Sinoscopic Treatment of Rostral Maxillary and Ventral Conchal Sinusitis in 60 Horses

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Objective—To evaluate the use of sinoscopy for detection and treatment of ventral conchal sinus (VCS) and/or rostral maxillary sinus (RMS) disease in horses.

Study Design—Case series

Animals—Horses (n = 60) with suspected paranasal sinus disease.

Methods—Horses were evaluated by sinoscopy through a conchofrontal sinus (CFS) portal with ventral conchal bulla (VCB) fenestration. Other endoscopic sinus approaches and adjunctive diagnostic tests; oral examination, computed tomography, radiography, scintigraphy and endoscopic examination of the upper portion of the respiratory tract were used in some horses.

Results—The CFS approach permitted adequate observation of the RMS and VCS in 53 horses (88%). Hemorrhage caused by VCB fenestration prevented examination of the RMS and/or VCS in 12 horses (21%). Observation of lesions was possible in all horses diagnosed with neoplasia, sinus cysts, and progressive ethmoidal hematomas. Endoscopy of the paranasal sinuses was useful diagnostically in 82% of horses with primary sinusitis. Other diagnostic modalities were usually required to confirm a diagnosis of dental sinusitis.

Conclusions—Trephination into the CFS with VCB fenestration is a minimally invasive technique that provides consistent access to the RMS and VCS. It facilitates diagnosis of many sinus disorders and endoscopically guided treatment of many horses with sinus cysts and primary sinusitis, in combination with sinus lavage.

Clinical Relevance—Many diseases affecting the RMS and VCS can be diagnosed and resolved endoscopically using a CFS approach with VCB fenestration, thus avoiding the need for osteoplastic sinus surgery and its associated risks and complications.

INTRODUCTION

SINOSCOPY IS a minimally invasive technique that can be used to examine, diagnose, and treat diseases of the paranasal sinuses in conscious horses.1–5 Sinoscopy is of greatest diagnostic value in horses with primary sinusitis, but contributes to the diagnosis of other sinus disorders including dental sinusitis, sinus cysts and progressive ethmoidal hematoma (PEH).4 In addition to facilitating examination of the paranasal sinuses and intrasinus structures, sinoscopy enables sample collection for histologic examination and microbial culture.3 In 1 study, 69% of horses with paranasal sinus disease had resolution of clinical signs after trephination, sinoscopy, sinoscopic treatment and lavage, with the technique being most effective in horses with primary sinusitis, hemorrhage, or small sinus cysts.3

In a sinoscopic study of 40 cadaveric, normal equine heads a portal into the conchofrontal sinus (CFS), coupled with fenestration of the ventral conchal bulla (VCB), provided the most consistent endoscopic access of any single-portal approach to evaluate the rostral maxillary
sinus (RMS) and the ventral conchal sinus (VCS). We report the diagnostic information obtained from sinonasal examination of 60 horses with paranasal sinus disease using a CFS portal with fenestration of the VCB and describe complications and limitations of sinoscopy.

**MATERIALS AND METHODS**

**Clinical Cases**

Medical records (January 2006–June 2008) of horses, admitted to 2 referral hospitals, that had sinonasal examination of the RMS and VCS were reviewed. Sinoscopic technique, ability to examine the RMS and VCS during sinoscopy, diagnostic efficacy of sinoscopy, postoperative complications, adjunctive diagnostic aids, treatments, and resolution of clinical signs were recorded.

**Diagnostic Methods**

Adjunctive diagnostic methods included oral examination, radiographic, scintigraphic and computed tomographic (CT) examination of the skull, and endoscopic examination of the upper respiratory tract.

**Sinoscopy**

Horses were sedated with detomidine (10 μg/kg intravenously [IV]) and butorphanol (0.025 mg/kg IV), readministered as needed. The CFS portal site was prepared for aseptic surgery. Mepivacaine hydrochloride (2%, 1–3 mL) was infiltrated subcutaneously around the trephination site. A 25–30 mm long incision, parallel to the long axis of the head and located 60% of the distance from the midline to the medial canthus of the eye and 0.5 cm caudal to a line joining both medial canthi, was made through the skin and periosteum, which were retracted with a Gelpi retractor, to expose the frontal bone for trephination. Trephination was performed using a 15 mm diameter skull trephine (Galt Skull Trephine; American Hospital Supply, McGaw Park, IL). Sinoscopy was performed with a 10 mm diameter, 1.4 m long digital videoendoscope (EV Veterinary Products Limited, Brockhurst, UK). The VCB was desensitized with 10–15 mL 2% mepivacaine hydrochloride applied topically and fenestrated with either a Ferris-Smith arthroscopic rongeur (Karl Storz GmbH & Co. KG, Tuttingen, Germany) or a Matthews aural (crocodile) forceps (Dechra Arnolds Veterinary Products, Shrewsbury, UK) passed through the same portal as the videoendoscope or by use of a diode laser (VetArt 810 Diode Laser 30W, Jorgen KRUUSE A/S, Denmark) passed through the biopsy channel of the endoscope. Suction was used to improve examination of the VCS and RMS when moderate hemorrhage occurred after fenestration of the VCB.

If hemorrhage from VCB fenestration obscured observation, sinoscopy was repeated 24–48 hours later. Ability to examine the RMS and VCS was assessed and recorded for each horse. If observation of, and instrument access to the affected sinus compartment was insufficient using the CFS portal, additional portals including a light-indicated RMS approach, a rostrally positioned RMS portal or a caudal maxillary sinus (CMS) portal were used. In some horses, samples of fluid or abnormal tissue were obtained at sinoscopy for cytologic, microbiologic, or histopathologic examination. If sinus lavage was required a 24F Foley lavage catheter (Surgivet Ltd, Waukesha, WI) was inserted 4 cm into the CFS and secured with 2–0 monofilament polyamide suture in a Chinese fingertrap pattern. The skin incision was closed with 2–0 monofilament polyamide suture in a simple interrupted pattern.

**Postoperative Care**

Antimicrobial administration was the surgeon’s preference. Common antimicrobial drugs administered included procaine benzylpenicillin (22,000 U/kg intramuscularly [IM] once daily) with or without gentamicin (6.6 mg/kg IV once daily) for 3 days followed by trimethoprim (15 mg/kg, orally every 12 hours) administered for 3–10 days. Sinuses were lavaged either once or twice daily using 5–10 L lukewarm isotonic saline (0.9% NaCl) solution for 3–7 days.

**RESULTS**

Sixty horses met the inclusion criteria. We were able to fenestrate the VCB of 57 horses (95%) through a CFS portal (Table 1). Fenestration of the VCB was not possible in 3 horses (5%) because of an inability to see the VCB in 2 horses and absence of a VCB in 1 horse.

When the VCB was fenestrated, hemorrhage prevented examination of the RMS and/or VCS in 12 horses (21%; Fig 1), and sinoscopy was repeated 24–48 hours later. Of the 57 horses where VCB fenestration was possible, observation of, and access to, the RMS and VCS was adequate in 50 horses (88%). Observation of, and instrument access into, the RMS or VCS was inadequate via the CFS portal in 7 horses, and in 6 of these horses other portals were made: light-indicated RMS approach (2 horses); rostrally positioned RMS portal (3 horses); and a CMS portal (1 horse). Sinoscopy was diagnostically useful in 40 horses (67%). Disease of the paranasal sinuses resolved in 26 horses (43%) after sinoscopic treatment and longer-term sinus lavage.

**Primary Sinusitis**

Primary sinusitis occurred in 22 horses (37%). Typical sinonasal findings included thickened and edematous mucosa with mucopurulent exudates and/or inspissated purulent material within the sinuses (Fig 2). A diagnosis of primary sinusitis was possible after sinoscopy in conjunction with other diagnostic modalities in 18 horses (82%) and sinoscopy was considered diagnostically useful. Of these 22 horses, 9 (41%) had inspissated purulent exudate within the paranasal sinuses, of which 4 (45%)...
had inspissated exudate solely within the VCS, 2 (22%) had inspissated exudate within both the VCS and RMS, 2 horses had inspissated exudate throughout all the compartments of the paranasal sinuses, and 1 horse had inspissated exudate solely within the RMS. Seventeen horses (77%) had resolution of their clinical signs after improved sinus drainage by fenestration of the VCB, sinus lavage with or without systemic antimicrobial therapy. All 13 horses that did not have inspissated exudate within the sinuses resolved with this treatment. Four of the 9 horses (44%) with primary sinusitis complicated by the presence of inspissated exudate had resolution of clinical signs after improvement of the sinus drainage by endoscopic fenestration of the VCB, endoscopically guided removal of inspissated exudate (Fig 3), sinus lavage with or without systemic antimicrobial therapy. The other 5 horses (56%) with primary sinusitis complicated by the presence of inspissated exudate required removal of the inspissated material through an osteoplastic sinus flap for resolution of their clinical signs.

**Dental Associated Sinusitis**

Sixteen horses (27%) had sinusitis caused by apical dental infections of the caudal 4 maxillary cheek teeth (Triadan 08–11; 15 horses, 25%), or deep periodontal disease (1 horse, 2%). Horses with dental sinusitis had the highest prevalence of hemorrhage on VCB fenestration.

### Table 1. Sinoscopic Findings in 60 horses with Paranasal Sinus Disease

<table>
<thead>
<tr>
<th>Number of Horses (%)</th>
<th>Bulla Entered via CFS Portal (%)</th>
<th>Hemorrhage After VCB Fenestration via CFS Portal (%)</th>
<th>Able to see VCS and RMS after VCB Fenestration via CFS Portal (%)</th>
<th>Diagnostically Useful (%)</th>
<th>Clinical Signs Resolved after Sinoscopic Treatment (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Sinusitis</td>
<td>22 (37%)</td>
<td>21 (95%)</td>
<td>4 (19%)</td>
<td>19/21 (90%)</td>
<td>18 (82%)</td>
</tr>
<tr>
<td>S. equi sinusitis</td>
<td>1 (2%)</td>
<td>1 (100%)</td>
<td>0 (0%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
</tr>
<tr>
<td>Mycotic sinusitis</td>
<td>1 (2%)</td>
<td>1 (100%)</td>
<td>0 (0%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
</tr>
<tr>
<td>Apical infection and sinusitis</td>
<td>15 (25%)</td>
<td>14 (93%)</td>
<td>7 (50%)</td>
<td>11/14 (79%)</td>
<td>3 (20%)</td>
</tr>
<tr>
<td>Periodontal disease/oromaxillary fistula</td>
<td>1 (2%)</td>
<td>1 (100%)</td>
<td>0 (0%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
</tr>
<tr>
<td>Sinus cyst</td>
<td>10 (16%)</td>
<td>10 (100%)</td>
<td>0 (0%)</td>
<td>8/10 (80%)</td>
<td>10 (100%)</td>
</tr>
<tr>
<td>Trauma</td>
<td>3 (5%)</td>
<td>3 (100%)</td>
<td>0 (0%)</td>
<td>3 (100%)</td>
<td>1 (33%)</td>
</tr>
<tr>
<td>Neoplasia</td>
<td>3 (5%)</td>
<td>3 (100%)</td>
<td>1 (33%)</td>
<td>3 (100%)</td>
<td>3 (100%)</td>
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<tr>
<td>Ethmoidal Hematoma</td>
<td>2 (3%)</td>
<td>1 (50%)</td>
<td>0 (0%)</td>
<td>1 (100%)</td>
<td>2 (100%)</td>
</tr>
<tr>
<td>No diagnosis</td>
<td>2 (3%)</td>
<td>2 (100%)</td>
<td>0 (0%)</td>
<td>2 (100%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>57 (95%)</td>
<td>12/57 (21%)</td>
<td>50/57 (88%)</td>
<td>40 (67%)</td>
<td>26 (43%)</td>
</tr>
</tbody>
</table>

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Fig 1. Sinoscopic view through a left conchofrontal sinus portal showing the VCB with some evidence of hemorrhage after fenestration with crocodile forceps. CMS—caudal maxillary sinus; FMA—frontomaxillary aperture; IOC—infracrimal canal; RMS—rostral maxillary sinus; VCB—ventral conchal bulla; VCS—ventral conchal sinus.

Fig 2. Sinoscopic view through a left conchofrontal sinus portal of the RMS of a horse with primary sinusitis. PE—purulent exudate; RMS—rostral maxillary sinus; TA—tooth apex of 3rd maxillary cheek tooth.
Of the 12 horses that had hemorrhage severe enough to interfere with sinus examination after VCB fenestration, 7 (58%) had an apical dental infection. Sinoscopy was diagnostically useful in only 4 horses (25%) with dental sinusitis. Sinoscopic findings in these 4 horses that indicated sinusitis was associated with dental disease included observation of food material within the sinuses, an orosinus fistula, a vertically impacted tooth, and apical granulomas. For 12 horses (75%) the sinoscopic findings were non-specific and did not enable us to determine a definitive diagnosis. For 7 of these horses, sinusitis was determined secondary to dental disease based on oral and radiographic examination findings whereas for 5 horses, sinusitis was determined to be associated with dental disease based on scintigraphic and or CT examination findings. Horses with dental sinusitis were treated by removal of the diseased tooth/teeth by repulsion (6 horses) or oral extraction (9 horses). The owner of 1 horse declined treatment.

**Sinus Cysts**

Sinus cysts were diagnosed in 10 horses (17%). Observation of the cystic structure was possible in all horses, thus sinoscopy was diagnostically useful in all horses with a sinus cyst. Cysts were located in the RMS (Fig 4), VCS, and on the maxillary septum. Cysts in 6 horses (60%) were removed entirely sinoscopically via minimally invasive osteotomies leading to resolution of clinical signs. In 4 horses (40%), an osteoplastic sinus flap was needed to remove the entire cyst because of the size and/or location of the cysts.

**Trauma**

Three horses (5%) had sinus disease secondary to fracture of the frontal (2 horses) or maxillary bones (1 horse). Only 1 frontal bone fracture could be identified sinoscopically, and thus sinoscopy was judged diagnostically useful in 33% of the horses with sinusitis caused by trauma. Sinoscopy was helpful therapeutically in these horses as it enabled the endoscopically guided removal of bone splinters, blood clots, and VCB fenestration to improve sinus drainage. One horse was treated conservatively (sinus lavage and systemic antimicrobial therapy) but the other 2 horses required surgical intervention to resolve their clinical signs.

**Neoplasia**

Three horses (5%) had clinical signs of paranasal sinus disease from intra-sinus neoplasia; 2 had squamous cell carcinomas (1 of which developed subsequent to PEH) and 1 had an adenocarcinoma. Sinoscopy allowed observation and enabled endoscopically guided biopsies of the lesions in all 3 horses, and thus was diagnostically useful in all horses. The adenocarcinoma was excised and the lesion base injected with cisplatin (1 mg/mL of tumor), but when regrowth was discovered 12 months later, the horse was euthanatized. Treatment of squamous cell carcinoma was not attempted and these horses were euthanatized after histologic confirmation.
Two horses (3%) had clinical signs of sinus disease secondary to PEH. In 1 horse, PEH was located within the CFS, overlying the VCB, and in the other horse, the PEH was located within the RMS (Fig 5). Because of the intrasinus location of PEH in these horses, the lesions were not visible during nasal endoscopy but were identified by sinoscopy. The frontal sinus PEH was excised through an osteoplastic frontonasal flap and the lesion base injected with 4% formaldehyde solution. The RMS PEH was treated by surgical debulking sinoscopically and then ablating the remaining portion with a transendoscopic diode laser.

Complications

Three horses had major complications after sinoscopy: sinocutaneous fistula at the CFS trephine site (1 horse), nasofrontal exostosis (2 horses), and delayed onset cellulitis (1 horse).

DISCUSSION

Sinoscopy through a CFS portal enabled examination of the RMS and VCS in most horses affected with paranasal sinus disease. Others have reported that a CFS portal provides excellent observation of the CFS and CMS. Creating a portal into the caudal aspect of the RMS has been recommended to examine the VCS and RMS, but sinoscopy performed through this portal provides poor visibility of the VCS, and can result in iatrogenic damage to the alveolar bone overlying the apices of the cheek teeth. In 40 equine cadaver heads free of paranasal sinus disease, evaluation of the RMS and the VCS through a single-portal was most easily achieved through a CFS portal if the VCB was fenestrated. This approach avoided iatrogenic damage to the alveolar bone overlying the apices of the cheek teeth.

The VCB was fenestrated through a CFS portal in 57 horses (95%), and in 36 horses (90%) in a cadaver study. In both studies, when the VCB could not be fenestrated through the CFS portal, it was successfully fenestrated through a CMS portal. In our clinical study, variations in paranasal sinus anatomy and presence of inspissated material obscuring the bulla accounted for our inability to fenestrate the VCB of some horses through a CFS portal.

Hemorrhage, a minor but not infrequent complication of sinoscopy, occurred in 12 horses (21%) after VCB fenestration to the extent that it obscured observation. Others have suggested that although hemorrhage is not a complication of sinoscopic evaluation in normal horses, horses with paranasal sinus disease may be at increased risk of excessive hemorrhage, because the mucosa of the sinuses is often thickened and hyperemic. Of the 12 horses with sufficient hemorrhage to impair examination, 7 had dental associated sinusitis, which typically has mucosal inflammation of all paranasal sinus compartments, making hemorrhage more likely when the VCB is fenestrated. Thus the extent of hemorrhage may be an indication of disease severity and chronicity. Hemorrhage may be so severe that the RMS and VCS cannot be examined adequately necessitating a repeat sinoscopy, 24-48 hours later.

Fenestrating the VCB not only enables detailed RMS and VCS examination through a CFS portal, it also provides direct communication between all sinus compartments, which, in turn, enhances lavage of all compartments through a single portal by preventing sequestration of purulent material within any individual compartment. Lavage has been advocated by many authors for treatment of primary sinusitis, but lavage alone is usually insufficient to evacuate large amounts of inspissated exudate. Traditionally, inspissated exudate within the paranasal sinuses has been removed through an osteoplastic maxillary or frontonasal flap. The ability to remove inspissated purulent material sinoscopically and lavage all the paranasal sinuses through a single-portal enabled 77% of horses with primary sinusitis and 44% of horses with primary sinusitis complicated by presence of inspissated exudate to be resolved by improved sinus drainage and lavage with or without systemic antimicrobial therapy. Sinoscopy avoided the need for an osteoplastic sinus flap or large frontal trephine hole to remove purulent material from the RMS and
VCS, thus reducing the morbidity, convalescent time, and cosmetic complications. Our results compare favorably with an earlier study\(^5\) where only 54% of horses in which sinus lavage was attempted responded to this treatment. In that study,\(^5\) the VCB was not fenestrated. Because primary sinusitis affects all compartments of the paranasal sinuses,\(^18\) horses affected with primary sinusitis are most effectively treated by lavage when all compartments of the sinuses communicate directly. Direct communication between all the paranasal sinus compartments can be achieved by fenestrating the VCB. The poorer response of horses treated for primary sinusitis by sinus lavage\(^5\) may have been because more horses had inspissated exudate within the sinuses, or because the VCB was not fenestrated.

In our study, sinus cysts within the VCS and RMS were removed sinoscopically, and as reported previously for sinus cysts removed through an osteoplastic sinus flap,\(^3,5,19,20\) the prognosis for resolution of clinical signs was good. Because sinoscopic removal of a sinus cyst via minimally invasive osteotomies requires a much smaller incision than does removal of a cyst through an osteoplastic, frontonasal flap, healing time is reduced, enabling the horse to return to exercise more quickly. Sinus cysts can be removed successfully sinoscopically, by first reducing the size of the cyst by aspiration, to enable cyst removal through the sinoscopy portal. Large sinus cysts and those located in sites difficult to access, such as the VCS or in areas where greater exposure is needed, such as the ethmoidal area, are best removed through an osteoplastic sinus flap, as was required in 4 horses in our study.

In another report,\(^4\) sinoscopy was of greatest use in diagnosing sinusitis caused by primary bacterial infection, resulting in a correct diagnosis in 91% of affected horses. Although we found sinoscopy useful for diagnosing primary sinusitis in a similar percentage of affected horses (82%), its greatest value was for diagnosis of a sinus cyst, a neoplastic lesion, or PEH. We were able to correctly identify the lesion sinoscopically in every affected horse. In agreement with another study,\(^5\) we found sinoscopy least useful for identifying dental sinusitis, perhaps because the sinosscopic features of dental sinusitis, such as the presence of grossly thickened mucosa and purulent material, are non-specific and obscure the affected tooth. We found sinoscopy to be useful, however, in ruling out the presence of other sinonasal disease.

In agreement with others,\(^1\) we found that sinososcopic treatment of horses with paranasal sinus disease was most effective for horses that had primary sinusitis or a sinus cyst. Another study showed sinososcopic treatment alone to be successful in 69% of 16 horses with disease of the paranasal sinuses.\(^3\) Clinical signs of paranasal sinus disease resolved in a smaller number of horses (43%) in our study after sinoscopic treatment and conservative therapy without the need for further surgery, but unlike our study, the other study\(^3\) did not include a large number of horses with disease affecting the RMS or VCS, which may account for our poorer success in resolving the clinical signs of disease. Other authors have recommended treating horses with disease of the RMS or VCS through an osteoplastic frontonasal flap,\(^3\) but we found that sinoscopy was a valuable technique for treating horses affected with primary sinusitis, sinus cysts, or PEH involving the RMS and VCS.

Our findings demonstrate that sinoscopy performed through a single CFS portal combined with VCB fenestration is a useful diagnostic and therapeutic technique with little likelihood of complications. The technique enables observation of the internal structure of the paranasal sinuses and identification of changes (eg, mucosal thickening, inspissated purulent exudate, intrasinus mass) facilitating diagnosis. This sinoscopic technique allows treatment of some diseases by minimally invasive osteotomies using endoscopic guidance to remove cystic and other intrasinus masses and improve sinus drainage by VCB fenestration without the need for a 2nd trephine hole or for an osteoplastic sinus flap.

**ACKNOWLEDGMENT**

We would like to thank Brian Cox and Martin Whiting for their assistance with the figures.

**REFERENCES**


