

A Large Fronto-nasal-maxillary Bone Flap Technique for the Removal of an Invasive Ethmoid Hematoma in a Horse

Fernando Amitrano¹, Ashley Brabon², and Lorenzo Quiroz³

¹University of Arizona College of Veterinary Medicine

²Charles Sturt University

³Affiliation not available

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Abstract

An 8-year-old Thoroughbred gelding presented for evaluation and investigation for recurrent unilateral epistaxis. Computer tomography (CT) confirmed the presence of an invasive and expansive progressive ethmoid hematoma (PEH) located in the right paranasal sinuses. The mass invaded the right paranasal sinuses compartments causing moderate leftward displacement of the nasal septum with subsequent collapse of the left nasal passages, complete obliteration of the right ethmoid turbinate, right infraorbital canal, and nasolacrimal duct. Also, impingement of the axial margin of the right orbit. A large frontonasal maxillary bone flap was performed standing under sedation and local anesthesia and the PEH was removed successfully with minimal surgical complications. The gelding made an unremarkable recovery from surgery and progressed well after recovering from post operative pleuropneumonia. Follow-up (25 months post operative) confirmed the reoccurrence of the PEH, but the horse remained healthy in pasture turn out.

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F. N. Amitrano¹, A. Brabon² and L. Quiroz¹

¹ School of Veterinary Medicine, University of Arizona, 1580 E Hanley Blvd, Oro Valley, AZ 85737 USA.

²Veterinary Clinical Centre, Charles Sturt University, Agricultural Ave, Wagga Wagga, NSW, 2650 Australia.

Key words: Ethmoid hematoma, paranasal sinuses, bone flap, computer tomography, equine

Summary

An 8-year-old Thoroughbred gelding was presented for evaluation and investigation for recurrent unilateral epistaxis. Computer tomography (CT) confirmed the presence of an invasive and expansive progressive ethmoid hematoma (PEH) located in the right paranasal sinuses. The mass invaded all right paranasal sinuses compartments causing moderate leftward displacement of the nasal septum with subsequent collapse of the left nasal passages, complete obliteration of the right ethmoid turbinate, right infraorbital canal, and nasolacrimal duct. Also, impingement of the axial margin of the right orbit. A large frontonasal maxillary bone flap was performed standing under sedation and local anesthesia and the PEH was removed successfully with minimal surgical complications. The gelding made an unremarkable recovery from surgery and progressed well after recovering from post operative pleuropneumonia. Follow-up (25 months post operative) confirmed the reoccurrence of the PEH but the horse remained healthy in pasture turn out.

Introduction

Surgical access to the equine paranasal sinuses can be obtained by bone flap techniques (Auer *et al* 2019). Two main techniques have been described for the exploration of the paranasal sinuses, the maxillary, and the frontonasal bone flaps (Freeman et al 1990; Auer *et al* 2019). The maxillary flap provides excellent access to the maxillary sinus, entrance to the ventral concha sinus and visualization of the root of the first (109/209), second (110/210) and third (111/211) molars. The frontonasal bone flap, affords access to the concho frontal sinus, ethmoturbinate, caudal maxillary sinus and caudal nasal cavity (Freeman et al 1990; Auer *et al* 2019).

Bone flap techniques are usually performed for the exploration and treatment of the paranasal sinuses, or for the removal of sinus neoplasia, cyst, and hematomas (Auer *et al* 2019; Cook and Littlewort 1974). Progressive ethmoid hematomas (PEH) are encapsulated, slow growing non-neoplastic masses (Greet 1992; Smith and Perkins 2010) PEH usually extend into the nasal passages and nasopharynx or expand into the paranasal sinuses pursuing the path of least resistance.

Treatment of PEH is difficult, with variable success and high reoccurrence rates (Cook and Littlewort 1974; Greet 1992; Smith and Perkins 2010). Horses with small PEH are commonly treated with Laser ablation, cryotherapy, or chemical ablation with repeated intralesional injections of 4% formal saline (Greet 1992; Schumacher 1998). However, in larger expansive lesions; surgical abrasion (debridement or removal or reduction?) via fronto nasal or maxillary flaps are more effective (Cook and Littlewort 1974; Smith and Perkins 2010; Auer *et al* 2019).

This article describes the use of a combined frontonasal-maxillary bone flap for the removal of a PEH invading into the sphenopalatine, frontal, maxillary sinuses, and the nasal cavity in a horse.

Case History

An 8-year-old Thoroughbred gelding presented to the Charles Sturt University Veterinary Clinical Centre (CSUVCC) for recurrent unilateral epistaxis. The horse had a previous history of a traumatic head injury during a trailer ride approximately 3-months prior to presentation to CSUVCC, which resulted in a small circular fracture of the right frontal bone. Upper airway endoscopy and skull radiographs were conducted after the traumatic episode at a referring equine hospital which revealed a small progressive ethmoid hematoma (PEH). The PEH was then treated with sequential formalin injections via endoscopy. The hematoma was thought to have been notably reduced in size on recheck radiographs, however, the owner reported that the gelding had suffered continuous episodes of bilateral epistaxis that had been progressively worse in volume and duration over the past 6 weeks.

Clinical Findings

Physical examination performed at the CSUVCC identified mild bilateral epistaxis, more prominent from the right nostril than the left nostril, marked inspiratory stertor and increased inspiratory effort were noted and air flow through the right nostril was absent. An approximately 0.5 cm by 0.5 cm circular bone defect was located on the frontal bone at the level of the lateral cantus of the right eye, 2 cm lateral from midline. Also, the right eye presented with moderate exophthalmos and chemosis.

Diagnosis

Upper airway endoscopy revealed a severe narrowing of the right nasal passage, dynamic nasal collapse observed in the left nostril and mild to moderate thick dark sanguineous discharge was also noted. Computer tomography (CT) was performed under general anesthesia. The gelding was sedated with xylazine (Xylazil 100 0.5 mg/kg bwt i.v.)¹ and Butorphanol (Butorgesic 0.1 mg/kg bwt i.v.)¹. General anesthesia was induced with ketamine (Ketamil 2.2 mg/kg bwt i.v.)¹ and midazolam (Midazolam Alphafarma 0.05 mg/kg bwt i.v.)² and maintained on isoflurane (Isorane)³ and medical oxygen delivered through a circle breathing system. The examination disclosed a large infiltrative, heterogeneous, and partially hyperattenuating, non-contrast enhancing mass extending throughout most of the right paranasal sinuses (Figure 1 and 2). The mass was effacing the right ethmoid turbinate and was expansile caudally, impinging upon the axial margin of the right orbit. The mass extended dorsally into the rostral aspect of the right frontal sinus and caudoventrally into the rostral aspect of the right sphenopalatine sinus and was causing moderate leftward displacement of the

nasal septum with subsequent collapse of the left nasal passages. There was complete obliteration of the right infraorbital canal and nasolacrimal duct at the level of the mass. A lobular soft tissue attenuating structure is present throughout the left sphenopalatine sinus. An emergency tracheostomy was performed during recovery from general anesthesia. A metal 22 mm diameter tracheostomy tube was placed and remained in position until the surgical procedure was completed.

Surgery

The horse was prepared for a standing removal of the PEH under sedation and local anesthesia. Prior to surgery, the gelding was administered procaine penicillin (Propericillin 22 mg/kg bwt i.m. q. 12 h)⁴ and gentamicin (Gentam 6.6 mg/kg bwt i.v. q. 24 h)¹ and intravenous phenylbutazone. Antimicrobial administration continued with the same regimen for 5 days, phenylbutazone (Nabudone 2.2 mg/kg bwt i.v q 12 h)¹ was administered orally every 24 hours for 5 days post-operatively.

The surgical area was clipped and surgically prepared. Mepivacaine (Vetacaine 0.07 mg/kg bwt s.c to effect)¹ was infiltrated around the proposed surgical site. A combined fronto nasal and maxillary bone flap incision approach was performed. The rostral perpendicular incision was made from midline to the rostral end of the facial crest 1 cm dorsal to the infraorbital foramen, a ventral parallel incision was made 0.5 cm dorsal to the facial crest to the caudal aspect of the facial crest, a perpendicular caudal incision was made from the caudal aspect of the facial crest to approximately 0.5 cm abaxial to the incisive notch, then a short 5 cm parallel incision starting approximately 2 cm medial to the medial canthus of oculus dexter and finally a caudal perpendicular line from dorsal midline to join the last incision. The periosteum was incised to expose the underlying bone and 0.5 cm of periosteum was reflected using periosteal elevators. A Jacobs chuck with a 2mm Steinman pin was used to create equidistant holes along the flap edges. The exposed bone was then cut with an oscillating saw along the outlines of the flap.

The opening created in this way allowed direct access to the conchofrontal sinus, sphenopalatine and the maxillary sinuses, ethmoid labyrinth and the frontomaxillary opening. A large smooth oval, mottled, to dark green tinged mass occupying the frontal, sphenopalatine, maxillary and choncal sinuses was visualized (Figure 3 and 4). The hematoma was isolated from the ethmoid turbinates and surrounded mucosa by digital dissection and removed by careful traction. The sinuses were lavaged with sterile fluids and packed with sterile gauze bandage. Hemorrhage was considered minor during the procedure.

The fronto-nasal maxillary bone flap was replaced. The periosteum, and subcutaneous layers were closed with number 0-2 Glycomer 631(Byosin)⁵ in a simple continues pattern and the skin was then closed using a number 1 polydioxanone (MonoPlus)⁶ in a simple interrupted pattern. An elastic, self-adhesive bandage was applied to protect the surgical incision.

Post-operatively the horse was maintained on a 5-day course of Phenylbutazone, procaine penicillin and gentamicin sulphate as labeled above. The tracheotomy tube was removed 24 hours post-operatively.

Outcome

Seven days post-operatively the patient developed a temperature of 38.7 °C (101.6 F) and demonstrated dull behavior and inappetence. The remainder of the physical examination did not reveal any other abnormalities. Complete blood cell count demonstrated marked leukopenia of 5.4 10⁹ g/L (reference range, g/L, increased fibrinogen of 6.5 g/L (0.127-0.224 g/L) and Serum Amyloid A (SSA) of 1305mg/L (<0.5 to 20 mg/L). Upper airway endoscopy and thoracic ultrasonography were performed and revealed severe changes associated with bilateral pleuropneumonia. Thoracic drains (Mila Chest Tube with Sharp Trocar Size 12)⁷ were placed into the right and left thoracic cavity. Nine liters of turbid orange pleural fluid were evacuated from the right hemithorax and 2 liters from the left hemithorax. Fluid collection from the thoracic cavity demonstrated the growth of *S. equi* subsp *zooepidemicus* sensitive to Rifampin (5 mg/Kg bwt p.o q. 12 h)⁸ and Trimethoprim Sulfamethazine (Sulprim 30mg/kg bwt i.m. q. 12 h)¹

Three months recheck upper endoscopy examination demonstrated a small, 1.0 by 0.7 cm area of discoloration, surrounded by a fungal plaque on the ventral aspect of the rostral maxillary sinus mucosa. The

plaque was removed, and the area was lavaged. A tissue sample was submitted for histopathology and confirmed the presence of hematoma like tissue. Findings were discussed with the owner and due to the size and the minimal progression of the hematoma, it was decided to recheck the gelding every three months to monitor the evolution of the hematoma. At the six months recheck no noted changes in size and progression from the previous endoscopic examination were noted. At the twelve-month post-operative recheck, upper airway r endoscopy showed anatomical structural reorganization of the right rostral maxillary sinus (Figure 5). The maxillary sinus opening had narrowed after surgery and the sinus mucosa was clear and no signs of progressive growth or hematoma formations was visualized. At the twenty-five-month post-operative recheck, the owner reported that the horse developed a mild episode of epistaxis, for this reason a CT scan was performed which showed a progressive regrowth of the hematoma. The owner reported that the horse is currently in pasture turned out and in good health.

Discussion

This report documents an optional combined frontonasal maxillary bone flap technique for the removal of large expansive hematoma from the paranasal sinuses. PEH can lead to progressive nasal obstruction and is generally unresponsive to conservative therapy (Schumacher et al 1998), for this reason radical excision is the treatment of choice (Greet 1992) with the main objective of a complete removal of the mass and the destruction of its origin (Auer et al 2019). In addition, laser surgery, chemical ablation with 4% formaldehyde solution, cryosurgery has been used in conjunction to achieve this objective (Schumacher et al 1998, Rush and Mair 2004). The choice of treatment modality depends on the size, position, and accessibility of the lesion (Rush and Mair 2004, Auer et al 2019). Large and expansile lesions are best approached via frontal or maxillary bone flap techniques, gaining access to the origin of the lesion (Freeman et al 1990, Auer et al 2019). This surgical technique can be performed with the horse standing or under general anesthesia and exposing the nasal passages, maxillary, and frontal sinuses (Auer et al 2019).

In this case, due to the expansive nature of the hematoma and the suspected destruction of the infraorbital canal and nasolacrimal duct observed on CT scan an en bloc sinus flap was performed.

Radiographs have been shown to be a poor diagnostic imaging tool to evaluate the sphenopalatine sinus due to the superimposition of multiple anatomical structures over this axially located structure (Tucker et al 2010). In addition, endoscopy has a limitation on the visualization of the complete anatomic margins of the mass (Textor et al 2012). CT provides important anatomic information, superior lesion localization, extension and facilitates the effective treatment of horses with PEH (Tucker et al 2010, Textor et al 2012). In this case, CT examination provided extremely valuable diagnostic imaging information which allowed for detailed surgical planning and decision making for the removal of this PEH. Textor et al reported an impact of the treatment decision in 60% of the patients presented in the study after CT results (Textor et al 2012).

Surgical exploration of the paranasal sinuses is limited by the surrounding anatomical structures. The nasolacrimal duct and infraorbital nerve and canal delimitate the opening of the maxillary sinuses (Auer et al 2019). Following CT findings, it was decided to perform a complete en bloc fronto-nasal maxillary flap. This technique creates a larger opening into the sinus compartments, which allows for increased visualization and provides a comfortable space for instrument maneuverability. The expansive hematoma was successfully removed, and no complications were experienced replacing the flap into the original position.

Intra-operative hemorrhage is the most frequent and expected complication after surgical excision of PEH due to the damage of the normal nasal, sinusoidal and ethmoturbinates by the hematoma or iatrogenic during surgical removal (Freeman et al 1990, Schumacher et al, 1998 Auer et al 2019), however, no excessive hemorrhage was experienced during or after surgical removal. Also, complications associated with the damage of the nasolacrimal duct and the infraorbital nerve are rare in horses and usually linked to obstruction, trauma and compression of the duct or the canal (Roberts 2009, Robinson et al 2016). Epiphora is an expected consequence of the nasolacrimal duct obstruction, which may create chronic moist dermatitis, fly dermatitis or infectious keratoconjunctivitis (Robinson et al 2016), furthermore, head shaking, and facial pain behave have been correlated with injuries of the infraorbital nerve in horses. In this case, no post-operative

complications previously reported were noted. In addition, pneumonia has been reported as a potential complication of permanent tracheostomy in adult horses (Chesen and Rakestraw 2008), also, Freeman et al reported a case that developed pleuritis and pneumonia 3 days post-operative after the removal of an osteoma through a large fronto-nasal bone flap. In this case the suspected primary source of infection was the aspiration of the sinus discharge and devitalized-necrotic tissue post-operatively, standing surgery, necessitating prolonged head elevation in conjunction with the temporary tracheostomy opening likely played a role in the development of bilateral pleuropneumonia. Furthermore, no deficits were observed.

Prognosis for PEH is unfavorable without treatment because the lesion is progressive and eventually causes obstruction and dyspnea (Rush and Mair 2004, Auer et al 2019). Lesion recurrence rates have been reported to be between 13- 45% within 18 months of surgical intervention. The recurrence after routine surgical removal is relatively high with a 43% chance of lesion recurrence (Rush and Mair 2004, Auer et al 2019). However, success rates have been shown to be greater when all lesions identified on CT were treated, and there is no involvement of the sphenopalatine sinus (Textor 2012, Auer et al 2019). In this case, the PEH had reoccurred 3 months post-operatively. The recurrent lesion was smaller and hadn't shown any signs of progression, for this reason the owner elected monitoring for further progression and recheck endoscopic appointments.

In conclusion, a complete frontonasal maxillary bone flap can be performed safely in horses. Understanding that sedation and local anesthesia for the treatment and removal of large sinus masses, increases the rate of complication which has been previously reported in the literature. The major limitation is the requirement for a CT scan to obtain detailed imaging of the head to determine the integrity of the nasolacrimal and infraorbital canal. No neurologic or ophthalmic complications developed in this case post-operative.

Authors' declaration of interests

No conflicts of interest have been declared.

Ethical animal research

This is a retrospective case report. Permission was obtained from the owners to allow this report to be published.

Authorship

F.N Amitrano, A. Brabon were the admitting clinician and were the attending surgeons at CSUVCC. All authors contributed to the preparation of the manuscript and gave the manuscript their approval.

Manufacturers' addresses

¹TROY Laboratories PTY LIMITED, Glendenning, New South Wales, Australia

²Alphafarm PTY LTD, MYLAN Millers Point, Sydney, New South Wales, Australia.

³Baxter Healthcare PTY LIMITED, Old Toongabbie, New South Wales, Australia.

⁴ Intervet Australia PTY LIMITED, Bendigo East, Victoria, Australia.

⁵ Medtronic Australia PTY LIMITED, Macquarie Park, NSW, Australia

⁶ B. Braun Surgical S.A, Rubi, Spain

⁷ Mila International Inc, Florence, Kentucky, USA

⁸ Bova Aus, Caringbah NSW, Australia

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