

*Case report*

## COMPUTED TOMOGRAPHY FINDINGS IN A CASE OF GIANT FRONTAL SINUS MUCOPYOCELE IN A DOG

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A 16-month-old male crossbreed dog, which suffered a previous traumatic incident, was presented for evaluation of a chronic fluctuant right supraorbital mass. On computed tomography, a well-defined, expansile, hypodense mass, showing a thin peripheral enhancement was occupying the right frontal sinus and extending into the cranial cavity. Imaging findings, bacteriological culture, and histopathology of the surgically excised mass were consistent with a frontal sinus mucopyocele. Frontal sinus mucopyocele should be included as a differential diagnosis for a well-marginated expansile frontal sinus mass, especially when present in young animals or/and associated with a previous craniofacial trauma.

**Key words:** frontal sinus mucocele, nasofrontal opening, craniofacial trauma.

### INTRODUCTION

The frontal sinuses are located between the outer and inner tables of the frontal bone [1]. The size and shape varies more than any other cavity of the skull in dogs, and depends on breed skull conformation and age [2]. Mucocèles of the paranasal sinuses are chronic, expanding, mucosa-lined lesions characterized by mucous retention, which can be infected, becoming a mucopyocele [3]. They originate from obstructed sinus outflow caused by congenital anomalies, trauma, benign or malignant tumors, infection, inflammation, allergy, and post-surgical complications [4].

### CASE PRESENTATION

#### Signalment, history, and clinical findings

A 16 month-old castrated male crossbreed dog was referred for a chronic fluctuant subcutaneous mass located in the frontal sinus region, dorsal to the right orbit.

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The referring veterinarian reported a traumatic episode one year earlier resulting in bilateral metacarpal bone fractures and a head trauma. On previous evaluation, one year after the accident, the referring veterinarian identified a firm painful mass over the right frontal sinus. The dog was treated systemically with antibiotics (amoxicillin-clavulanate) and non-steroidal anti-inflammatory drugs (meloxicam) but did not show any improvement. At the follow-up evaluation 4 weeks later, the mass had doubled in size and was causing increasing signs of pain. The mass was lanced and drained, and a viscous reddish-brown fluid was obtained. Cytological analysis of the fluid revealed numerous neutrophilic granulocytes of normal morphology, and there was no evidence of bacteria or other etiological agents. Fungal and bacterial cultures did not yield growth. After this episode the swelling receded for a time, but finally recurred and the dog was referred to our institution. Physical examination of the dog revealed only a firm mass with fluctuant areas located in the right frontal sinus region, dorsal to the right orbit, and left microphthalmia. Palpation of the mass elicited signs of pain. A complete blood count and serum biochemistry were performed and revealed moderate thrombocytopenia ( $82 \times 10^3/\mu\text{L}$ ; reference interval  $175\text{-}500 \times 10^3/\mu\text{L}$ ) and a mildly increased concentration of urea ( $31\text{mg/dL}$ ; reference interval  $7\text{-}27\text{mg/dL}$ ).

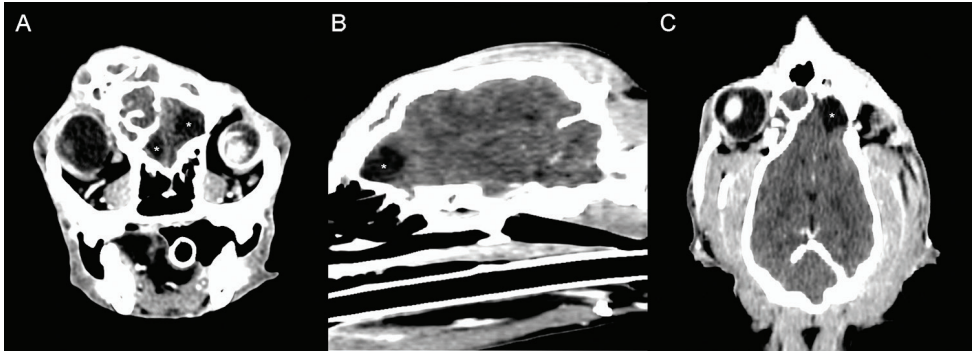
### **Imaging, diagnosis and outcome**

Computed tomography (CT) of the head was performed (Brivo CT-385, General Electrics Healthcare, Buckinghamshire, UK) and revealed an enlarged right frontal sinus filled with fluid attenuating material. There was marked expansion of the right frontal sinus, with thinning, and disruption of the frontal bone, which showed a multi-septated appearance with multiple irregular areas of osteolysis (Fig. 1). The right sinus communicated with the cranial cavity through the rostral part of the inner table of the frontal bone and the right aspect of the cribriform plate. A material of similar fluid attenuation was located in the rostral aspect of the cranial cavity, surrounding the olfactory bulbs. The lesion was causing moderate displacement of the olfactory bulbs and the rostral part of the frontal lobes, as well as a left midline shift (fig. 2). The post-contrast study showed a thin peripheral capsular enhancement with multiple septated areas conferring a polycystic appearance. The left frontal sinus was markedly reduced in size and the dorsal surface of the frontal bone had a flattened depressed conformation. Moderate destruction of the caudal maxillary and ethmoid turbinates was observed bilaterally, although more marked on the right side. The nasofrontal openings were not visible. In conclusion, a large expansile mass was present in the right frontal sinus that extended intracranially. Differential diagnoses included mucocele, abscess related with chronic sinusitis, or cystic neoplasia. Mucocele was considered most likely due to the appearance of the mass and the previous traumatic incident. Consecutive right frontal sinus trepanation, exposed a reddish-brown mass, with a hyperemic capsule containing mucous material, involving the rostral aspect of the cranial vault and caudal nasal region. The mass was evacuated with suction and the sinus epithelium was removed. The nasofrontal opening was obstructed, so the

dorsal roof of the opening was removed and enlarged. A drain was placed at the level of the nasofrontal aperture and through the frontal sinus. Bacteriological culture of the mucinous mass gave a positive result for coagulase positive *Staphylococcus spp.* A piece of the resected frontal bone and multiple samples of the viscous mass were submitted for histopathological examination. The histological sections of the mass showed disorganization of the connective tissue with an intense mixed inflammatory infiltrate, mainly consisting of activated macrophages and neutrophils. The mucoid mass was characterized by a pyogranulomatous inflammation and the bone fragment showed a periosteal reaction with no evidence of neoplasia. No foreign body or fungal structures were found. Mucopyocele of the right frontal sinus was diagnosed in basis of the imaging, histopathological, and bacteriological findings.



**Figure 1.** Post-contrast transverse CT image at the level of the frontal sinuses, displayed with a soft tissue window. A well-defined, expansile, cavitated hypodense mass, was occupying the right frontal sinus (white arrows). Note the marked expansion of the right frontal sinus, with thinning, and disruption of the frontal bone, which showed a trabecular appearance with multiple irregular areas of osteolysis. In addition, microphthalmia of the left eye was present (asterisk).



**Figure 2.** Transverse (A), sagittal (B), and dorsal (C) CT reconstruction images displayed with a brain window. Intracranial extension was evident, affecting the rostral aspect of the cranial cavity; fluid attenuating material was surrounding the olfactory bulbs (arrow heads).

## DISCUSSION

Frontal sinus mucocele is relatively rare in dogs compared to humans, and this could be explained because of their larger nasofrontal opening [5, 6] (Fig 3). The clinical manifestations of mucoceles in dogs are: a frontal sinus mass, facial swelling, ocular and nasal discharge, and neurological signs such as seizures, ataxia, and depressed mental status [5]. Mucoceles are capable of expansion by virtue of a dynamic process of bone resorption and new bone formation. When the mucocele expands so that the sinus volume is insufficient to house the mucocele, pain and pressure erosion can occur. With continued secretion and accumulation of mucus, the increasing pressure causes atrophy or erosion of the bone of the sinus, allowing the mucocele to expand in the path of less resistance [4, 7]. This may be into the orbit, adjacent sinuses, nasal cavity, cranial cavity, or through the skin [4, 7]. On a previous report, a 4-month old dog with facial swelling and intermittent ocular discharge was diagnosed with a frontal sinus mucocele with radiographs and confirmed at surgery [2]. Intracranial extension is uncommon, but when it occurs is referred to as a giant frontal sinus mucocele [4, 6]. An erosive intracranial mucocele may lead to meningitis, meningoencephalitis, pneumocephalus, brain abscess, seizures, or cerebrospinal fluid fistulas [7]. In our case, erosion and destruction of the inner table of the frontal bone and cribriform plate was present, and the mucocele was invading the rostral aspect of the cranial cavity, causing a mass effect and medial displacement of the olfactory bulb and the rostral aspect of the right frontal lobe. However, our patient did not present any neurological signs. This could be due to the location and size of the intracranial extension of the lesion, which did not result in a significant mass effect, or more probably because of its slow development. CT has proven to be the gold standard diagnostic tool for this condition and is essential in surgical planning [3]. The extent of bone destruction is best appreciated on CT, compared with other imaging techniques [4]. MRI may provide additional information in detailing the relationship between the intracranial and intraorbital structures and the mucocele, and may be the preferred technique if

other soft tissue tumours of the orbit causing proptosis cannot be excluded [3]. In this case report, trauma was assumed to have resulted in the closure of the nasofrontal opening. To our knowledge, only a few cases of frontal mucocele are described in the literature, but several of these, postulated a traumatic origin as the probable cause [8, 5]. The possibility of a congenital malformation affecting the nasofrontal opening could not be completely ruled out, however the correlation between the head trauma and the subsequent onset of the clinical signs, reinforce our hypothesis. In humans, mucocele tend to occur between the fourth and seventh decades of life and is uncommon in children [7]. In contrast to humans, skeletally immature and young mature dogs are over-represented in veterinary literature; in most cases a previous traumatic event was also present. A mucocele can become infected, with risk of infectious complications



**Figure 3.** Comparison between transverse and sagittal CT images of a normal dog (**A** and **B**) and the patient (**C** and **D**), at the level of the frontal sinuses, displayed with a bone window. Images **A** and **B** show the normal appearance of the nasofrontal opening (white arrow) communicating the nasal cavity with the frontal sinus trough a delicate scroll of ectoturbinates. In our patient (**C** and **D**) the nasofrontal opening is not recognizable, due to the expansion of the frontal sinus mucopyocele.

including orbital cellulitis, meningitis, meningoencephalitis, and brain abscess [3, 4]. The infection stimulates production of cytokines, interleukin-1, and tumour necrosis factor from lymphocytes and monocytes, and increases synthesis of prostaglandin and collagenase from fibroblasts in the mucosal lining being responsible for the reabsorption and destruction of the sinus wall, allowing for the expansion of the mucocele [9]. In our case, after an initial negative culture, a *Staphylococcus spp.* growth was obtained, which could be secondary to the initial drainage procedures and previous sampling. This infection could have contributed to the process of reabsorption and bone expansion, and could be partly responsible for the pain. The dog in this report was treated with the reestablishment of the nasofrontal opening and removal of the mucocele lining. A similar treatment was previously described in two dogs [5, 8]. One of the reported dogs recovered successfully after reestablishment of the nasofrontal opening [8]. However, the other dog needed a more aggressive surgical exploration and fat graft obliteration of the sinus [4]. In conclusion, frontal sinus mucopyocele should be included as a differential diagnosis for a well-marginated low attenuation expansile frontal sinus mass with ring enhancement, especially when present in young animals and/or associated with a previous craniofacial trauma. Intracranial extension is possible.

### **Authors' contributions**

AR performed conception and design, acquisition, analysis and interpretation of data, drafting the article and revising article for intellectual content. NR performed conception and design, analysis and interpretation of data and revising article for intellectual content. GF and MX performed acquisition of data and revising article for intellectual content. AC performed analysis and interpretation of data and drafting the article. EY performed analysis and interpretation of data and revising article for intellectual content. All authors read and approved the final manuscript.

### **Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## **REZULTATI KOMPJUTERSKE TOMOGRAFIJA U SLUČAJU NALAZA GIGANTSKE MASE U FRONTALM SINUSU KOD PSA**

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Pregledan je pas, mešanac, star 16 meseci, mužjak, koji je prethodno imao traumatsku povredu, pri čemu je uočena masa u desnoj supraorbitalnoj regiji, koja fluktuirala. Promena je bila hroničnog toka. Primenom kompjuterske tomografije, uočena je jasno ograničena, ekspanzivna, masa manje gustine, sa periferno naglašenom senkom, koja je zahvatala desni frontalni sinus i koja se širila ka kranijalnoj šupljini. Na osnovu CT nalaza, bakteriološke kulture iz uzorka i histopatološke analize hirurški izvađene mase, zaključeno je da se radi o mukopyocele frontalnog sinusa. Mukopiokele treba da se uzme u obzir prilikom diferencijalne dijagnostike u slučaju da se uoči jasno ograničena ekspanzivna masa u frontalnim sinusima, naročito ako se radi o mladim životinjama i/ili u slučaju prethodnih kraniofacijalnih trauma.