Evaluation of Inflammatory Disease in the Nasal Cavity and Paranasal Sinuses using CT in Dogs and Cats

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Abstract: Inflammatory sinonasal disease was diagnosed in five dogs and two cats with clinical signs of nasal discharge and epistaxis. Survey radiography and CT were performed in all of patients. CT scan of the rostral cranium was performed with a thickness of 2 or 5 mm. Nasal cytology and culture from nasal smear were performed immediately after CT examination. Remarkable increase of opacity in the nasal cavities and frontal sinuses was observed in only 3 cases. On CT images, the cavitating lesions were isodense in nasal cavity (7 cases), frontal sinuses (3 cases), and nasopharynx (2 cases) with destruction of the nasal septum (4 cases), maxillary turbinates (5 cases), maxilla (3 cases), and hard palate (2 cases). The lesions were enhanced after intravenous contrast administration in 5 cases and were not enhanced in 2 cases. Inflammatory cells were observed in nasal cytology. Most of the cultures from nasal smear were bacteria. CT is useful to diagnose sinonasal disease and is more accurate in demonstrating the extent and character of lesions of nasal cavity than radiography.

Key words: CT, inflammation, dog, cat, nasal cavity.

Introduction

Chronic sinonasal diseases such as aspergillus, inflammation or nasal neoplasia are common in cats and dogs and are often challenging to diagnose (1,2,8). Diagnostic imaging is an essential component to determine the cause of chronic nasal disease and evaluate the nasal cavity in dogs (8,17). The radiologic features of sinonasal disease have been described (3-8). Although the radiography has a role in the investigation with nasal signs such as sneezing, epistaxis, and nasal discharge, the radiography is not very reliable for diagnosis of chronic sinonasal diseases based on the previous studies (5,6,7). Computed tomography (CT) and magnetic resonance imaging (MRI) were superior to radiography for evaluation of the nasal cavity and paranasal sinuses because of a better demonstration of some changes suggestive of sinonasal disease (6-9,18). CT was the best technique for detection of bone lysis and evaluation of frontal sinus (9). MRI was especially useful for differentiating between a primary inflammatory sinonasal disease caused by bacterial agents and secondary pathologic lesions attributed to primary causes (3,9).

The purpose of this retrospective study was to assess the value of nasal CT in dogs and cats with inflammatory sinonasal disease. Also, characteristics of inflammatory sinonasal disease was establish using CT and compare with previous studies.

Materials and Methods

Inflammatory sinonasal disease was diagnosed in five dogs and two cats with chronic nasal discharge or epistaxis. All of patients underwent physical, radiographic, and CT examination. Swabs, cytobrush, and biopsy were taken for bacterial culture and sensitivity, fungal culture, cytology, and histologic examination. Rhinoscopic examination was performed in one dog. Definitive diagnosis was based on the histology, cytology, culture, rhinoscopy, and response of antibiotic treatment.

Radiographic examinations included a dorsoventral and a lateral projection of the entire skull in all patients and dorsoventral intraoral projection of nasal cavity in some patients. The X-Omat® regular film (Kodak Co., U.S.A) was used with intensifying screen.

The CT examinations were performed on a third-generation whole body scanner (CTmax®, GE, U.S.A.). All of patients were under general anesthesia by isoflurane for the imaging procedure. The patient was positioned in ventral recumbency and the head introduced in the CT unit. Contiguous transverse 2 or 5 mm thickness images of the nasal cavity were obtained from the nares to the caudal level of the frontal sinuses. Scanning was repeated in a same manner after intravenous contrast administration (Omnipaque®, Nycomed, Norway). The CT images were examined on soft tissue (WW: 250, WL: 20) and bone window (WW: 2000, WL: 200).

Results

The patients aged 3 years to 14 years (mean = 10.5 years) in
dogs and 3 to 6 years in cats. Signalments of animals are described in Table 1. The breeds represented were two Pomeranian, one poodle, two mongrel, and two domestic shorthair cats. The major clinical signs for the study group were chronic nasal discharge (7 cases), epistaxis (3 cases), and sneezing (2 cases). Included in the study were 2 cases with bacterial rhinitis (Pasteurella sp), 1 case with rhinitis secondary to dental disease, 1 case with traumatic rhinitis, and 4 cases with non-specific rhinitis.

The radiographic signs and results of culture were summarized in Table 1. Accurate increase of radiographic opacity of the nasal cavities and frontal sinuses were observed in only 1 dog and 2 cats (Fig 1). Periodontal destruction was detected in one dog (Fig 2). The CT images were evaluated for nasal cavity, paranasal sinuses, or surrounding tissues and structures (Table 2). On CT images, the cavitating lesions were isodense in nasal cavity (7 cases), frontal sinuses (3 cases), and nasopharynx (2 cases) with destruction of the nasal septum (4 cases).

**Table 1. The radiographic signs and results of culture in 7 cases with rhinitis**

<table>
<thead>
<tr>
<th>no.</th>
<th>Age/Sex/Species/Breed</th>
<th>Clinical Signs</th>
<th>Radiographic Findings</th>
<th>Nasal Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10y FS Canine Pomeranian</td>
<td>Nasal discharge Sneezing halitosis</td>
<td>Periodontal bone destruction</td>
<td>No identification</td>
</tr>
<tr>
<td>2</td>
<td>14y Female Canine Pomeranian</td>
<td>Nasal discharge</td>
<td>Lt. External ear narrowing</td>
<td>Pasteurella haemolytica Klebsiella spp. Streptococcus spp.</td>
</tr>
<tr>
<td>3</td>
<td>12y Male Canine Mongrel</td>
<td>Nasal discharge Epistaxis</td>
<td>NSF</td>
<td>Staphylococcus spp. Streptococcus spp.</td>
</tr>
<tr>
<td>4</td>
<td>10y6m Female Canine Poodle</td>
<td>Nasal discharge Sneezing</td>
<td>NSF</td>
<td>Staphylococcus spp. E. coli</td>
</tr>
<tr>
<td>5</td>
<td>6y Male Canine Mongrel</td>
<td>Epistaxis</td>
<td>Increase of opacity of the NC and frontal sinuses</td>
<td>Staphylococcus spp. Streptococcus spp.</td>
</tr>
<tr>
<td>6</td>
<td>6y Male Feline DSH</td>
<td>Purulent discharge</td>
<td>Increase of opacity of the NC</td>
<td>Pasteurella multocida</td>
</tr>
<tr>
<td>7</td>
<td>3y MC Feline DSH</td>
<td>Nasal discharge Epistaxis Dyspnea</td>
<td>Increase of opacity of the NC and frontal sinuses</td>
<td>Proteus spp.</td>
</tr>
</tbody>
</table>

FS: female spayed  MC: male castrated  NC: nasal cavity  NSF: no significant finding

**Fig 1.** Dorsoventral radiography of the skull in case 5 with traumatic rhinitis. Note the unilateral increase of opacity in the left nasal cavity and the loss of turbinate detail.

**Fig 2.** Right lateral radiography of the skull in case 2 with rhinitis secondary to dental disease. Note the destruction of alveolar bone at molar teeth region (arrow) and severe dental calculi (arrowhead).
were considered as bacterial rhinitis because of identification in dogs and cats (10-12). In this study, two patients (case 2, 6) are less frequent, but important, causes of chronic rhinitis are nasopharyngeal disease, congenital abnormalities, and nasopharyngeal stenosis, rhinopharyngeal polyps, rhinitis secondary to dental disease, and nasopharyngeal polyps in cats (10). Nasal foreign body rhinitis and aspergillosis in dogs (8) and idiopathic chronic rhinitis were lack of ipsilateral sinus lesions, lucent foci, and asymmetry of the cribriform plate (2,10,16). The cavitary lesion in nasal cavity, frontal sinus, and nasopharynx and destruction of the nasal concha and nasal septum were detected. (C, D) The unilateral isodense lesion in the nasal cavity and nasopharynx are detected. (D) The diffuse isodense lesion bilaterally in the frontal sinus of cat.

maxillary turbinates (5 cases), maxilla (3 cases), and hard palate (3 cases) (Fig 3). The lesions were enhanced after intravenous contrast administration in 5 cases and were not enhanced in 2 cases.

### Discussion

The most common causes of chronic nasal disease are neoplasia and aspergillosis in dogs (8) and idiopathic chronic rhinosinusitis and nasal neoplasia in cats (10). Nasal foreign body rhinitis, nasopharyngeal polyps, rhinitis secondary to dental disease, congenital abnormalities, and nasopharyngeal stenosis are less frequent, but important, causes of chronic rhinitis in dogs and cats (10-12). In this study, two patients (case 2, 6) were considered as bacterial rhinitis because of identification of Pasteurella species in culture. Case 1 was thought of rhinitis secondary to periodontal disease based on physical and radiographic examination and response of surgical treatment. Case 5 was strongly suspected traumatic rhinitis by reason of history that epistaxis was started after trauma.

Dogs with rhinitis tend to be younger than those with nasal neoplasia; however the age range of dogs affected by either of these conditions is wide (2,4). The typical signs associated with chronic nasal disease in dogs and cats are nasal discharge, sneezing, stertorous respiration, and epistaxis (13-15). The type and location of the nasal discharge may help limit differential diagnoses (10). However, a supplementary examination such as diagnostic imaging, cytology, and culture was required for accurate diagnosis.

As has been reported previously, the radiographic signs for rhinitis were lack of ipsilateral sinus lesions, lucent foci, focal or multifocal loss of turbinate detail, and localized soft tissue opacities, whereas the those of nasal neoplasia were diffuse lesion of ipsilateral cavity, generalized loss of turbinate detail, invasion of bones, and generalized soft tissue opacities (2,4). In this study, radiographic abnormalities of nasal cavity and paranasal sinuses were detected in only 3 cases (multifocal lesion of ipsilateral or bilateral nasal cavity; 3 cases, soft tissue opacities of frontal sinus; 2 cases, multifocal loss of turbinate detail; 3 cases). The reason for this result was considered that most of patient were small breeds or brachycephalic breeds and evaluation of nasal cavity was difficult on radiographs. CT is a powerful tool for evaluation of the nasal cavities, frontal sinuses, and differentiation between a cavitated -like or a mass-like process (7). On CT, rhinitis appeared as a cavitating lesion that spared the paranasal sinuses, thickened and distorted or destroyed the turbinates, and widened the meatus in dogs (6,13). Unlike the CT of rhinitis, those of tumors appeared as space-occupying lesions that obliterated the turbinates, caused deviation of the nasal septum, and eroded bone in dogs (6,15). Although morphologically distinct on CT images, infectious rhinitis and nasal neoplasia could not be differentiated by attenuation measurements or degree of contrast enhancement (6). In cats, however, a recent study showed that pathognomonic difference was not found between nasal neoplasia and severe rhinitis using CT (16). Also, when compared with radiographic studies, CT was not more sensitive than radiographs at detecting the presence of nasal cavity abnormalities but was more sensitive at localizing these changes and determining the extent of disease (16). Findings often seen on CT with chronic sinonasal disease in cats include soft tissue opacification of the nasal cavity and frontal or sphenopalatine sinuses, lysis of nasal and frontal bones, turbinate destruction, and asymmetry of the cribiform plate (2,10,16). The cavity lesion in nasal tumor, frontal sinus, and nasopharynx and destruction of nasal concha and nasal septum identified in this study was similar to the recent reports on CT in dogs and cats with rhinitis (6,16). However, bone lysis of maxillary bone and hard palate that commonly detected in dogs and cats with nasal neoplasia was verified in 3 dogs and 1 cat in this study. Contrast enhancement was detected in 3 dogs and 2 cats. The contrast enhancement in patients with rhinitis or nasal neo-

### Table 2. CT findings in 7 cases with rhinitis

<table>
<thead>
<tr>
<th>CT Characteristics</th>
<th>Number of Case</th>
<th>Location of Fluid Accumulation</th>
<th>Location of Destruction</th>
<th>Bone Lysis</th>
<th>Contrast Enhancing</th>
</tr>
</thead>
</table>

Fig 3. Precontrast CT images with soft tissue window (A,C,D) and bone window (B). (A) The cavitating isodense lesion bilaterally in nasal cavity and destruction of the nasal concha and nasal septum. (B) Fluid accumulation in the nasal cavity, destruction of the nasal concha, bone lysis of left maxilla and hard palate, and swelling (arrow) were detected. (C) The unilateral isodense lesion in the nasal cavity and nasopharynx (arrowhead). (D) The diffuse isodense lesion bilaterally in the frontal sinus of cat.
plasia was not pathognomonic finding by reason of the marked vascularity of tissue in the normal nasal cavity (6). An absence of contrast enhancement in 2 cases was considered because of severe fluid accumulation in nasal cavity. Although there was the very small number of cases in cats, nasal cavity abnormalities were identified on radiographs and CT imaging and CT was more sensitive at determining the extent of disease like previous study (16).

One limitation in this study was the small number of cases. In the future, more cases should be accumulated for definitive assessment of CT in nasal cavity. Although the diagnosis should always be confirmed by cytologic or histopathologic examination of tissue and many of the CT findings associated with rhinitis overlapped those found with nasal neoplasia, CT is an excellent tool and greatly enhances the ability to establish an accurate definitive diagnosis of chronic nasal disease.

References