematoma of the ethmoid turbinate are readily diagnosed endoscopically. Rhinitis secondary to respiratory viral infection is characterized by adhesive pseudomembranes of a cheese-like material deposited on the nasal septum or turbinates. Cases of nasal sinus infection must be differentiated from chronic bronchitis. Both present a chronic catarrhal bilateral nasal discharge. With chronic bronchitis, the discharge originates from the bronchial tree, is generally accompanied by pulmonary emphysema, and the mucus may be seen endoscopically in the ventral trachea, at the carina, or on the laryngeal face of the epiglottis. In cases of sinusitis, a catarrhal or purulent exudate may be seen on the ethmoid turbinate area draining from the superior maxillary sinus through the nasomaxillary duct orifice, just lateral to the ethmoid meatus. Progressive hematoma of the ethmoid region is a specific clinical entity seen as a thin-walled sac enclosing a hematoma invading the nasal cavity from its origin in the ethmoidal labyrinth. The horse usually presents signs of epistaxis and possibly obstruction.

The anatomical location and anatomical relationships of the gutteral pouches make any pathology in these compartments especially significant from a clinical standpoint. These relationships include cranial nerves 7, 9, 10, 11, mandibular nerve, cerebral cervical ganglion, internal maxillary artery, superficial temporal artery, internal and external carotid arteries, several veins, and the parotid and mandibular salivary glands (Figure 1).

Fig. 1. Normal anatomy in gutteral pouch. Cranial nerves (center) and external carotid artery (near right).

Gutteral pouch pathology that extends to include any of these relationships may present a complex set of clinical signs and a difficult diagnostic challenge, making endoscopic exam indispensible for a definitive diagnosis.

Although entrance into the gutteral pouch may be initially difficult, it can become a routine technique with practice. Entrance into the gutteral pouch can be accomplished by introducing the flexible scope to a point just rostral to the pharyngeal orifice of the pouch. The pharyngeal orifice can be recognized as a flap-like vertical slit in the lateral pharyngeal wall. A blunt-ended nylon rod is then passed into the orifice, using the fiberscope for visual direction in its placement. The fiberscope is then threaded into the orifice, using the rod as a guide. If the horse swallows, passage into the pharyngeal orifice is much easier, since the orifice is open during swallowing. If the passage into the pharyngeal orifice is too difficult with this technique, another technique may be used. In this technique, the endoscope is withdrawn and passed down the opposite nostril. A Chamber's mare catheter can then be passed up the original nostril and be manipulated into the pharyngeal orifice, using the endoscope as a visual guide. The endoscope can then be withdrawn and passed down the same side as the catheter and slipped into the orifice alongside the catheter.

The most common lesion of the gutteral pouch is empyema. Stenosis of the caudal end of the vestibule in the pharyngeal orifice has been associated with this condition. Presenting signs are swelling in the area of the pouch, anorexia, nasal discharge, and dyspnea. Pressure applied to the glossopharyngeal and hypoglossal nerves as a result of empyema may result in partial pharyngeal paralysis, which can be recognized clinically as the regurgitation of food and water from the nostrils. Chronic infection of the gutteral pouch may produce facial paralysis, epistaxis, purulent exudate, and parotid pain. A sequela to empyema may be chondroids, which can also be diagnosed endoscopically.

Mycosis of the gutteral pouch may present signs of spontaneous epistaxis, abnormal head posture, sweating, transient colic, nasal discharge, regurgitation of food and water through the nostrils, depression and weight loss. Diphtheritic plaques may be seen endoscopically and are usually on the dorsal

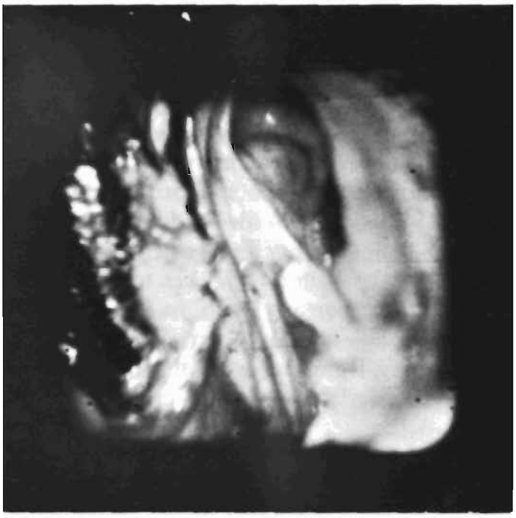

Fig. 2. Mycotic diphtheritc plaque (left) adjacent to cranial nerves (center).

wall of the medial compartment in the region of the petrous termporal bone (Figure 2). Mycotic infection of the gutteral pouch can have serious sequelae. It is the most common cause of pharyngeal paralysis as a result of interference with the pharyngeal nerve plexus, usually resulting in dysphagia. It may also cause fatal epistaxis.

The soft palate is subject to several pathologies which may be evaluated endoscopically. It may be dorsally displaced as a result of several etiologies, commonly including elongation, paresis or paralysis, and hypoplasia or deformity of the epiglottis resulting in a shortened axis. Repeated deglutition, the best evaluation of soft palate function, can be accomplished by introducing water through the fibroscope and then blowing air through the channel to clear it. The air and water contacts the epiglottis and stimulates deglutition. Elevation of the soft palate from its normal position ventral to the epiglottis can result in elevation of the epiglottis and, as a result, interference with airflow.

Elongated soft palate and entrapment of the epiglottis are two upper airway pathologies with no obvious symptoms useful in facilitating a differential diagnosis. Both conditions may present signs of inspiratory rattling, gurgling, or choking that increases with exercise, and respiratory distress. These conditions may be easily differentiated endoscopically, however. Elongation of the soft palate is recognized by the absence of the epiglottis, the soft palate being dorsal to it. Confirmed diagnosis of elongated soft palate requires three criteria: 1.) the soft palate must be dorsal to the epiglottis on several occasions 2.) the soft palate should be dorsal to the epiglottis after exercise and 3.) the soft palate should be dorsal to the epiglottis after the horse has made several attempts to swallow.[4] These criteria are required since elongation may be relative or absolute. In cases of entrapment of the epiglottis due to dorsal displacement of the aryepiglottic fold, endoscopic exam may reveal an epiglottis that appears to be chronically enlarged and hyperemic, with a loss of the normal vascular pattern of the epiglottis. Loss of normal vascular pattern is the result of the fold covering the epiglottis (Figure 3). Ulceration of the fold or epiglottis may occur. The abnormal fold gives the lateral edges of the apex of the epiglottis a rounded and bordered effect with a sharp caudomedial demarcation between the aryepiglottic fold and the laryngeal surface of the epiglottis. Because the caudomedial aspect of the fold may not be adherent to the laryngeal border of the epiglottis, it may be seen to flutter during expiration. The pathology involved consists of the dorsal displacement of a loose fold of mucosa from the oral surface of the epiglottis, which is a direct ventral-rostral continuation of the normal aryepiglottic fold.

Congenital cleft soft palate is the most probable cause of a bilateral nasal discharge of milk and food material and coughing during deglutition in the foal. Cleft palate usually affects only the caudal one-half of the soft palate and should therefore be confirmed by endoscopy under anesthesia. The differential diagnosis is megaesophagus, which may be confirmed by esophagoscopy.

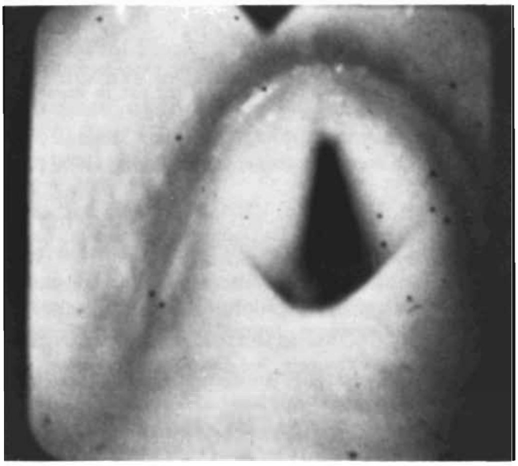

Fig. 3. Entrapment of the epiglottis. Arytenoids normally symmetrical. Sharp caudomedial demarcation between the aryepiglottic fold and the laryngeal surface of the epiglottis.

Obstruction of the pharynx as a result of narrowing of the airway results from pharyngeal paralysis, which causes flaccidity of the pharyngeal walls. This condition is best observed by endoscopy, where one may see collapse of the pharyngeal walls during the inspiratory phase of vigorous respiration, a dorsal displacement of the soft palate, and food material on the nasopharyngeal surface of the soft palate.

The single most common cause of airway obstruction diagnosed with the fiberoptic endoscope is probably pharyngeal lymphoid hyperplasia (follicular hyperplasia, chronic pharyngitis). In this condition, the normal submucosal lymphoid tissue of the pharynx proliferates and becomes hyperplastic as a result of the combined chronic effects of training, stabling, and exposure to respiratory pathogens, especially viruses. It is seen especially in yearlings and two-year-olds in training and may be accompanied by a coughing or choking-up syndrome during racing. These hyperplastic follicles cause the covering pharyngeal mucosa to extend downward to give the dorsal pharynx a cobblestone

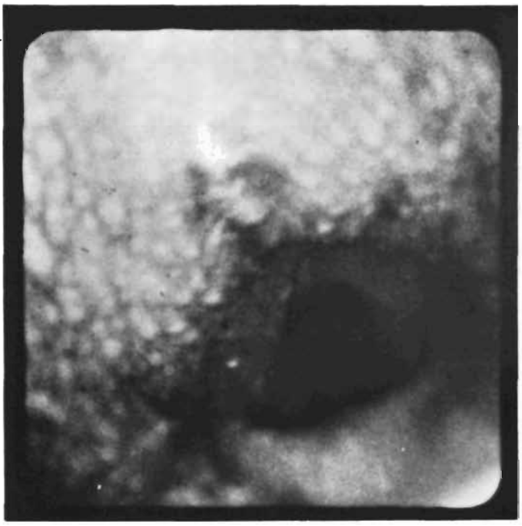

Fig. 4. Chronic pharyngitis. Hyperplastic lymphoid follicles lining the dorsal pharynx.

appearance, if mild, to the appearance of severe acne if acutely inflamed (Figure 4). This appearance is the result of hyperemic, densely populated follicles that may be exuding a mucopurulent exudate.

Clinical signs presented in horses affected with laryngeal paralysis, or roars, are characterized by a whistling or roaring sound heard on inspiration when the horse is breathing deeply from exercise. Due to impaired function of one or both recurrent laryngeal nerves, the intrinsic laryngeal muscles can't draw the arytenoid cartilage(s) and vocal cord(s) laterally during inspiration (Figure 5). On inspiration, therefore, these structures are passively drawn medially and vibrate as air passes to produce the whistling sound.

In cases of serious left laryngeal hemiplegia, the diagnosis made in 92% of the diagnosed cases of roars, the endoscopic exam performed at rest reveals a collapsed left arytenoid cartilage, resulting in asymmetrical arytenoids, and a slackened vocal fold on the left side.[5] The dorsal aspect of the left arytnoid is rotated anteriorly and medially. The left laryngeal saccule, if intact, may be dilated ventral to the aryttenoid. In less advanced cases, the vocal fold will be slackened and a slightly collapsed left laryngeal cartilage may be seen.

Deep inspiration with full laryngeal abduction follows deglutiton in the normal horse. Induction of the swallowing reflex under endoscopic observation is therefore an effective means of evaluating laryngeal function. An endoscopic exam performed at rest should reveal the arytnoids in a median position between abduction and adduction in the normal horse. After exercise, the paired arytenoids should be fully abducted. Clamping the nostrils shut with a hand simulates exercise as the horse attempts to inspire. While air is being withheld, fully functional arytenoids abduct, giving full view to the vocal cords and openings of the laryngeal saccules. When full access to air is allowed, arytenoid movement is accentuated, making their range of motion more apparent.

Fig. 5. Laryngeal hemiplegia. Assymetrical arytenoid cartilages indicative of roars.

This article has been intended as an introduction to the fiberoptic endoscope and its utilization as an aid to diagnosis of some common pathologies of the equine upper respiratory tract. It is not intended to be a complete evaluation of all upper respiratory tract pathologies. The flexible fiberoptic endoscope has other applications not discussed, such as evaluation of the equine female reproduction and urinary tracts, anterior and posterior segments of the digestive tract, and laparoscopy. It is becoming an indispensable diagnostic aid to practice competent, professional equine medicine. The author wishes to sincerely thank Richard A. Mansmann, VMD, PhD, Goleta, California, and the Upjohn Company for the use of photos.

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