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Descriptive Clinical Reports

Paranasal sinus cysts in the horse: Complications related to their presence and surgical treatment in 37 cases

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Summary

Background: Paranasal sinus cysts (PSC) are a common cause of equine secondary sinusitis. The outcome and associated complications have not been frequently reported.
Objectives: To review the associated clinical signs, associated morbidities and outcomes of horses treated for PSC.
Study design: Retrospective multicentre case series.
Methods: Retrospective analysis of case records and telephone follow up survey.
Results: Subjects were 37 horses 1–24 years old that were presented with nasal discharge (n = 31), facial swelling (n = 25) and epiphora (n = 19). Radiography and computed tomography allowed identification of the cyst-induced changes including concomitant tissue destruction (n = 31), leading among other things to local nerve damage causing headshaking (n = 6) and unilateral blindness (n = 1). Radiographic changes to adjacent dental apices were present in 10 horses. Horses over 10 years old showed more of the named associated problems. Post-operative complications included surgical site infection (SSI) (n = 11), nasofrontal suture periostitis (n = 6) and sequestration (n = 1) following removal of the PSC via osteotomy.
The long-term response to treatment was available for 28 cases with 22 horses (78.6%) fully cured, 4 (14.3%) partially cured and 2 (7.1%) not responding to treatment. In 7 horses (18.9%) there was recurrence of the cyst post-operatively.
Main limitations: Due to the study being a multicentre retrospective case series with collection of data over an extended period, there may be inconsistency in data recording and absence of reporting of some findings.
Conclusions: Overall, the diagnosis and treatment of sinus cysts is relatively straightforward and carries a good prognosis. In long-standing cases complications secondary to the expansive growth of cysts will dramatically affect the prognosis for full recovery due to pressure-induced changes to facial bones, cheek teeth and nerves. These secondary complications mainly occurring in older horses may be due to a combination of a relatively longer period of affection and the inflexibility of older horses' bones. Cyst recurrence following treatment can occur in up to 19% of cases.

Keywords: horse; nasal discharge; facial swelling; epiphora; headshaking; surgical site infection; suture periostitis

Introduction

Paranasal sinus cysts (PSC) are reported to be the second most frequent cause of secondary sinusitis [1]. These fluid-filled, space occupying, expansive lesions have been described by several authors [1–6], who have postulated on their aetiology. While no final aetiology and pathogenesis is known, some authors have suggested a link with ethmoidal haematomas [3,6]. PSC can be seen in animals of all ages, but most cases are diagnosed in pre-weaning foals, young adult horses, and adults above the age of 10 years [6]. Woodford et al. [5] found horses of 11–12 years of age most commonly affected.

Radiographically, a PSC appears as a homogenous well defined rounded soft tissue density in the frontal or maxillary sinus. Definitive diagnosis can only be made histologically; however, the presence of viscous, sterile, translucent and odourless yellow fluid obtained via sinus centesis is pathognomic [3,7,8].

Paranasal sinus cysts are progressively expansive with no reports of spontaneous regression [6]. Although surgical drainage of the cyst may be effective in certain cases [3,8], surgical removal remains the optimal treatment. Complete removal of the cyst lining through one of the various sinus osteotomy techniques [1,3,8–10], generally is associated with a good prognosis.

Due to the expansive nature of the cyst, affected animals may develop distortion of the facial, maxillary and conchal bones leading to external signs of gross facial swelling, epiphora and even exophthalmos. Additionally, cyst expansion may lead to compression and destruction of internal structures including the infraorbital canal and dental apices. The presence of these changes can dramatically affect the overall prognosis.

The purpose of this retrospective case series is to describe the associated morbidities that can occur related to the presence of PSC and to present the outcomes and complications related to surgical treatment.

Materials and methods

Medical records (2005–2015) from six European-based Equine Hospitals (Clinic for Horses, University of Veterinary Medicine Hannover; Large Animal Hospital, University of Copenhagen; Philip Leverhulme Equine Hospital, University of Liverpool; Clinic for Large Animal Surgery, University of Veterinary Medicine Vienna; Veterinary Clinic Gessertshausen; Polo Universitario Veterinario Di Lodi, Faculty of Veterinary Medicine – University of Milan) were reviewed for horses that had a diagnosis of PSC, were surgically treated and had a complete post-operative patient record available. Preoperative, surgical and post-operative data were retrieved.

Preoperative data

The following pre-operative data were obtained: age, sex, breed and type of work, clinical signs at first presentation and duration of clinical signs. The

horses were divided into three are groups: ≤1 year, between 2 and 10 years, and ≥10 years. Results of diagnostic imaging (radiography, computed tomography (CT)) and upper airway endoscopy were recorded. Data included the following: the affected sinuses and involvement of the infraorbital canal, nasolacrimal duct, nasal septum or nasal passages. PSC- associated morbidities including epiphora, compression and distortion of the nasolacrimal duct and infraorbital canal with or without headshaking, blindness and presence of structural changes on the cheek teeth were also recorded.

Surgical data

Retrieved surgical data included the type of sedation or anaesthetic protocol, surgical approach and technique and whether exposure of the infraorbital nerve occurred intra-operatively.

Post-operative data

Information obtained included postoperative medication, treatment after hospital discharge, healing of the surgical site, residual clinical signs and postoperative complications including surgical site infection and facial suture periostitis.

Outcome was determined by telephone conversation with the owners or by follow-up examination of the horse. Recorded data regarding long-term outcome included availability of follow-up, period of time after discharge, resolution of primary owner complaint, response to initial treatment, recurrence and resolution of associated morbidities.

Results

Horses

The study included 37 horses: Warmbloods (n = 19), Thoroughbreds (n = 5), ponies (n = 5), Arabians (n = 3), Icelandic horses (n = 2), draught horses (n = 2) and a Standardbred (n = 1) comprised of 18 mares, 17 geldings and two stallions. Age of the horses ranged from 6 months to 24 years (median age 14 years). There were 2 horses ≤1 year of age, 6 between 2 and 10 and 29 ≥ 10 years of age.

History

The initial presenting complaint was nasal discharge (n = 30), facial swelling (n = 21), epiphora (n = 16), stertor (n = 13), headshaking (n = 5, all intermittent) and exophthalmos (n = 3). Poor performance (dyspnoea) was reported in two horses. A foul-smelling nasal discharge was reported in another two horses. In 34/37 horses where this information was available, clinical signs were present for 1 week to up to 36 months (median: 4 months). A slightly longer duration of clinical signs was observed in horses ≥10 years (median: 5 months; IQR: 5) than in horses <10 years (median: 3 months; IQR: 0). In 26/37 horses, treatment before referral was recorded. Treatment included antibiotics (n = 9), antibiotics and nonsteroidal anti-inflammatory drugs (NSAIDs, n = 7), mucolytics and antibiotics (n = 3), NSAIDs, mucolytics and antibiotics (n = 5), NSAIDs alone (n = 1) or puncture of the facial swelling (n = 1). Four horses had had sinus lavage via trephination (n = 3) or nasal sinoscopy (n = 1).

Clinical examination

All 37 horses were bright, alert and responsive at initial presentation. The main clinical signs were as follows: nasal discharge (31/37), nasal airway obstruction (27/37), facial swelling (25/37; Fig 1a, b), epiphora (19/37; Fig 1a, b) and respiratory noise (15/37) (Table 1).

Diagnostic procedures

Radiography, CT, nasal endoscopy and ultrasonography (US) were used either alone or in combination. Details of the examinations are available in Supplementary Item 1. On a lateral radiographic projection, discrete, partially circumscribed masses were identified in 17 horses. Poorly marginated, diffuse soft tissue masses could be observed in 10 horses.

Fluid lines were identified in one or more of the paranasal sinuses in two horses and focal mineralisation of the soft tissue mass in one horse.

Examination of the ventrodorsal radiographic projection revealed nasal septal deviation in 22 horses. Flattening of dental apices was noted in 3 horses and bulging and thinning of maxillary bones was identified in one horse. In 2 horses, the osseous infraorbital canal was suspected to be damaged because it could not be identified on any projection.

CT was performed on 27 horses. In 7 horses, focal mineralisation of the soft tissue mass was seen. Fluid lines in one or more paranasal sinuses were identified in 5 horses and dental apex flattening was noted in 10 horses. Bulging and thinning of maxillary bone was seen in 10 additional horses; in 8 horses partial destruction of the osseous orbit was noted.

The radiographical evidence of infraorbital canal changes in two horses was validated by CT. In addition, CT revealed displacement and distortion of the osseous infraorbital (n = 13) and lacrimal (n = 10) canal in other cases (Fig 2a, b).

On endoscopic examination, the nasal passage of the affected side was found to be obstructed in nearly all examined horses due to distension of the dorsal and ventral conchae. In 4 horses, the obstruction occurred both ipsi- and contralaterally as the protruding masses resulted in severe nasal septum deviation, and in 6 horses there was mucopurulent discharge, draining from the nasomaxillary aperture.

Ultrasonography was performed in only three horses in the region of the facial swelling. Due to the bone thinning, homogenous anechoic fluid was detected beneath the bone.

Affected sinuses

All six ipsilateral sinuses (caudal maxillary sinus, conchofrontal sinus, rostral maxillary sinus, ventral conchal sinus, sphenopalatine sinus and ethmoidal sinus) were affected in 16/37 horses (43.2%). Five sinuses were affected in 5/37 horses (13.5%) More detailed information can be found in Supplementary Item 2.

Affected nasal and paranasal internal structures

The nasal and paranasal architecture was, in most cases, found to be abnormal. In nearly 60% of the cases (n = 21), it was no longer possible to differentiate between the different sinus compartments. The different sinus compartments that now formed one enlarged cavity and structures including the infraorbital canal,

nasolacrimal duct or the maxillary bone surfaces were not identifiable (Figs 2a, b and 3a, b, c). Further morbidities associated with the cyst and its expansive nature, are listed in Table 2.

Surgery

Detailed information about the applied osteoplastic techniques for approaching the affected sinuses can be found in Supplementary Item 3. Access was created by using an oscillating saw (n = 34), a trephine (n = 2) or chisel and mallet (n = 1). In 26 cases, surgery was performed with the horses standing and sedated and the remaining 11 horses were treated under general anaesthesia. In 13 of the standing cases, the maxillary nerve was anaesthetised. Findings during exploration of the paranasal sinuses included areas of bone thinning at the site of facial swelling (n = 10) and resorption of the osseous surface of the infraorbital canal (n = 18) with the infraorbital nerve lying free within the sinuses in 12 cases.
Accidental manipulation of the infraorbital nerve during standing procedures (n = 8) led to explosive defensive withdrawal of the horse's head. Haemorrhage during cyst lining extirpation was minimal in 28 cases. Yet, in nine horses a sinonasal fistula was created and a stockinette bandage was inserted into the nasal cavity for about 48 hours to control haemorrhage.

Post-operative medication and average clinic stay

All included horses were treated post-operatively with NSAIDs, usually for 7–12 days (median: 9/range: 4–21 days) and antibiotics for 8–14 days (median: 10/range: 4–75 days). In one case, the antibiotic treatment lasted for 75 days because of a severe surgical site infection of the wound with osteitis and sequestration. Additionally, two horses were treated to the institutions standard protocol of penicillin or trimethoprim sulfonamide, based on a culture sensitivity test, with metronidazole for 10–12 days and four horses with mucolytics for 10–18 days.

Hospitalisation ranged from 2 to 75 days (median: 10 days).

Post-operative treatment

In 22 cases, post-operative sinus lavage was performed for 3–4 days using saline. In 2 cases, sinus lavage was performed for 8 and 10 days. Post- surgery endoscopic examination in 6 horses with persistent nasal discharge, revealed the presence of opportunistic mycotic infections of the affected sinus compartment. These horses were treated by addition of enilconazol (Imaverol [a]) to an iodine solution lavage fluid. Complications of surgical site healing occurred in 12 horses (32.4%) and are reported in Table 2.

Outcome

Full remission was obtained in 22/28 (78.6%) cases with follow-up periods of 6 months to 10 years (median: 8 months) post-surgery (Table 2). Partial remission was reported in 4 horses due to persistent clinical signs from associated morbidities. In 2 of those horses, cyst recurrence at 8 and 16 months post operatively occurred. One horse suffered from dental- related late sequelae and one horse was reported to have on-going low- grade intermittent headshaking during exercise.

Furthermore, two horses were not cured, i.e. had cyst recurrence and were retired following unsuccessful second treatment. Twenty-one horses (21/28, 75%) returned to their previous athletic activities. Two horses returned to partial work (7.1%), two were retired prior to (7.1%) and three following treatment (14.3%) (Table 3).

Outcomes related to associated morbidities: Of the 25 horses with cyst-associated morbidities (Table 3), 23 returned to work. The different remaining clinical signs attributed to the associated morbidities are listed in Table 2. Five of those 25 horses with cyst-associated morbidities were <10 years of age, while 20 were ≥10 years.

Full remission of headshaking immediately after the surgery occurred in five out of six horses with headshaking at initial presentation. In one case, headshaking persisted for 12 months before resolving. In one of the 5 horses that initially had remission, headshaking reappeared about 6 months post-surgery, but at 1.5 years post-surgery, the horse was nearly nonclinical and returned to partial work.

In three horses, headshaking developed post-surgery. In these cases, the infraorbital nerve was found lying free within the sinuses and was accidentally manipulated during the surgical procedure. All three horses were reported to be free of headshaking after follow-up periods of 4–18 months.

In one horse with severe exophthalmos, where CT revealed distortion of the lacrimal and infraorbital canal and the infraorbital nerve was lying free within the sinuses, unilateral blindness and low-grade ataxia were noted post-surgery. The exophthalmos and ataxia resolved after discharge from hospital, but the blindness remained. The horse returned to its previous athletic activity.

Epiphora present before surgery disappeared in all but one case. In this case, follow-up radiographs with contrast medium (Fig 4) and flushing of the nasolacrimal duct performed 1.5 years after surgery revealed complete obstruction of the lacrimal canal in the former cyst area. The horse remained in full activity.

Dental problems eventually occurred in 2 of the 10 horses which showed structural changes of various cheek teeth adjacent to the cyst. In one horse, 10 years post-surgery, a follow-up investigation for mucopurulent nasal discharge revealed involvement of the 109 (Fig 5), which was extracted.

Discussion

This case series reports on the clinical signs, associated morbidities, surgical outcomes and complications related to paranasal sinus cyst disease. There is conflicting reporting on the most commonly affected age groups for PSC, with the literature describing the disorder as mostly affecting younger horses between preweaning foals and 3 years of age [6,8]. In the present series, more than 80% of the horses were >5 years and 30% >16 age as found by Lane et al. [3], Woodford et al. [5] and Quinn et al. [11]. This observed difference in age of presentation, may be attributed to the time lapse between the start of the pathological cystic process and the occurrence of clinical signs. The timeframe in which PSCs develop remains unknown and potentially the cyst may be a developmental pathology that appears clinically later in life, with variable growth rates between individuals. Morbidities associated with the PSC were common. Epiphora, headshaking, blindness and structural changes of cheek teeth seem to be related to pressure induced atrophy caused by the expansive and destructive growth of the cyst [12,13]. Horses ≥10 years of age were observed to have longer periods of clinical signs before referral than younger horses, which may be one reason for the higher proportion of older horses suffering from cyst-associated morbidities. Bones in general are known to reduce their ability to remodel, regenerate and have decreased flexibility with age [11,14]. As a result, the mature skull and its internal bony anatomical structures are possibly more prone to the destructive forces ensuing from growing sinus cysts. Therefore, older horses may also be more predisposed to develop severe associated morbidities.

One of the less well-described associated morbidities of PSC are the induced structural changes on cheek teeth. This case series reports on two horses of two different ages with dental abnormalities induced by the PSC. In younger horses where the dental structures are not fully mineralised[15], the teeth are likely to be more sensitive to the compressive forces of the cyst and can be more easily deformed. One of the foals from this series, which had structural changes on the dental bud of 109 at presentation, later in life developed pathological changes in its adult dentition. Additionally, 10 years after treatment of the cyst, one of the cases was represented with clinical signs related to dental disorders of the 109 that had already been recognised as structurally compromised by the cystic process at first presentation. So even in young adult horses, the long reserve crowns that protrude far into the maxillary sinus compartments and are exposed to the forces of expanding cysts, are at risk of being damaged permanently, leading to disturbance of the lifelong physiological eruption of teeth in the horse [16].

One of the more severe associated morbidities is the occurrence of headshaking. Compression and destruction of the infraorbital canal can lead to headshaking, as previously reported [17]. The present data also supports that accidental manipulation of the exposed nerve during surgery may lead to headshaking post-operatively.

Exposed nerves may be difficult to visually identify during extirpation of the mass. If an exposed nerve is palpated, a violent reaction is generally induced, if the procedure is performed with the horse standing and sedated. A similar response is observed with the horse under general anaesthesia even though the described withdrawal reaction might in those cases be less pronounced. However, when maxillary nerve blocks are performed, the sensitivity to nerve palpation is reduced or absent potentially creating more risk of damage to the nerve structure. One of the authors (D.V.) does not perform maxillary blocks in cases of PSC when imaging signs are suggestive of nerve exposure.

In general, neuroregeneration is more likely to occur in cases in which the nerve has just been acutely damaged by external trauma than in cases of neuronal damage after chronic compression [18]. Nevertheless, all cases that had headshaking whether present preoperatively or developed after manipulation of the nerve, fully recovered. Whether this is due to full regeneration or full degeneration of the nerve is unclear. Although a long time may be needed, the signs related to infraorbital nerve damage seem to resolve completely.

Neuronal damage caused by expansive forces on the ophthalmic nerve led to permanent unilateral blindness in one horse. This case was presented with severe exophthalmos, which resolved following cyst removal although the eye remained blind. Unfortunately, no ophthalmic examination was performed prior to surgery and it remains unclear if the horse was or was not blind before the intervention. However, as no signs of sudden blindness were apparent post-surgery the horse was likely already blind for a longer period and had adapted to a restricted visual field. An ophthalmological examination, including visual testing should be performed in cases of PSC, particularly those with exophthalmos.

Nasal endoscopy and ultrasound did not establish a diagnosis of PSC, and radiography or CT was needed for final diagnosis. In all horses in which only radiography was performed, a diagnosis of PSC was made. However, the exact extent of the cystic lesion and the associated pressure- induced osseous destruction was only clearly visible and confirmable by CT. CT imaging is clearly superior for diagnosis, assisting in preoperative planning and prognostication. With the advent of standing CT imaging, it is more advantageous, using CT imaging for horses suspected of PSC [9,19].

About one-third of the horses suffered from surgical site complications, similar to other reports [5,7,11,20]. Surgical site infection, nasofrontal suture periostitis and sequestration are known complications of sinus bone flap surgery [9,11]. We were not able to detect differences between the chosen surgical access, technique, or originally affected sinus compartment and the presence of post-surgical complications. As reported elsewhere [21], nasofrontal suture periostitis can be induced by surgical trauma of the bone flap. In most cases, the occurrence of nasofrontal suture periostitis will be linked to the surgical trauma itself or the presence of a sequestrum. Either the identified sequestrum is infected or not necessarily infected, but unrecognised and contributing to continuous local inflammation. With removal of the sequestrum, the periostitis generally resolves [21]. In the present cases, sequestration and infection were present in 3 of the 6 nasofrontal suture periostitis complications, all of which resolved following treatment.

Although about one-third of cases suffered from complications related to surgical intervention, conservative treatment of PSC is contraindicated. Surgical treatment of PSC is indicated at diagnosis as the long-term effect of associated morbidities created by the disease process are far more destructive and difficult to manage than the surgical complications. Trans- nasal endoscopic sinus surgery as described recently [22] could provide a minimal invasive alternative with reduced surgical site complications compared to the open approach. This technique will hopefully improve future sinus surgery, though its efficacy is unproven.

Although still debated, full extirpation has been considered mandatory, since recurrence of partially removed cysts is likely [1–3,17,23]. In the present series, recurrence of the cyst occurred in 19% of cases (7/37). Since direct post-operative CT was not available for cases with recurrence, it is unclear if recurrence was due to regrowth from remaining parts of the cystic lesions or from new cyst formation. Ideally, post-operative CT scanning would allow for confirmation of complete PSC removal, especially in cases where the cyst involves more difficult to access sinuses, such as the sphenopalatine sinus.

In relation to the recurrence rate, it is noteworthy that 5 of the 7 affected horses returned to full work after further treatment and only 2 were retired because of cyst recurrence.

Considering the multicentre retrospective collection of data over an extended period, limitations to our findings may include inconsistency in data recording and lack of reporting of findings such as mild intermittent headshaking or intraoperative findings like denuding of the infraorbital nerve. The number of associated morbidities related to PSC and wound complications may be higher than reported here.

Conclusion and clinical relevance

Paranasal sinus cysts are a common cause of secondary sinusitis in horses. Provided they are recognised before gross changes of the internal sinonasal architecture and the skull have occurred, they can easily be removed by surgical intervention, with a good to excellent prognosis. A delayed diagnosis can allow pressure atrophy of osseous structures, teeth and nerves to occur and, the prognosis may be drastically affected. Early recognition of cysts is, therefore, crucial.

Authors' declaration of interests

No competing interests have been declared.

Ethical animal research

Research ethics committee oversight not required by this journal: retrospective analysis of clinical data. Owners gave consent for their animals' inclusion in the follow up study.

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Authorship

All authors contributed either to the conception and design of the work or the acquisition of data for the work. Further did all named authors contribute to the intellectual content of the work by revising the draft critically until all authors gave their final approval of this version to be published. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Supplementary Item 1: Diagnostic imaging methods. Supplementary Item 2: Affected paranasal sinuses. Supplementary Item 3: Osteoplastic techniques.