

Clinical and Diagnostic Imaging Findings in Canine Fungal Rhinitis

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Abstract

Fungal rhinitis poses a diagnostic challenge due to similar clinical manifestations with other chronic nasal diseases. Definitive diagnosis requires various diagnostic imaging modalities along with biopsy. The present study evaluates the clinical, rhinoscopic and computed tomographic changes in six dogs with fungal rhinitis. Dogs suspected with nasal cavity diseases were subjected to radiography and computed tomography of skull and rhinoscopy with biopsy collection. Six dogs confirmed with fungal rhinitis is presented in detail. Ten apparently healthy dogs were utilized for reference values of parameters under study. The present work describes clinical, haemato-biochemical and diagnostic imaging changes in canine fungal rhinitis.

Key words: Dogs- fungal rhinitis- rhinoscopy – computed tomography

Fungal rhinitis in dogs can cause severe damage of nasal mucosa and turbinates. Definitive diagnosis often requires advanced imaging diagnostic modalities along with a biopsy. Radiography often fails to provide accurate data on lesion size and extension to adjacent structure of nasal cavity whereas computed tomography of the head enables detailed assessment of the nasal cavity and adjacent structures (Lefebvre *et al.*, 2005). Rhinoscopy allows direct visualization of the nasal mucosa and enables endoscopy-guided biopsy for confirmative diagnosis (Knotek *et al.*, 2000).

Materials and Methods

Dogs brought to the Small Animal Out-Patient unit of Madras Veterinary College Teaching Hospital from March 2021 to November 2022 were utilized for the study. For this, 44 dogs with history and clinical signs suggestive of nasal cavity diseases were screened and subjected to detailed clinical, haemato-biochemical, radiographic, computed tomographic and rhinoscopic examinations.

All diagnostic imaging were done in these dogs under general anaesthesia in a standard manner. The radiographs of skull were taken in standard dorsoventral and lateral views as described by Thrall *et al.* (2017). Computed tomography of skull was performed as described by Schwarz and Saunders (2011) where contiguous images were obtained from the caudal limit of the frontal sinuses to the nares with the animal on sternal recumbency.

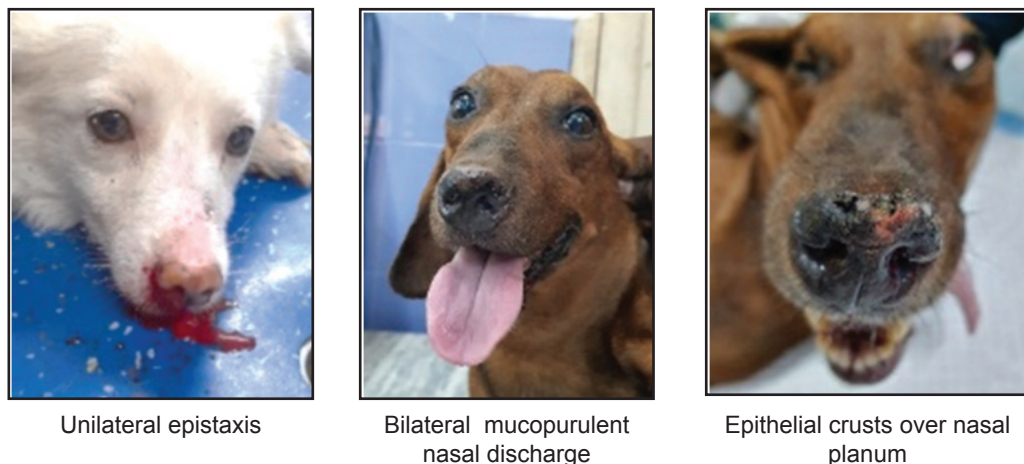
Rhinoscopy was performed using anterograde and retrograde methods. A flexible bronchoscope (bronchoscope 3.5 mm diameter with two-way deflection- Olympus type BF 1T150, Japan) was used for posterior rhinoscopy. An arthroscope with cystoscopy sheath (2.7mm 30-degree Karl Storz, Germany) was used for anterior rhinoscopy. Nasal swabs obtained from both nasal cavities were subjected to cytological analysis. Tissue sample obtained using endoscopic forceps were fixed in 10 per cent formalin and used for histopathological studies.

Results and Discussion

In the present study, a total of 44 dogs with

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Plate 1 Clinical signs in dogs with fungal rhinitis



nasal cavity diseases were screened, of which 6 dogs (13.64 per cent) were diagnosed with fungal rhinitis. Ostrzeszewicz and Sapieryński (2015) reported that 20.9 per cent of dogs with clinical signs of upper respiratory tract diseases had fungal rhinitis. Data on patient characteristics and clinical signs are presented in Table I and Plate 1.

In the present study, dogs were aged between 1.7 and 10 years and no sex predilection was noted. Nasal aspergillosis occurs mostly in young to middle aged patients and the age of patients ranged from 1 to 13 years (Benitah, 2006 and Sharman and Mansfield, 2012). No breed or sex predisposition was reported in dogs with fungal rhinitis (Lobetti, 2009).

Clinical signs

Clinical signs were suggestive of nasal disease

that persisted from 10 days to 3 months. The predominant clinical findings in dogs with fungal rhinitis are presented in Table I and Plate 1. Chronic nasal discharge or/and epistaxis were recorded in all the patients except one dog. In the present study, the consistent clinical manifestation was epistaxis. The most typical clinical signs of canine fungal rhinitis according to previous studies included purulent or mucopurulent nasal discharge, sneezing, facial pain, epistaxis, stridor, ulceration or depigmentation of external nares (Mathews, 2004; Lorenzi *et al.* 2006 and Meler *et al.* 2008).

The haematobiochemical changes in dogs with fungal rhinitis from apparently healthy dogs was analysed using independent t test (Table II). The haematological and serum biochemical values in dogs with fungal rhinitis were unremarkable according to previous studies (Wolf, 1992). In contrast, dogs with fungal rhini-

Table I: Signalment, duration and character of clinical signs in dogs with fungal rhinitis

Case	Breed	Age (years)	Sex	Clinical signs	Duration
01	Labrador	6.0	F	U-Ep,	2 weeks
02	Spitz	10.0	F	U-Ep, Sn	2 months
03	Labrador	4.0	M	U-Ep	2 months
04	Dachshund	6.0	M	B MPu ND, Ep, NB D, Sn, FP, EC NP	3 months
05	Spitz	5.0	F	U-Ep, Sn, FP	2 months
06	Labrador	1.7	M	Sn, R Sn, MB	10 days

U- unilateral; B – bilateral; M - Mucous; Pu – purulent; ND - nasal discharge ;Ep – Epistaxis; EC NP – Epithelial crusting on nasal planum ; NB D – Nasal bridge deformity ; MB - mouth breathing; Sn - Sneezing; R Sn – Reverse sneezing

Table II: Haemogram and serum biochemistry in apparently healthy dogs and dogs with fungal rhinitis (Mean \pm S.E.)

Parameter	Apparently healthy dogs (n=10)	Dogs with fungal rhinitis (n=6)	"t" test
Hb g/dL	15.09 \pm 0.32	12.23 \pm 0.73	4.123**
PCV %	44.73 \pm 0.92	36.83 \pm 2.33	3.696*
RBC 10 ⁶ /cmm	6.85 \pm 0.15	5.83 \pm 0.39	2.883*
PLT 10 ⁵ /cmm	2.5 \pm 0.25	2.56 \pm 0.70	0.107 ^{NS}
WBC 10 ³ /cumm	12.53 \pm 1.11	21.57 \pm 5.08	2.202 ^{NS}
Neutrophils 10 ³ /cumm	9.14 \pm 0.79	17.79 \pm 4.82	2.283*
Lymphocytes 10 ³ /cumm	2.85 \pm 0.27	2.73 \pm 0.23	0.289 ^{NS}
Monocytes 10 ³ /cumm	0.52 \pm 0.06	0.99 \pm 0.19	2.911*
Eosinophils 10 ³ /cumm	0.1 \pm 0.04	0.11 \pm 0.09	0.062 ^{NS}
Total protein g/dL	7.34 \pm 0.12	6.97 \pm 0.31	1.320 ^{NS}
Albumin g/dL	2.89 \pm 0.14	2.78 \pm 0.34	0.333 ^{NS}
Creatinine mg/dL	1.05 \pm 0.05	1.05 \pm 0.20	0.008 ^{NS}
ALT IU/L	51.3 \pm 6.33	43.87 \pm 9.04	0.692 ^{NS}

*Significant (p < 0.05), ** Highly significant (P < 0.01) and NS :Non significant (p > 0.05)

tis in the present study had a reduced mean red blood cell count, haemoglobin and haematocrit compared to that of the respective mean of the healthy dogs. Anaemic changes in dogs with fungal rhinitis might be due to chronic blood loss in nasal discharge. Tasker *et al.* (1999) and Lefebvre *et al.* (2005) reported leukocytosis and neutrophilia in dogs with persistent nasal diseases.

Radiographic findings

Radiographic findings in cases of fungal rhinitis were increased radiopacity of nasal cavity (3/6;

50 per cent) and frontal sinus (1/6; 16.67 per cent) and increased areas of radiolucency of nasal cavity (2/6; 33.33 per cent) (Plate 2). The characteristic radiologic feature of fungal rhinitis was documented as the loss of trabecular pattern of fine nasal turbinate detail and an increase in radiolucency in the nasal cavity (Benitah, 2006). The increased opacity of nasal cavity in other patients might be probably due to the accumulation of fungal plaques or nasal discharge masking the turbinate damage in radiography as reported by Sullivan *et al.*

Plate 2 Radiography of dog skull

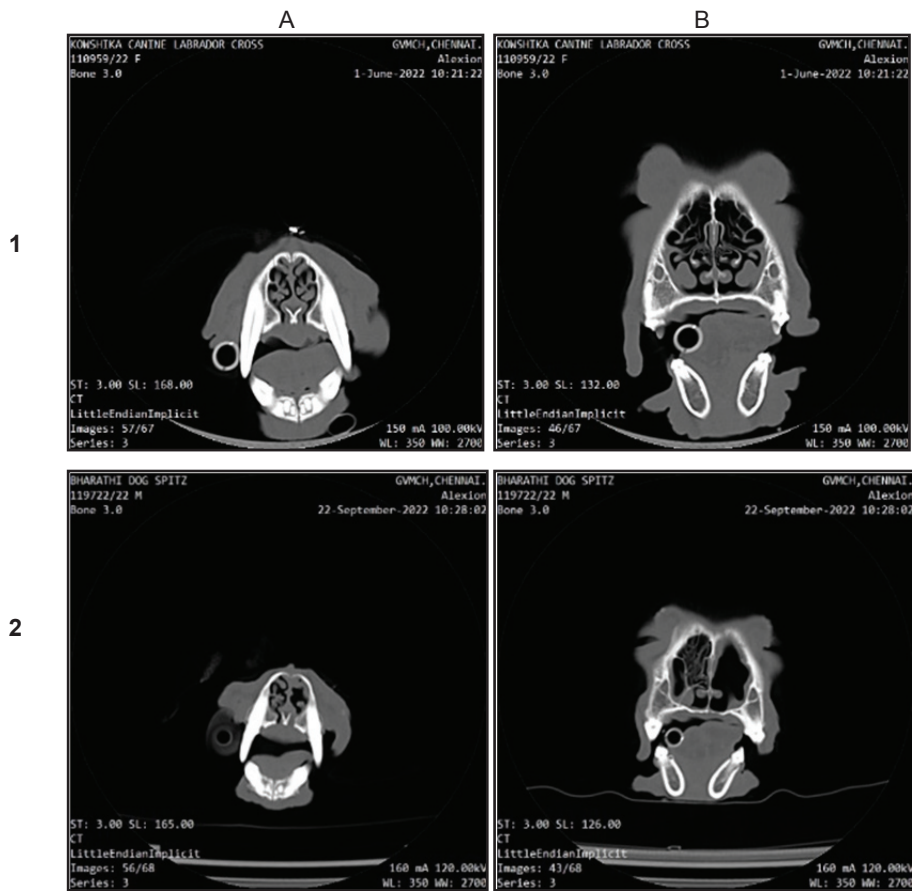


Lateral view of skull - Loss of turbinate-bone detail of nasal conchae and increased radiolucency of nasal cavity



Dorsoventral view of skull - Loss of turbinate-bone detail of nasal conchae and increased radiolucency on the right side

Plate 3. Computerized tomographic images of dog skull



Computed tomography images through the nose of (1) normal dog and (2) dog with fungal rhinitis.

A: at the level of incisors, B: at the level of canine

1 Clear nasal passage showing (A) nasal meatus and (B) ethmoturbinates free of tissue density.

2 (A) and (B) Hollow cavernous appearance of right nasal cavity due to complete destruction of turbinates

(1986). The presence of fungal granuloma in frontal sinus increases its soft tissue density and appears as a mass-like lesion (Benitah, 2006).

Computed tomographic findings

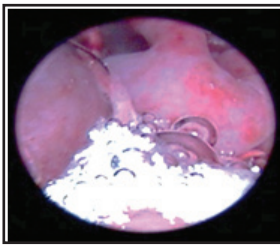
In computed tomography of skull, findings were moderate to severe turbinate destruction, scattered areas of soft tissue opacity that did not contrast enhance in the nasal cavity (Plate 3). The most common computed tomographic findings in fungal rhinitis as per previous studies were cavernous appearance due to destruction of the turbinates, variable amount of soft tissue opacities in the nasal cavities and in advanced

cases osteolysis and periosteal reaction (Peeters and Clercx, 2007). Computed tomography of skull is more sensitive than radiography for diagnosis of nasal aspergillosis and to rule out other primary causes like nasal neoplasia which is the most important differential diagnosis for fungal rhinitis.

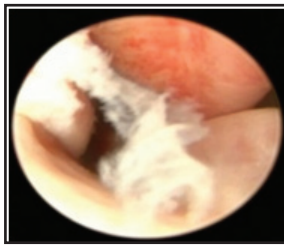
Rhinoscopic findings

The common rhinoscopic changes observed in all dogs with chronic nasal diseases were congestion and excessive fragility concurrent with the findings of Sapierzyński and Żmudzka (2009) and Ostrzeszewicz and Sapierzyński (2015).

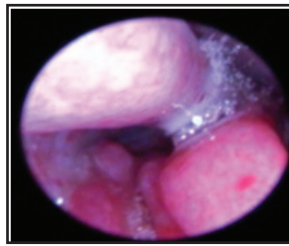
Plate 4 Rhinoscopy



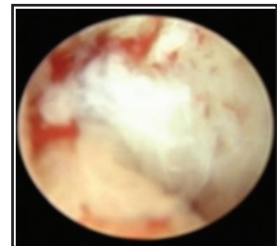
A medium-sized fungal colony showing the bright iridescent metallic appearance



White fungal colony occupying the turbinate space



Turbinate destruction with more space between turbinates along with fungal colonies



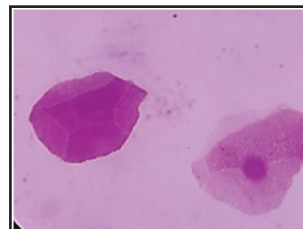
Large white fungal colony and bleeding in the turbinate space

Anterior rhinoscopy revealed haemorrhagic or purulent nasal discharge, nasal mucosal hyperaemia, excessive fragility of nasal mucosa, creamy to white fungal plaques and increased space between turbinate due to turbinate destruction (Plate 4). In all cases, a presumptive diagnosis of fungal rhinitis was made during rhinoscopy due to direct visualization of fungal plaques on the mucosal surface. Multiple biopsy samples were obtained under rhinoscopic guidance, in some cases, subsequent conduct of biopsy was difficult due to haemorrhage from nasal mucosa.

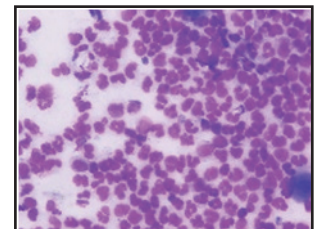
Cytology

Cytological analysis revealed inflammatory cells in the nasal swabs collected blindly from all the patients (Plate 5). Neither fungal hyphae nor spores were visualised in any of the cases in this study. Cytology has poor sensitivity in the

Plate 5 Cytology



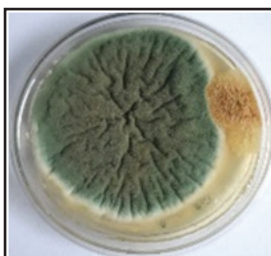
Normal nasal cytology: squamous epithelial cells with abundant eosinophilic cytoplasm 10X



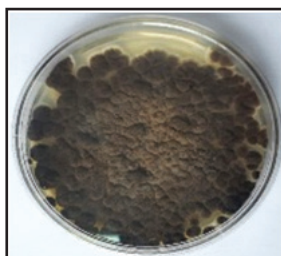
Numerous neutrophils in nasal discharge 40X

diagnosis of nasal aspergillosis when the fungal plaques are not visualised during sampling. According to Lorenzi *et al.*, 2006 and Ostrzeszewicz and Sapierzyński (2015), the most effective methods of sample collection that yielded fungal hyphae on cytological examination were squash technique (100 per cent) and samples

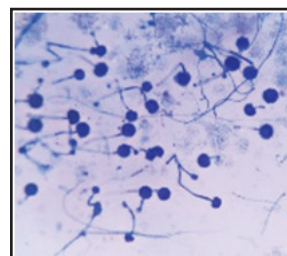
Plate 6 Fungal Culture



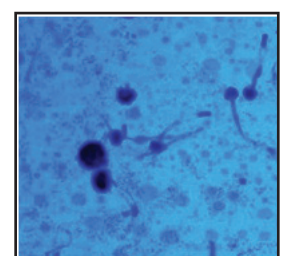
Aspergillus flavus on Sabouraud Dextrose Agar; green coloured granular colonies



Aspergillus niger on Sabouraud Dextrose Agar; black colonies with velvety surface

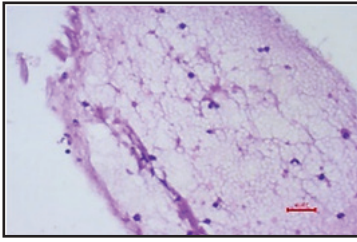


Acetate tape impression of fungal colonies of *A. flavus* stained with Lactophenol cotton blue; mycelium and conidiophores 10 X

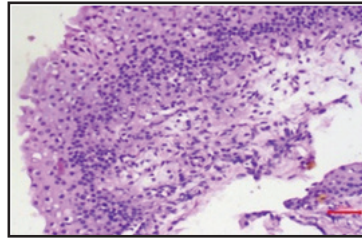


Acetate tape impression of fungal colonies of *A. niger* stained with Lactophenol cotton blue; phialides and conidial heads 10 X

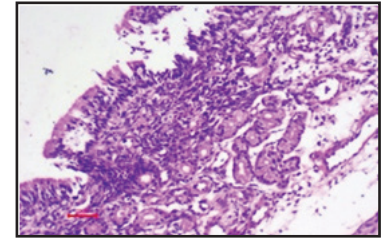
Plate 7 Histopathology



Fungal hyphae
H&E- Bar=10µm



Apoptotic and vacuolated cells
H&E- Bar=20µm



Degeneration of nasal epithelium
with mononuclear cell infiltration
H&E- Bar=20µm

collected with cytological brush from suspected lesions (93.3 per cent) whereas low sensitivity was found with direct smears made from nasal discharge (13.3 per cent) and blind nasal swab collection (20 per cent).

In dogs with fungal rhinitis, fungal culture was positive only in two dogs: *Aspergillus flavus* in one dog and *Aspergillus niger* in the other dog (Plate 6). No bacteria were cultured in two dogs and only normal flora was cultured in four dogs with fungal rhinitis. Lobetti (2009) reported that bacterial culture from dogs with nasal disease was not very relevant since the nasal passages of healthy dogs were not sterile and primary bacterial rhinitis was uncommon. Billen *et al.* (2009) in their study found that blind sampling of nasal secretions using cotton swabs was unreliable unlike direct sampling from fungal plaque visualized in rhinoscopy. Cohn (2019) opined that if fungal plaques were visible, then subsequent fungal culture was not required.

Histopathological changes in dogs with fungal rhinitis were vacuolation of epithelial cells, apoptotic cells in nasal mucosal epithelium, necrosis of epithelial cells with fibrous tissue along with infiltration of inflammatory cells and fungal hyphae (Plate 7). Similar histopathological features were described by Ferreira *et al.*, 2011.

Summary

Based on present study, it can be concluded that mild and acute clinical signs as short as 10 days, even without a single episode of epistaxis prompts diagnosis towards fungal rhinitis. The gold standard test for diagnosing nasal aspergillosis is the direct visualization of fungal plaques

during rhinoscopy or demonstration of fungal elements on cytology or histopathologic examination of biopsy sample whereas computerized tomography of skull helps to rule out nasal neoplasia and provides details in localization of lesion.

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Cyclophosphamide Induced Testicular Toxicity Mechanisms and Ameliorative Agents

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Abstract

Cyclophosphamide is an alkylating agent that is widely known for its anticancer and immunosuppressive properties used in various cancerous and autoimmune diseases. Acrolein and phosphoramidate mustard, are its toxic metabolites, majorly involved in toxic effects such as induction of oxidative stress that can induce oxidative damage in tissues. The free radicals thus produced are implicated in gonadotoxicity, hepatic and kidney disorders, hemor-

rhagic cystitis *etc.* Clinical efficacy of cyclophosphamide is restricted because of its toxicity. The reproductive system due to presence of rapidly dividing cells is highly vulnerable to cyclophosphamide toxicity. Especially male subjects treated with cyclophosphamide demonstrated severe alterations in testis and epididymis as well as disturbed gonadotropin and reproductive hormone levels. Several studies suggested the usage of medicinal plants with antioxidant properties along with cyclophosphamide could protect against its organ toxicity. Supplementation of the dietary antioxidant's during chemotherapy can reduce the drug induced toxic side effects and can further improvise the response

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