Standing Surgery: The Equine Head

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Abstract

Only 10-15 years ago, most surgeries on the head were performed with the horse under general anesthesia. This frequently required inhalant anesthesia due to the long duration of the procedures and possible associated complications. Nowadays, most surgeries on the head and upper neck, including upper airway surgeries, are performed in standing sedated horses and several of them can be done in the field. Case selection as well as knowledge of the relevant anatomy, appropriate diagnostic techniques and correct surgical management are important for successful case management.

Anatomy of the Paranasal Sinuses and Associated Soft Tissue Structures

Understanding the complex anatomy of the head is required to identify, pinpoint, and treat diseases that can develop in this part of the body.

There are seven, paired *paranasal sinuses* in the horse: frontal; caudal and rostral maxillary; dorsal, ventral, and middle conchal and the sphenopalatine sinus. The frontal and dorsal conchal sinuses are continuous and referred to as the conchofrontal sinus. The dorsal and ventral nasal conchal bullae are located within the rostral aspect of the dorsal and ventral conchae. They do not communicate with the paranasal sinuses but can become diseased in cases of chronic infection of the closely associated sinuses. The apices of the 109/209, and occasionally 108/208

teeth, form part of the floor of the rostral maxillary sinuses, while 110/210 and 111/211 extend into the caudal maxillary sinuses.

Knowledge of the course of the *facial (CN VII)* and *trigeminal nerve (CN V)* is particularly important when doing surgery on the head. The clinically most important branches of the trigeminal nerve are the infraorbital nerve (the rostral continuation of the maxillary nerve) and the inferior alveolar nerve (a branch of the mandibular nerve). The infraorbital nerve runs through the infraorbital canal and enters the face through the infraorbital foramen. It provides sensory innervation to the upper teeth, lips, nostrils, and nasal vestibule. The inferior alveolar *nerve* enters the mandibular canal on the inside of the mandible and exits via the mental foramen. It provides sensory innervation to lower teeth, lip, and chin. The *facial nerve* is the main motor nerve for the superficial muscles of the head and responsible for facial expressions. The nerve crosses the border of the ramus of the mandible 3.5 - 4 cm ventral to the temporo-mandibular joint and enters the face. Its buccal branches continue their rostral path subcutaneously and can be seen on the surface of the masseter muscle in thin-skinned horses. Facial and infraorbital nerve are the most encountered or damaged nerves during surgery of the head. The buccal branches of the facial nerve can be affected by disease, trauma, or by iatrogenic damage during tooth extractions or prolonged lateral recumbency. The infraorbital nerve can be affected by disease of the sinuses or by iatrogenic trauma during trephination and other surgical procedures involving the sinuses. When opening a sinus, iatrogenic damage to the infraorbital nerve is avoided by staying about 1 cm ventral to a line drawn between the medial canthus of the eye and the infraorbital foramen. This line does not only predict the course of the infraorbital canal, but also that of the *nasolacrimal duct*, which should also be avoided.

The *parotid salivary duct* has of be avoided when completing a buccotomy or laceration repair. Various branches of the external jugular vein and the common carotid artery may be encountered during surgical procedures of the head and damage to these vessels can result in significant hemorrhage.

Sinus Surgery

Trephination, sinus centesis and endoscopic exploration are useful field techniques to diagnose and treat sinus disease in horses. They can be completed in the standing horse with appropriate sedation and subcutaneous local anesthesia. In addition to basic surgical equipment, only a trephine (Galt or Michelle trephine of at least $\frac{1}{2}$ inch in diameter) and an endoscope (≤ 15 mm in diameter) are required.

The conchofrontal (CFS), caudal maxillary (CMS), and rostral maxillary sinuses (RMS) are the sinus compartments that can directly be accessed via trephination or centesis. Trephination of the CFS is easiest and allows excellent access to the CFS and, via the frontomaxillary opening, the CMS. The approach is made in line with the medial canthi of the eyes and approximately 5 cm from midline. In a 450 kg horse, this will place the portal directly over the frontomaxillary opening. In addition to excellent diagnostic access to the CFS and CMS, the RMS can also be entered after the caudal outpouching of the ventral conchal sinus has been fenestrated. Consequently, CFS trephination is recommended for general sinoscopic explorations. However, access to the RMS is limited and not sufficient to lavage or treat a disease process in this sinus. The CMS is trephined 2 cm rostral and 2 cm ventral to the medial canthus of the eye.

provides limited utility in young horses because of the long reserve crowns of the cheek teeth that reside in the maxillary sinuses.

Trephination of the RMS in mature horses should be performed at a location 40% of the distance from the rostral end of the facial crest to the medial canthus of the eye and 1 cm ventral to the line joining the medial canthus and the infraorbital foramen. In horses younger than 6 years, it is recommended to use radiographic guidance for the procedure, because of the increased risk of inadvertent damage to underlying tooth roots. A lateral radiograph with a radiopaque marker can ensure that the trephination will open the RMS, while a dorsoventral view provides information about the distance of the teeth from the overlying maxilla. However, examination of the RMS in young horses can be very unrewarding, since most of the sinus is occupied by the reserve crowns of the cheek teeth.

Once the site for trephination or centesis (completed in the same locations) has been identified, the site is blocked, clipped, and sterilely prepared. For trephination, a curvilinear incision large enough to accommodate a ¹/₂ - ³/₄ inch Galt trephine is created in the skin and underlying periosteum. The periosteum is elevated and a Galt trephine or a Michele trephine is used to access the sinus. The bony disk is discarded. If only a fluid sample is obtained from the sinus (centesis), a small skin incision is made before a 3-4 mm Steinman pin is used to penetrate the bone and allow fluid sampling with a 14-gauge catheter or needle. For placement of a lavage catheter (18-20 French Foley catheter), a larger opening must be created. Once the procedure is complete, closure of the skin can be accomplished with staples or nonabsorbable sutures in a simple interrupted pattern.

Soft Tissue Lacerations

Lacerations of the lips, cheeks and tongue are frequently caused by sharp external objects, the bit or blows to the head. They can also be the result of iatrogenic damage during intraoral procedures or occur when horses recover from general anesthesia. Minor injuries to the lips and cheeks can heal satisfactorily without surgery. More severe lacerations, including full thickness defects, require surgery to restore function or avoid unacceptable cosmetic outcome.

Tongue Laceration Repair

The tongue is a muscular organ that occupies the greater part of the oral cavity and consists of the intrinsic striated *lingual muscle proper*. It is anchored to the mandible and divided into three main anatomical regions: the root, the body, and the apex. The root, the posterior part of the tongue, begins at the palatoglossal arch, the anatomical border between the oral cavity and the oropharynx, and continues rostrally into the dorsoventrally thick body. The spatula-shaped apex is freely moveable and only its caudal aspect is connected to the floor of the oral cavity via the lingual frenulum. Blood supply comes from the lingual artery, a branch of the linguofacial trunk. The hypoglossal nerve (CN XII) is the sole motor nerve to the tongue.

Lacerations most commonly affect the apex, the most exposed part of the tongue, and transverse lacerations are more often found than longitudinal ones. The clinical signs vary with the degree of tissue damage and include oral hemorrhage, ptyalism, inappetence, dysphagia, halitosis and tongue protrusion. The severity of the trauma also dictates, in combination with duration and location of the injury, possible treatment options: partial glossectomy, primary closure of the wound or healing by second intention. Surgical procedures can be carried out in the standing, sedated horse with the help of local analgesia or under general anesthesia.

Partial glossectomy is required in cases of apical tongue trauma, where the lacerated part of the tongue is mostly separated and tissue temperature and/or lack of hemorrhage from the incision suggest that the tissue is not viable. Following amputation, the stump is debrided and closed (mucosa-to-mucosa) if possible. *Primary closure* of a tongue laceration is recommended whenever possible. After thorough debridement and cleaning of the wound, the defect is closed in up to three layers (full-thickness, muscle, mucosa). *Healing by second intention* can be considered for small lacerations and might be the only option in older wounds or in cases where the owner cannot afford surgery. During the healing process, the horse's ability to eat and drink has to be closely monitored.

Following primary closure of a tongue laceration, horses are typically able to eat normally. The same can be expected in cases where a small part of the tongue had to be removed. However, a horse that has lost most of the lingual apex might need several days to adjust to the altered anatomy and learn how to drink, masticate, and swallow. During this time, intermittent feeding and administration of water via a nasogastric tube might be required. Generally, soaked pellets or wetted hay should be offered in the days following tongue laceration repair.

Lip Laceration Repair

Small lacerations of the lips can be managed conservatively, but larger defects require primary closure to preserve lip function (selection and prehension of food) and cosmetic appearance. Delayed repair might be indicated in cases where viability of the wound edges is questionable. Surgical repair can be completed in the sedated horse with the help of local analgesia. Following debridement and lavage, the laceration is prepared for a multi-layer closure that minimizes the risk of dehiscence in this highly mobile tissue. Skin and oral mucosa are sharply

undermined for 1 - 1.5 cm before large, vertical mattress sutures are placed through the skin and lip musculature without penetrating the oral mucosa. Skin and mucosa are closed in a simple interrupted pattern or a vertical mattress pattern (skin). The main complication following surgical repair is wound dehiscence, which is particularly likely to occur in horses that rub the surgery site.

Cheek Laceration Repair

Partial thickness cheek lacerations can be closed or left to heal by second intention, while fullthickness lacerations should be closed to avoid the formation of orocutaneous fistulas. However, large transmural defects that cannot be closed primarily may heal well by second intention. While the defect is healing it is important to prevent loss of water and nutrients by keeping the wound bandaged.

Tracheotomy and Temporary Tracheostomy

Tracheotomy is best performed in the standing horse, at the junction of the upper and middle thirds of the neck where the trachea is located superficially. The horse is sedated, ideally placed in stocks, and the surgical site prepared for aseptic intervention. Before an incision is made, local anesthetic is injected subcutaneously on ventral midline and into the paired sternothyrohyoideus muscles. Now, a 10-cm incision is made through the skin, subcutaneous tissue and cutaneus colli muscle. The paired sternothyrohyoideus muscle bellies are bluntly divided along the ventral midline for about 8 cm and held in a retracted position. The tracheal rings are now easily palpable. A transverse tracheotomy is recommended in horses: using a scalpel, the annular ligament between two adjacent cartilage rings is incised parallel to the orientation of the rings. This technique prevents postsurgical tracheal collapse and intraluminal granulation tissue formation. The incision between the rings is lengthened to allow placement of a tracheostomy tube but should not exceed 50% of the tracheal circumference.

A variety of tracheostomy tubes are manufactured and can be used to maintain a temporary tracheostomy. Self-retaining metal tubes do not require suturing for security and are easily removed and cleaned. Short, cuffed silicone tubes are usually tied around the neck and might be more comfortable for the horse. To avoid pressure erosions or necrosis of the tracheal mucosa, the cuff should not be inflated for prolonged periods of time. Any tracheostomy tube should be removed twice daily to allow for removal of the accumulated tracheal secretions from the tube and the tracheotomy site.

In emergency situations with near total upper airway obstruction, preparation of the surgery site and careful surgical dissection might not be possible. However, it is important to avoid damage to surrounding anatomical structures when approaching the trachea. Since tracheostomy tubes are often not available to maintain the opening in these situations, a segment of stomach tube, garden hose, or large plastic syringe casing with the tip removed can provide an airway until a better option is available.

The use of aseptic technique and limited soft tissue dissection reduce the risk of acute postoperative complications. However, this might not be feasible in an emergency. Accidental placement of the tube into the surrounding loose areolar tissue is easily recognized by the lack of airflow. Obstruction of the tube with mucous secretions is the most common problem in temporary tracheostomies. This can be avoided by cleaning or replacing the tube at least every 24 hours, preferably every 12 hours. Infection of the surgery site and subcutaneous emphysema are occasional complications. Damage to the cartilage rings, intraluminal granulation tissue formation and mucosal stricture are possible long-term complications and highlight that the described technique is not appropriate for the creation of a permanent stoma.

Take Home Points

- 1. Know your anatomy it might not be that difficult after all!
- 2. Sinusotomy and lavage are simple and effective diagnostic and treatment methods.
- 3. Conchofrontal trephination is a safe way to access the most relevant sinuses.
- 4. Sinoscopy is an interesting and (in the right cases) very effective diagnostic tool.
- 5. Soft tissue lacerations heal well, but closure in different layers is important to minimize complications.

References/Suggested Reading

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