COMMON NASAL DISEASES OF THE DOG AND CAT

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CLINICAL SIGNS ASSOCIATED WITH NASAL DISEASE

Sneezing and nasal discharge are usually associated with diseases of the nose, paranasal sinuses, and nasopharynx. Sneezing frequently precedes the onset of notable nasal discharge. A peracute onset of explosive sneezing is often seen initially with nasal foreign bodies. Regardless of the underlying cause for the nasal disease, the severity and frequency of sneezing may diminish over time while the nasal discharge frequently worsens in severity and changes in character. Dogs with long-standing chronic rhinitis are frequently presented with chronic nasal discharge rather than persistent sneezing. However, chronic sneezing is a common clinical sign in cats and often is accompanied by nasal discharge. The nature of sneezing may aid in localization of the problem. Expiratory (forward) sneezing is typically associated with sinus or intranasal disease. Reverse or inspiratory sneezing (aspiration reflex) is a normal response to mechanical irritation of the dorsal nasopharyngeal mucosa. The presence of reverse sneezing is usually correlated with caudal nasal, nasopharyngeal, or sinus disease. Some dogs or cats may have posterior, rather than anterior, nasal discharge, and the only indication for primary nasal disease may be obstructive nasal breathing. In dogs, obstructive nasal breathing is often observed to be worse while the dog is nasal breathing (i.e., sleeping or resting) and not open mouth breathing. Recurrent pacing or profound restlessness may be seen in some dogs with severe obstructive disease while attempting to rest or sleep due to inability to breath through the nose. Open-mouth breathing in cats is rare and associated with severe obstruction of the nose.

Epiphora may be seen with obstruction of the nasolacrimal duct. Gagging, dysphagia, or halitosis may occur when disease involves the oral or pharyngeal cavities. Facial deformity may occur in advanced stages of nasal, extraocular, or oral neoplasia or fungal rhinitis. Chronic nasal disease may be concurrent with otitis externa or vestibular disease in cats with nasopharyngeal polyps. Behaviour changes, seizures, or obtundation in patients with a chronic history of nasal disease may occur with neoplasia or fungal rhinitis resulting from compromise of the cribriform plate with extension of disease into the brain.

The type and location of the nasal discharge may help limit differential diagnoses. Unilateral nasal discharge may be seen with nasal foreign bodies, early nasal neoplasia, and dental disease. However, chronic inflammatory rhinitis may present with unilateral nasal discharge. Bilateral nasal discharge is most commonly seen and does not further define the cause for the rhinitis. Mucopurulent nasal discharge is most common and often results from bacterial infection or colonization secondary to the primary cause for the rhinitis. Serous discharges are uncommon and typically seen with allergic rhinitis or early viral infection. Serous discharges are often modified to mucoid or mucopurulent types with persistence of the underlying cause for the nasal disease. Blood may be seen intermittently in mucopurulent discharges from a wide variety of underlying nasal diseases due to erosion of blood vessels and sneezing. Epistaxis is not commonly seen in cats, as compared to dogs, with chronic nasal disease. Epistaxis is seen with aggressive intranasal diseases causing erosion of blood vessels (e.g. neoplasia, inflammation) or coagulopathies. Oronasal fistula in adults or cleft palate in puppies or kittens may be associated with food material appearing in the nasal discharge.

INITIAL EVALUATION OF PATIENTS WITH CHRONIC NASAL DISEASE

Clinical history and physical examination findings generally offer an indication for primary nasal disease as opposed to systemic or extra-nasal disease. A thorough physical examination with particular attention to orofacial structures is important in the evaluation of patients with chronic rhinitis.

The maxillary and frontal sinus regions should be visualized and palpated for evidence of asymmetry or swellings. The eyes should be examined for any evidence of exophthalmia. The external nares should be studied for patency, symmetry, and masses protruding through the openings. Facial asymmetry or exophthalmia would suggest an underlying neoplastic process or the presence of fungal rhinitis. Approximately 35% of cats with nasal cryptococcosis have prominent swellings over the bridge of the nose and some cats with nasal cryptococcosis will have a polypoid mass protruding through the nostril. The patency of airflow through each nostril may be determined by noting condensation on a glass slide held in front of the nose or alternately holding each nostril closed with assessment of airflow through the opposite nostril. Lack of airflow through one or both nostrils indicates presence of obstructive disease, but does not define an underlying cause. Plugs of inspissated mucopurulent debris will be as likely to obstruct airflow as a space occupying mass (e.g., neoplasia, fungal granuloma). Oral examination should be attempted (depending on the temperament of the patient) with visualization around the teeth and the hard plate for the presences of masses or clefts within the hard or soft palate. The mandibular lymph nodes should be palpated for enlargement or asymmetry. An otoscopic examination should be performed to detect signs of otitis, which may occur in cats with nasopharyngeal polyps. Finally, a complete ophthalmic examination to detect signs of systemic or fungal disease (e.g., anterior uveitis, chorioretinitis, optic neuritis) and evidence for hypertension or hyperviscosity syndrome (e.g., retinal hemorrhage, tortuous vessels, retinal detachment) may be indicated.

Routine laboratory tests (complete blood count, serum chemistries, and urinalysis), coagulation profile, blood pressure and thoracic radiographs are important to rule out most of the systemic or extranasal causes for nasal discharge. Culturing of nasal discharge for bacterial or fungal organisms are not recommended as secondary bacterial contaminates are typically isolated. Anesthesia is required for further evaluation of most patients with rhinitis. A thorough oral examination with inspection of the hard palate, oropharynx and dental structures should be performed. The soft palate should be palpated for the presence of masses (e.g., nasopharyngeal polyp in cats) in the nasopharyngeal region. If a mass is palpated above the soft palate, a spay hook may be used to gently retract the soft palate forward for visualization of the mass. If a nasopharyngeal polyp is identified, otoscopic examination should be performed to detect involvement of the ear canal. A periodontal probe should be used to inspect the gingival sulci of maxillary teeth. Oronasal fistulae are often associated with the maxillary third incisors, first and second premolars, and the mesial root of the third premolar.

DIAGNOSTIC IMAGING

Radiography

Diagnostic imaging studies are performed with the patient under anesthesia. Imaging studies are essential in most dogs or cats with chronic rhinitis to help achieve a diagnosis. It is critical that imaging studies are completed prior to rhinoscopy or collection of intranasal samples so that secondary hemorrhage does not obscure subtle lesions or affect the quality of diagnostic images. Radiographic images of the nose and sinuses may provide some insight but often do not reveal a specific cause for the nasal disease. The canine and feline head each consist of 50 bones and numerous soft tissue structures. Superimposition of these structures introduces ambiguity and confounds interpretation of survey radiographs of the nasal cavity and paranasal sinuses. Due to the complexity of the nose and overlying boney structures, radiography rarely offers the detailed information required to determine a precise cause and extent of chronic nasal disease. Radiographs also frequently lack sufficient resolution to identify or localize early nasal disease. The only exception is if dental disease is suspected following detailed examination of dental structures. High detailed dental films will offer superior information in regards to tooth roots and surrounding boney structures.

Patient positioning is critical for radiographs of nasal and paranasal structures. Views commonly used for evaluation of the nose and paranasal structures are dorsoventral (DV), intraoral DV, ventrodorsal (VD), open-mouth VD, lateral, and frontal. Particular attention needs to be made to placement of the tongue, pinnae, endotracheal tube, and ancillary supporting devices so that these

do not superimpose with the structures of the skull. Additionally, the position of the forelimbs and cranial trunk can have profound effects on skull rotation. Done correctly, these studies are time consuming and expensive. Careless patient positioning will invariably lead to images of suboptimal quality.

Computed Tomography

Computed tomography (CT) is vastly superior to plain radiographs of the nasal cavity. The methods commonly used to attempt to obtain a definitive diagnosis for chronic nasal diseases, such as nasal radiographs and even rhinoscopy, have proven unreliable. Due to the complexity of boney structures and large degree of overlapping structures, computed tomography is the imaging modality of choice for precise evaluation of diseases within the nasal cavity, paranasal sinuses, tympanic bulla, periorbital region, and skull. Computed tomography has proven to be superior to conventional radiography for detecting changes within the nasal cavity, determining the extent and severity of the disease process, and in differentiating infectious or inflammatory disease from nasal neoplasia. Radiographs have poor sensitivity for differentiating inflammatory rhinitis from neoplasia and fungal rhinitis. Rhinoscopy provides limited information about the extent of the disease and nasal biopsies can easily miss the primary disease process. In many situations, the presence of copious mucopurulent or hemorrhagic nasal discharge prevents adequate visualization of the nasal cavity. In addition to providing superior anatomic detail, the image acquisition time with computed tomography is considerably less than that for routine skull radiography.

Nasal CT is a rapid imaging modality that utilizes x-rays and complex computers to construct cross-sectional images of the nose, paranasal sinuses, and skull. The ability to obtain cross-sectional images allows for evaluation of internal structures and anatomical relationships that cannot be seen on conventional radiographs. Because x-rays are used to construct the tomographic images, the interpretation of computed tomography studies is comparable to basic radiographic principles. Computed axial tomography images are made by rotating a x-ray tube head around the patient in the area of interest. When image slices are collected in an axial fashion, the computed tomography table supporting the patient is held stationary during the time required to complete one revolution of the x-ray tube head. The computed tomography table then advances the patient a predetermined slice interval through the gantry and the next acquisition takes place. Newer spiral computed tomography units have the capacity to obtain images in a helical fashion. These scanners have the ability to move the patient through the gantry at a continuous rate while the x-ray tube head rotates continuously around the part of the patient being imaged. Advantages of helical computed tomography include reduced image acquisition time and the ability to reconstruct 3-dimensional images.

Nasal CT provides a thorough assessment of the nasal cavities and paranasal sinuses and provides superior insight to the nature and extent of disease. Nasal CT often can differentiate neoplastic nasal disease from fungal rhinitis and inflammatory rhinitis. Contrast-enhanced CT images are occasionally used and may be useful to distinguish between vascularized soft tissues versus mucous accumulation. Because nasal CT will clearly demonstrate the location and extent of nasal disease, it is often used to help guide post-imaging rhinoscopic and biopsy procedures. If routine diagnostics do not provide a cause for rhinitis, referral to an institution providing CT imaging is very much advised.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) of the nasal cavity has similar advantages to that of CT. Image acquisition time is considerably longer with MRI as compared to CT. MRI produces excellent tissue contrast with multiplanar imaging capacity and lacks ionizing radiation and bone beam-hardening artifact. From my current perspective, there does not seem to be superiority of MRI over CT for diagnostic evaluation of chronic nasal disease in dogs. Each modality has its own subtile strengths and weaknesses. One point that I believe CT has an advantage is that bone lysis is easier to identify, which is critical for treatment decisions should breach of the cribriform plate be present in patients with sinonasal aspergillosis. Over time MRI has become increasingly available in academic and private referral veterinary hospitals. Costs associated with MRI are considerable as compared to CT, although lesser for low-field veterinary MRI units. Image acquisition time is much more rapid with

CT than with MRI, which greatly reduces anesthetic time for the patient undergoing evaluation. Even though I have both advanced diagnostic imaging modalities in my hospital, the lack of a consistent advantage of MRI over CT and the faster acquisition time for CT are major reasons I will typically use CT in the evaluation of dogs with chronic nasal disease.

RHINOSCOPY

Rhinoscopy should only be performed after all imaging studies are completed and the patient is still under anesthesia. This is so that endoscopy-induced hemorrhage does not obscure the imaging studies. The nasopharynx is examined before the nasal cavity because if hemorrhage is induced by examination of the nasal cavities, blood will frequently pool in the nasopharynx and obscure visualization of abnormalities in this area. Retroflex nasopharyngoscopy is performed by turning a small flexible scope 180 degrees around the caudal margin of the soft palate for visualization and evaluation of the caudal nares, dorsal soft palate, and nasopharynx. Tumors or foreign bodies lodged within the caudal nares or within the nasopharynx occasionally cause chronic rhinitis in dogs and cats and are readily visualized with this procedure.

Anterior rhinoscopy is performed by direct passage of a scope through the rostral nares and allows for direct visualization of structures within the nasal cavity. Evaluation of the nasal cavity is often limited by the size of size of the scope in relation to the size of the nasal cavity, lesion location, and impeded visualization of intranasal structures by mucous or hemorrhage. The convoluted nature of the nasal passages will not allow for evaluation of the entire nasal cavity, so foreign bodies and neoplastic masses may be overlooked. Rhinoscopy is often of limited value in cats because of the specialized equipment required and the small size of the nasal passages. The rostral and middle regions of the nasal cavity may be evaluated in cats using a small rigid scope. Although rhinoscopy has utility in the diagnosis of chronic nasal disease, the various limitations outlined above severely limit its use as a sole (or preferred) diagnostic procedure. When available, nasal computed tomography is a vastly superior method for evaluation of the entire nasal cavity.

During rhinoscopy, the nasal mucosa is evaluated for color, vascularity, friability, edema, and presence of parasites or fungal plaques. The nasal passages should be evaluated for obstruction by tissue masses, foreign bodies, or secretions. A loss of normal nasal turbinates would indicate the presence of a destructive rhinitis secondary to fungal infection or severe inflammatory rhinitis. Rhinoscopy is especially helpful to aid in the diagnosis of fungal rhinitis and rostrally positioned nasal foreign bodies. Fungal rhinitis due to nasal aspergillosis is associated with widespread turbinate destruction and rhinoscopy reveals a cavernous nasal cavity with off white to grey fungal plaques scattered within the surface of the nasal mucosa.

NASAL BIOPSY

Procurement of nasal specimens and biopsies of nasal tissue should only be performed after all imaging studies are completed and the patient is still under anesthesia. Cytology of nasal secretions is rarely useful. Brush cytology directly obtained from masses or fungal plaques may be useful in establishing a diagnosis. Stained direct smears of nasal tissue specimens also can be useful for identifying fungal organisms. Tissue from lesions visualized during rhinoscopy may be obtained either by direct biopsy with forceps passed either adjacent to or through the endoscope. Rhinoscopic-directed biopsies of masses may be limited by the small size of tissue samples obtained and confounded by inflammation surrounding the mass. Lymphoplasmacytic inflammation often is concurrent with intranasal neoplasia, whereas idiopathic lymphoplasmacytic rhinitis in dogs or idiopathic chronic rhinosinusitis in cats are not associated with mass lesions in the nose. I prefer to use nasal CT images to guide instrumentation for procurement of biopsy samples. Depending on the size of the nose, either small clamshell or colonic biopsy forceps are advanced to the site of disease as identified from CT images and multiple biopsies are then obtained. During the biopsy procedure it is recommended that the dog or cat be in sternal recumbency with the rostral end of the nose directed downward to facilitate drainage of hemorrhage away from the nasopharynx and oropharynx. Following biopsy, the tip of the nose remains positioned downward and the oropharynx and cranial

esophagus is suctioned to remove blood clots. Nasal lavage may be required to dislodge foreign material identified or suspected to be present within the nose. The rostral aspect of the nose should be directed downward and copious amounts of saline are vigorously flushed through the nostrils.

In cats, if idiopathic chronic rhinosinusitis is suspected, deep tissue samples should be submitted for aerobic and anaerobic bacterial cultures as this disease is often complicated by primary bacterial infection. In dogs, tissue samples are not recommended routinely submitted for bacterial or fungal culture unless osteomyelitis is present. Nasal fungal and bacterial tissue cultures in dogs must be interpreted cautiously because fungal and bacterial isolates may be a consequence of nasal passage colonization rather than the cause of a given disease process. ***Primary bacterial rhinitis is exceedingly rare in the dog and bacterial infections are almost invariably secondary to underlying primary nasal disease.*** A heavy growth of even one or two bacterial isolates may merely be indicative of bacterial colonization; however, pure isolates of *Bordetella bronchiseptica* and possibly *Pasteurella multocida* may be significant if the clinical history is supportive. Normal dogs and dogs with nasal neoplasia or foreign bodies may have positive fungal cultures for *Aspergillus* species. A positive fungal culture should be supported by diagnostic imaging, cytological, rhinoscopic, or histological evidence of infection. If tissue cultures are submitted for dogs, they must be carefully interpreted in light of histopathologic and other diagnostic information. Hemorrhage is the only major complication following biopsy and may be managed using diluted 1:10,000 or 1:100,000 epinephrine in cold saline. The caudal pharyngeal region should be suctioned following nasal biopsy to remove blood clots, hemorrhage, and other secretions.

IDIOPATHIC CHRONIC RHINITIS

Feline Chronic Rhinosinusitis

Chronic rhinosinusitis is an extremely significant disease, representing one of the two most common causes of sneezing and nasal discharge in cats. Chronic rhinosinusitis may follow severe acute upper respiratory tract infection, particularly in kittens or adults cats exposed to an infected cat. Acute upper respiratory tract disease is presumed to be due to infection with feline herpesvirus type 1, feline calicivirus, Chlamydia felis, or some combination of these agents. Although viral (especially feline herpesvirus type 1) or Chlamydia infection is often implicated as the initiating cause of acute rhinitis, the pathogenesis of idiopathic chronic rhinitis is unknown and it is uncertain whether acute rhinitis is related to the chronic syndrome. Even though cats with idiopathic chronic rhinosinusitis have similar clinical signs, the disease syndrome appears heterogenous among the population perhaps due to individual susceptibility to microbial pathogens, genetic characteristics of the inflammatory response, and environmental factors (e.g., stress) having a role in the development of clinical signs. The complex interrelationship of viral or bacterial organisms involved in the acute disease process combined with individual uniqueness of the inherent inflammatory response may be important factors in the genesis of the chronic rhinitis. A thorough understanding of these characteristics would likely facilitate treatment recommendations for patients so affected.

Feline herpesvirus type 1 is estimated to account for the majority of cases of acute severe upper respiratory disease in cats, although calicivirus may be more prevalent in some populations. Feline herpesvirus type 1 is possibly an important pathogen for initiating chronic rhinitis. Experimental infection of germ-free cats with feline herpesvirus type 1 can cause severe upper respiratory disease in the absence of microbial flora. In the natural cat population, it is likely that some complex interrelationship between herpesvirus type 1 viral infection, the various bacterial organisms within the nose and host immunity play important factors influencing the severity and duration of upper respiratory disease. The role any one or combination of microbial agents plays in the pathogenesis of chronic rhinosinusitis is ultimately not understood. Keep in mind that identification of one or more bacterial or viral organisms via culture, antibody titers, or molecular techniques does not imply that the organism or organisms found are responsible for the clinical signs. In summary, a complex progression of microbial, physiological, anatomical, and immunological interactions are likely responsible for development of chronic rhinosinusitis.

Idiopathic chronic rhinosinusitis may be seen in cats of any age, although younger cats are most often afflicted. Affected cats with this disease syndrome typically have a recurrent history of chronic intermittent or progressive sneezing, stertor, and nasal discharge. The nasal discharge is usually copious, bilateral, and mucopurulent to purulent, although occasionally the discharge can be unilateral or intermittently contain blood. Systemic or ocular disease is generally not present. Older cats may develop anorexia due to loss of smell, which may exacerbate other underlying disease conditions (i.e., chronic renal failure, liver, or gastrointestinal disease).

Physical examination findings are generally unremarkable other than abnormalities confined to the upper respiratory tract. The dental arcade (e.g., gingivitis, tooth root abscessation, oronasal fistula), hard palate (e.g., neoplasia, oronasal fistula), soft palate (e.g., nasopharyngeal mass or polyp), and regional lymph nodes (e.g., lymphadenopathy) are all structures that should be carefully evaluated. A fundic examination is recommended if Cryptococcosis is suspected.

A complete health profile with serology for feline leukemia virus and feline immunodeficiency virus is essential to assess systemic health. General anesthesia is required for thorough oral examination and skull radiographs or advanced diagnostic imaging studies. In general, computed tomography provides better localization of lesions and determination of extent of disease within the nasal cavity, paranasal sinuses, and tympanic bulla than do radiographs. Nasal computed tomography findings in cats having chronic rhinosinusitis 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 cribriform plate.

Following completion of diagnostic imaging studies, the nasal cavity and nasopharyngeal region should be evaluated as completely as possible. Cats with idiopathic chronic rhinosinusitis have mild to severe hyperemia of nasal mucosa, moderate to large amounts of mucoid to purulent discharge between turbinates, and varying severity of turbinate destruction (although in some cats the turbinates may be normal). The degree of observed abnormalities may vary between each side of the nasal cavity. Histopathology findings may include moderate to severe neutrophilic, lymphocytic, or pleiocellular inflammation with epithelial ulceration, turbinate destruction and remodeling, fibrosis, necrosis, and glandular hyperplasia. Histologic changes may be predominately unilateral rather than bilateral. Nasal biopsy samples or material cultivated from deep nasal aspiration should also be submitted for microbial culture and sensitivity. Aerobic, anaerobic, and Mycoplasma cultures should be requested. ***Bacterial culture of nasal discharge is not recommended as secondary bacterial contaminates are typically isolated.*** Following visualization of the nasal cavity and collection of biopsy materials, the nasal cavities should be suctioned and flushed with copious amounts of warm isotonic solution to remove secretions and provide temporary improvement in clinical signs. When flushing fluids within the nasal cavity, the tip of the nose should be pointed downward and the oropharynx packed with gauze to prevent aspiration of the lavage solution and nasal secretions into the trachea.

Cats having chronic rhinosinusitis frequently prove to be very refractory to treatment. Broad-spectrum antibiotics are often used for treatment of secondary bacterial colonization or infection within the nasal and paranasal sinus cavities. Recent work has disclosed that potentially pathogenic bacteria and a wider variety of bacterial species are isolated from cats with idiopathic chronic rhinitis than from cats without disease. *Mycoplasma* spp. and anaerobic bacteria were only isolated from cats with idiopathic chronic rhinosinusitis. Antibiotic therapy should be determined from culture of nasal biopsy material or specimens collected from a deep nasal flush. Antibiotics recommended include doxycycline, clindamycin, amoxicillin-clavulanic acid, cefpodoxime, marbofloxacin, and azithromycin. Cats with idiopathic chronic rhinitis demonstrating an initial response to antibiotic therapy should have treatment continued for 6-8 weeks or longer. Antiviral therapy is not routinely recommended, as substantiation regarding a primary role for feline herpesvirus type 1 in this disease syndrome has not been established. However, it is likely that feline herpesvirus type 1 may play a role in the disease of certain cats. Lysine (500 mg PO q12h) therapy may benefit some cats. Lysine replaces arginine in viral proteins rendering them nonfunctional and thereby reducing viral replication. For those cats demonstrating response to lysine, therapy may be continued indefinitely as it is safe to use in young

or older cats. The role of immunosuppressant agents in management of idiopathic chronic rhinosinusitis is poorly understood. Glucocorticoids may exacerbate viral infection, cause recrudescence of viral shedding, or suppress immune response to bacterial infection. Piroxicam is a non-steroidal antiinflammatory agent that can ameliorate clinical signs in some cats with idiopathic chronic rhinosinusitis. Piroxicam is generally well tolerated at a dose of 0.3 mg/kg orally daily or every other day. Side effects may include anorexia, diarrhea, or vomiting. Piroxicam may also be combined with antibiotic therapy. Moisturization of nasal secretions promotes sneezing and evacuation of mucous from the nasal cavity. Some cats will tolerate the instillation of saline drops within the nasal cavity. Maropitant citrate (Cerenia) may be useful in some cats though inhibition of substance P, which has been implicated in inflammation owing to its effects on cells associated with acute and chronic inflammatory responses. Maropitant citrate should be given 5 days on and 2 days off standard anti-nausea dosing regimen. Finally, there are no clinical studies with evidence to support the use of immune simulators (e.g., interferon) in the management of this disease.

In summary, the prognosis for cats having chronic rhinosinusitis is extremely guarded. The chronic nasal discharge and sneezing are very difficult to control, and if control is achieved, it is often temporary with recurrence expected. A number of surgical techniques have been described but are attended with generally disappointing results and not recommended.

Canine Idiopathic Chronic (Lymphoplasmacytic) Rhinitis

Idiopathic chronic rhinitis is present in approximately 37% of dogs with chronic nasal disease. The definitive cause of chronic rhinitis remains undetermined; however, it is likely an aberrant innate and adaptive immune response to multiple precipitating factors. Dysregulation of genes encoding Toll- and Nod-like pattern recognition receptors involved in the innate immune response in the nasal mucosa of dogs with chronic rhinitis has recently been described. Inhaled aeroallergens and irritants probably play a primary role in the development of this disease. Hypersensitivity to native commensal fungal organisms within the nose also may play a role in some patients.

Dolichocephalic and mesaticephalic medium to large breed dogs and seemingly Dachshunds are typically affected. Chronic unilateral to bilateral mucoid to mucopurulent nasal discharge is often present, although some dogs may have mucohemorrhagic discharge or epistaxis. Obstructive nasal breathing in dogs so affected is from excessive mucous within nasal passages and turbinate mucosal edema.

Nasal CT findings in dogs having idiopathic chronic rhinitis are variable and may be completely unremarkable or only reveal diffuse edema of turbinate mucosa. Often mucous accumulation within air passages and sinuses is observed. Unilateral or bilateral mild to moderate turbinate destruction may also be seen and occasionally the turbinate destruction may be quite severe mimicking that seen with fungal rhinitis. Destruction of the nasal septum, frontal sinuses or cribriform plate, or extension of disease into the nasopharynx or periorbital region is not expected in dogs with idiopathic chronic rhinitis. These findings should prompt investigation into the presence of fungal rhinitis or neoplastic disease.

Rhinoscopic abnormalities include unilateral or bilateral erythema or hyperemia and edema of the nasal mucosa with the presence of mucopus with air passages. Turbinate atrophy or loss is occasionally appreciated. Nasal samples for microbial culture are often not informative and not routinely recommended. Histologic changes include mild to severe lymphoplasmacytic inflammation with occasional infiltration of neutrophils or eosinophils. Turbinate remodeling or destruction may be absent or vary from mild to severe. There may be discordance between the right and left sides of the nasal cavity in the severity of histologic changes. Lymphoplasmacytic inflammation may be present with other chronic nasal diseases (e.g., nasal neoplasia, fungal rhinitis or foreign body rhinitis), therefore it is imperative that these diseases be thoroughly excluded before a diagnosis of idiopathic chronic rhinitis is entertained.

Treatment in dogs having idiopathic chronic rhinitis is extremely frustrating with cure rarely achieved. Although this is not a life-threatening disease, owners of dogs so affected are often distraught by their pets' nasal obstruction or the need to frequently clean up sneezed nasal discharge or hemorrhage throughout the house. Allergen avoidance is rarely helpful; however, avoidance of

secondhand smoke can substantially reduce signs in some dogs. Controversy surrounds the use of systemic corticosteroid or immunosuppressive agents. I feel that these oral medications are seldom effective in controlling clinical signs. Topical glucocorticoid therapy with nasal steroid drops or aerosolized steroids administered using metered dose inhalers attached to a spacer and tightly fitting facemask has shown anecdotal promise in some dogs with chronic rhinitis. Antihistamine medications are rarely effective, but they occasionally slightly reduce the severity of nasal discharge. Long-term administration of antibiotics having immunomodulatory effects combined with nonsteroidal antiinflammatory agents can be helpful in some dogs. Doxycycline 3-5 mg/kg q12h, PO or azithromycin 5 mg/kg q24h, PO in combination with piroxicam 0.3 mg/kg q24h, PO is recommended. If distinct clinical improvement is observed within 2 weeks, daily piroxicam therapy is continued but the frequency of administration of doxycycline is reduced to once daily or azithromycin reduced to twice weekly. Therapy will likely be required for a minimum of 6 months if not indefinitely.

Oclacitinib (Apoquel) is a Janus kinase inhibitor that restrains the function of proinflammatory cytokines that are dependent on JAK1 or JAK3 enzyme activity with minimal effect on JAK2-dependent cytokines involved in hematopoiesis and innate immunity. Preliminary experience with use of oclacitinib in dogs with chronic rhinitis suggests it may ameliorate clinical signs in some, but not all dogs with this disease.

NASAL NEOPLASIA AND NASAL POLYPS

Nasal neoplasia is an important cause and accounts for approximately 45% of nasal disease in middle aged to older dolichocephalic and mesaticephalic dogs. Nasal neoplasia is second to idiopathic chronic rhinosinusitis as the most common causes of chronic nasal disease in cats. In dogs, tumors of epithelial origin account for approximately two thirds of nasal neoplasms. In cats, nasal lymphoma is most common with carcinomas occasionally seen and other neoplasms encountered much less frequently. The majorities of nasal tumors are malignant and primarily arise within the nasal cavity, although they occasionally may arise in the paranasal sinuses. Nasal tumors are locally invasive with local to widespread destruction of nasal turbinates seen initially, followed by invasion of septal, cribriform or facial bones later in the course of disease. Metastasis to regional lymph nodes or lung may occur, but this is rare and generally occurs in the very late stage of disease. Clinical signs are primarily related to obstruction of airflow through the nasal cavities, mucopurulent nasal discharge, epistaxis, sneezing, and reverse sneeze. Facial deformity (asymmetry), exophthalmia, or neurological signs may be seen as a result of tumor destruction of facial bones, orbital wall, or cribriform plate. Facial pain and head shyness is rarely seen (unlike that with fungal rhinitis). In some patients, initial clinical signs may be very subtile with unexplained onset of snoring, obstructive nasal breathing, or occasional reverse sneeze reported.

In dogs or cats having nasal neoplasia, nasal CT typically reveals a soft tissue contrast enhancing soft tissue mass with locally asociated bone destruction and often extension of disease into surrounding structures. The CT findings in cats with nasal lymphoma may be highly variable ranging from a very destructive disease to those mimicking changes similar to that seen with idiopathic chronic rhinosinusitis. Nasal CT studies facilitate direction and location for blind biopsy of the affected region(s) of the nose.

Radiation therapy is the treatment of choice for most nasal tumors. Thoracic radiographs are recommended when nasal neoplasia is identified prior to radiation therapy to rule out metastatic lung disease. To plan for radiation therapy, nasal CT or MRI is needed for staging and to delineate tumor boundaries. Surgery alone is ineffective with survival times similar to that observed in untreated dogs. Other than nasal lymphoma, there is limited information on the response of nasal tumors to chemotherapy alone. Depending on the mode of radiation therapy available, approximate median survival times are between 16.5-23 months and approximate 1 year survival rates are between 54-60% in dogs with nasal neoplasia. Exenteration of the nasal cavity following accelerated radiotherapy significantly prolongs survival time in dogs with intranasal neoplasia over radiotherapy alone.

Polyps within the nasal cavity are very rare in dogs. These are usually unilateral and rhinotomy is required for removal of the polypous tissue and surrounding conchae. Recurrence 1-2 years later is possible.

FUNGAL RHINITIS

Fungal rhinitis is an uncommon cause of chronic rhinitis in cats, although in some geographic areas the disease is seen frequently. Nasal cryptococcosis is most common and nasal aspergillosis is only occasionally encountered. Facial deformity of the rostral aspect of the nose is often striking in cats with cryptococcosis. Occasionally granulomatous tissue may be seen projecting through the external nares. The clinical signs of cryptococcosis are obstructive rhinitis with mucopurulent nasal discharge. Mucopurulent conjunctivitis may develop in some cats. Cytology can be highly diagnostic for nasal cryptococcosis. Fresh material from granulomatous lesions within the nose are gently smeared on a slide and stained with India ink. Cryptococcus spp. organisms are recognized as a thick, encapsulated round to oval yeast.

Nasal aspergillosis is rare in cats. The clinical signs are initially copious unilateral mucopurulent nasal discharge. Bilateral mucopurulent nasal discharge can be seen later in disease. Intermittent bleeding is not uncommon. Nasal pain is often present. Anorexia and depression may develop as the disease progresses, especially with frontal sinus involvement or with destruction of maxillary bones. Extensive turbinate destruction is present. The extent of destruction and determination of sinus or maxillary bone involvement is best demonstrated with computed tomography. The diagnosis of aspergillosis is made by direct observation of fungal plaques, identification of fungal elements in biopsy specimens or direct cytology obtained from affected tissue, or positive fungal culture of affected tissue.

Fungal rhinitis is a relatively common cause of chronic rhinitis in the dog within various geographic regions throughout North America. *Aspergillus fumigatus* is the most common cause of fungal rhinitis in dogs, but occasionally *Penicillium* spp and *Rhinosporidium seeberi* and very rarely *Cryptococcus neoformans* may cause disease. *Rhinosporidium seeberi* is associated with the growth of a granulomatous mass within the rostral nasal cavity. Cytology of tissue from these granulomatous masses is often diagnostic. Treatment for rhinosporidiosis is best accomplished by aggressive surgical resection of the granulomatous mass.

Nasal aspergillosis is most commonly seen in mesaticephalic and dolichocephalic large breed dogs. Affected dogs often present with copious unilateral or bilateral mucopurulent nasal discharge. Sneezing is common and may be accompanied by mild to severe epistaxis. Facial pain and depigmentation and ulceration of the nasal planum may be present. In contrast to nasal neoplasia, facial distortion is unusual in all but advanced cases of fungal rhinitis. Nasal CT studies along with rhinoscopic visualization of the nasal cavity are noteworthy for the presence of dramatic turbinate loss within the nasal cavity. Sinus involvement may be present. Invasion through the maxillary or palatine bones with extension into surrounding soft tissue structures is occasionally seen. Primary fungal sinusitis may be seen and in these patients nasal discharge may be minimal despite extensive turbinate destruction on the side of sinus involvement.

The boney destruction seen with this disease is not caused by the fungus itself, but appears to be due to the host inflammatory response due an aberrant dysregulation of innate and adaptive immune responses. Systemic immune suppression is not present in affected dogs. Local immune-dysfunction owing to imbalance between pro-inflammatory and anti-inflammatory signals is likely involved in the pathogenesis of this disease. Dysregulation of genes encoding Toll- and Nod-like pattern recognition receptors involved in the innate immune response in the nasal mucosa of dogs with sino-nasal fungal rhinitis has recently been described.

Diagnosis of nasal aspergillosis is confirmed by visualization of fungal plaques on nasal mucosa and demonstration of branching septate hyphae on cytologic or histologic samples from affected regions within the nose. There is high accuracy of cytology samples in the diagnosis of nasal aspergillosis or penicilliosis when collection is done under direct endoscopic visualization; whereas, there is poor value of samples collected by blind swabs or preparations from samples of nasal

discharge. Serologic tests positive for aspergillosis also support the diagnosis although negative results may occur even with extensive disease. Culturing nasal discharge material may be misleading because 30-40% of cultures from normal dogs and those with nasal neoplasia can yield *Aspergillus* or *Penicillium* species. Despite properly obtained samples there are some cases that fail to demonstrate fungal organisms. Repeated sampling or a trial of antifungal drugs may well be indicated in dogs with a high index of suspicion for fungal rhinitis.

The prognosis for treatment of nasal aspergillosis is fair to good, but relapses are possible necessitating re-treatment. Treatment of nasal aspergillosis has classically been approached with topical infusion of either clotrimazole or enilconazole, providing the cribriform plate is intact. Nasal CT or MRI studies are preferred over radiographs to evaluate integrity of the cribriform plate prior to local antifungal therapy. Topical therapy is more effective than orally administered antifungal agents. Clotrimazole (Lotrimin solution®, Schering Plough Corp.) is available over the counter as a 1% solution and enilconazole (Clinifarm-EC®, Sterwin Labs, Inc.) is provided as 13.8% concentrate that is diluted to a 1, 2, or 5% solution prior to instillation in the nasal cavity. Debridement and removal of diseased turbinate structures through the rostral nares prior to topical therapy will greatly improve response to treatment. Topical therapy with either drug alone is not effective in dogs in which the organism has invaded soft tissue structures adjacent to the nose. In these cases, topical therapy is combined with systemic antifungal agents.

The approach to topical therapy I prefer (providing the cribriform plate is not breached) having good success rate, shorter treatment time, and low patient morbidity is a combination of clotrimazole irrigation and depot therapy. Frontal sinus trephination is followed by a short, five-minute flushing of 1% topical clotrimazole solution followed by a 1% clotrimazole cream instilled as a depot agent into the frontal sinuses. With this treatment protocol, 86% of dogs with nasal aspergillosis or penicilliosis established a cure from infection. Debridement of diseased nasal turbinates prior to treatment may result in a higher cure rate with this treatment procedure.

Oral antifungal agents have relatively poor efficacy against *Aspergillus* infection, but are recommended if the cribriform plate is penetrated. Oral antifungal agents are used in combination with topical agents if invasion of local bone and soft tissue structures is present. The newer azole derivatives have the best results, but side effects include anorexia, vomiting, lethargy, elevated BUN, skin ulcerations, fever and hepatotoxicity. Itraconazole (Sporanox®, Janssen) is recommended due to its low toxicity. Itraconazole 5 mg/kg q12h, PO given for 3-6 months may cure up to 60-70% of dogs with aspergillosis, although some studies have shown only marginal efficacy (I find itraconazole to be minimally effective in dogs). Terbinafine (Lamisil®, Novartis) is also well tolerated and a dose of 5-10 mg/kg q12h, PO appears to effective when given for minimum of 3-6 months. Fluconazole (Diflucan®, Pfizer) is ineffective. Voriconazole (Vfend®, Pfizer) is a new generation broad-spectrum antifungal agent that has both fungicidal and fungistatic activities *in vitro* against *Aspergillus* spp. Clinical experience with this drug suggests it is highly effective at a dose for dogs of 5 mg/kg q12h for a minimum of 2-6 months.

NASOPHARYNGEAL POLYPS

Nasopharyngeal polyps occur predominately in young cats or kittens. Nasopharyngeal polyps usually arise from the middle ear and grow down the eustachian tube to the nasopharyngeal region. Polyps occasionally may be visible in the external ear canal. Clinical signs are caused by direct obstruction of either the oropharynx or nasopharynx. Chronic rhinitis develops secondary to polyps within the nasopharyngeal region due to secondary bacterial overgrowth due to the lack of clearance of nasal secretions. Clinical signs observed in the early stage of disease include stertorous respiration (snuffling sound), gagging, and minimal sneezing or nasal discharge. As the polyps attain greater size, obstructive breathing and increased nasal discharge with sneezing are seen. These signs may be indistinguishable from those of idiopathic chronic rhinitis, especially in a young cat with a prior history of acute upper respiratory infection. For this reason, any cat with chronic rhinitis (especially those of young age) should be carefully evaluated for the presence of polyps.

The diagnosis of nasopharyngeal polyp is relatively straight forward. Oropharyngeal examination and palpation of the area above the soft palate for a mass or direct visualization of the nasopharyngeal region is diagnostic. Once the diagnosis of nasopharyngeal poly is made, skull radiographs (obtained with the cat under general anesthesia) or computed tomography of the bulla region should be performed. Careful evaluation of the osseous and tympanic bulla and petrous temporal bones is essential for evidence of middle ear inflammation or infections characterized by osseous bulla thickening, soft tissue densities within the tympanic cavity, or sclerosis of the petrous temporal bone. Radiographic evidence of middle ear inflammation or infection may not always be present, whereas computed tomography offers enhanced discrimination of middle ear involvement.

Nasopharyngeal polyps may be removed by traction avulsion, however recurrence is common. Bulla osteotomy is definitely indicated and should be performed in cats when radiographic or tomographic evidence of middle ear involvement is present. It has been advocated that bulla osteotomy should always be performed on the side of polyp origin, even without radiographic changes without the osseous bulla. For polyps with recurrence following traction avulsion, bulla osteotomy on the side of polyp origin should always be recommended to allow for removal of the origin of the polyp.

FOREIGN BODY RHINITIS

Nasal or nasopharyngeal foreign bodies are infrequent in cats and are usually due to blades of grass lodged within the nasal cavity. Seeds and grass awns are less frequently encountered. Nasal foreign bodies are encountered a bit more frequently in dogs, with grass awns, sticks, and other plant material encountered most often. The parasite *Cuterebra* may be encountered as a foreign body occasionally in the nasal cavity of cats and very rarely in dogs. Foreign bodies enter the nasal cavity either rostrally or by entry through the caudal nares. In the later situation, foreign material is ingested and then either gagged or vomited, inadvertently transferring the foreign material into the nasopharynx and then through the caudal nares into the caudal nasal cavity.

Clinical signs associated with foreign bodies within the nasopharyngeal region are often peracute with coughing, gagging, and hard swallowing response usually observed. With time, stertorous respiration, phonation changes, nasal discharge, and sneeze may develop with nasopharyngeal foreign bodies. Clinical signs associated with foreign bodies confined within the nasal passages may be acute or chronic and often consists solely of sneezing and nasal discharge. Nasal foreign bodies not immediately expelled from the nose will develop progressively increasing nasal discharge, often attended by occasional hemorrhage. Severe granuloma tissue response may occur with long-term foreign bodies.

Grass blades and similar material can usually be removed under direct examination of the nasopharynx or nasal cavities. Retroflex nasopharyngoscopy is diagnostic for nasopharyngeal foreign bodies. Alternatively, a spay hook may be used to retract the soft palate forward (with or without the aid of a dental mirror) to observed the nasopharyngeal region. Flushing the nose with copious amounts of warm saline may dislodge smaller particles (e.g., seeds) within the nasal cavity. The nose should be directed downward and the caudal oropharynx should be packed with gauze to prevent aspiration of saline and nasal secretions into the trachea. Rhinotomy may be required for longstanding cases with excessive granulation tissue or foreign bodies resistant to direct removal (e.g., grass awns).

NASOPHARYNGEAL STENOSIS

Nasopharyngeal stenosis is a rare complication of acute upper respiratory tract infections or following episodes of severe vomiting (e.g., aspiration rhinitis). Nasopharyngeal stenosis is characterized by scar tissue that forms a membrane or “webbing” above the soft palate and obstructs airflow through the nasopharynx. Initially progressively worsening stertor is present with absence of nasal discharge. With severe stenosis, nasal discharge and extreme difficulty with nasal breathing is observed. Diagnosis is made using flexible endoscopy during evaluation of the nasopharyngeal

region. Retroflex nasopharyngoscopy will often reveal circumferential stricture or narrowing of a focal region of the nasopharynx.

Early stenosis may be managed by stretching the affected region followed by corticosteroid therapy to reduce scar tissue and reformation of the stricture. Recurrence unfortunately is very common necessitating extensive surgical techniques to resect the stenotic region, or balloon dilation of the affected region. The placement of stents in the affected region following surgery or balloon dilation is often required to prevent re-stricture.

NASOPHARYNGEAL TURBINATES

Nasopharyngeal turbinates is a condition upon which the nasal turbinates protrude caudally through the caudal nares into the rostral nasopharyngeal region. Nasopharyngeal turbinates are the 4th most important complicating related component causing upper airway obstruction as part of the brachycephalic airway syndrome (elongation of the soft palate, stenotic nares, and everted laryngeal saccules are the 1st thru 3rd imported related components, respectively). The presence of nasopharyngeal turbinates results in variable degrees of upper airway obstruction with nasal breathing. Nasopharyngeal turbinates are seen with highest incidence in Pugs, and less frequently in French and English bulldogs, and Pekinese dog breeds. This condition is also seen occasionally in Himalayan and Persian cats. Retroflex nasopharyngoscopy should be performed in the evaluation of dogs and cats with brachycephalic airway syndrome as this is a permanent and untreatable condition and may be a significant factor for constant airway obstruction in patients so affected.

XEROMYCTERIA

Xeromycteria (dry nose) can be unilateral or bilateral and is due to parasympathetic neurogenic loss of secretions from the lateral nasal gland in dogs. The lateral nasal gland provides moisture to the lining of the nose, and moisture translocates over the surface of the nasal planum. Otitis media can lead to transient or complete loss of parasympathetic innervation to the lateral nasal gland, because postganglionic parasympathetic innervation to the lateral nasal gland is via fibers coursing with the facial nerve through the petrous temporal bone. Clinically patients have unilateral or bilateral hyperkeratosis and dryness of the nasal planum and mild thick nasal secretions within the nostril(s). Tear production is often normal as long as there is no damage to the preganglionic parasympathetic nerve proximal to the pterygopalatine ganglion. Successful treatment of the otitis media may lead to restoration of normal secretions from the lateral nasal gland.

MISCELLANEOUS CASUSES OF CHRONIC RHINITIS IN DOGS

Parasitic rhinitis is uncommon. The treatment for nasal mites (*Pneumonyssus caninum*) is ivermectin 0.2 mg/kg, PO with the dose repeated in 2-3 weeks, or milbemycin 1 mg/kg PO once every 10 days for 3 treatments. The treatment for nasal nematodes (*Eucoleus [Capillaria] boehmi*) is not clearly defined although ivermectin 0.2 mg/kg, PO once has been reportedly effective. Allergic rhinitis is often mild, but if severe, antihistamines such as diphenhydramine, chlorpheniramine, or trimeprazine-prednisone (Temaril-P®, Pfizer Animal Health) may be tried to control symptomatology. In the rare situation of bacterial rhinitis due to *Bordetella bronchiseptica*, doxycycline 5-10 mg/kg q12h, PO for 2 weeks may be effective.