



Multiple Pulmonary Abscesses in a Greyhound Dog

Jasleen Kaur^{1*}, Swaran Singh², Kuldip Gupta³, Puneet Singh⁴ and CS Randhawa⁵

¹Ph.D Scholar, Department of Veterinary Medicine, Guru Angad Dev Veterinary and Animal Sciences University Ludhiana, Punjab, India

²Professor-Cum-Head, Department of Teaching Veterinary Clinical Complex, Guru Angad Dev Veterinary and Animal Sciences University Ludhiana, Punjab, India

³Professor, Department of Veterinary Pathology, Guru Angad Dev Veterinary and Animal Sciences University Ludhiana, Punjab, India

⁴M.V.Sc Student, Department of Veterinary Medicine, Guru Angad Dev Veterinary and Animal Sciences University Ludhiana, Punjab, India

⁵Professor-Cum-Head, Department of Veterinary Medicine, Guru Angad Dev Veterinary and Animal Sciences University Ludhiana, Punjab, India

***Corresponding Author:** Jasleen Kaur, Ph. D Scholar, Department of Veterinary Medicine, Guru Angad Dev Veterinary and Animal Sciences University Ludhiana, Punjab, India.

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Abstract

Pulmonary abscesses are rare in dogs. A 4-year old female Greyhound, weighing 20.6 Kg, was referred to Small Animal Clinics of the university with a complaint of non-productive cough, exercise intolerance, bilateral serous nasal discharge, weight loss and dyspnea for the last 2 months. Physical examination revealed tachypnea and negative inducible cough reflex along with crackles on both sides of chest on auscultation. Hematological findings revealed absolute neutrophilia (88%) and increased PCV. Biochemical tests demonstrated hyper globulinemia and hyper fibrinogenemia. Hypoxemia and hypercapnia were the main alterations noticed on blood gas analysis. Chest radiographs showed severe nodular interstitial pattern in all the lung lobes. Trans-tracheal wash (TTW) and Transthoracic fine needle aspiration cytology of the patient demonstrated markedly increased cellularity with most of foci showing preponderance of neutrophils and very few macrophages confirming the presence of largely suppurative inflammation suggestive of pulmonary abscessation. Due to multiple pulmonary abscessation and resistance to commonly used antibiotics, dog did not respond and died within 3 days of treatment before CST results. To the author's knowledge, multiple pulmonary abscessation is the first report of its kind in dogs in India.

Keywords: Dog; Fine Needle Aspiration Cytology; Greyhound; Pulmonary Abscessation; Transtracheal Wash

Abbreviations

TTW: Trans-Tracheal Wash; EMB: Eosin Methylene Blue; SDA-Sabouraud's Dextrose Agar

Introduction

Pulmonary abscessation has been rarely recorded in the veterinary medicine [16]. Only a few reports have been reported in dogs [16,20]. They usually occur as confined areas of pus or ne-

crotic debris in the lung parenchyma caused by microbial infection [10]. Any patch of earlier pneumonia may get necrosed, cavitated and result in formation of pulmonary abscess [3]. Pulmonary abscesses usually come under lung infections like lung gangrene and the necrotizing pneumonia in human pathology, which are primarily characterized by multiple abscesses [21]. Abscesses developing without a predisposing cause are categorized as primary and those occurring as a result of an innate lung defect, a foreign body or neoplasia are characterized as secondary [10]. However, they can be classified as acute or chronic based on the time duration (< or ≥4-6 weeks) of symptoms [12] and bronchogenic (inhalation, aspiration) and hematogenic based on the mode of spreading [10].

Anaerobic bacteria mainly isolated from human lung abscesses are gram-negative (*Bacteroides fragilis*, *Fusobacterium capsulatum* and *necrophorum*) and gram-positive (*Peptostreptococcus*), whereas aerobic bacteria predominantly includes *Staphylococcus aureus* (including MRSA), *Streptococcus pyogenes* and *pneumonia*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Haemophilus influenza* (type B), *Acinetobacter spp*, *Escherichia coli* and *Legionella* [5,10]. Opportunistic infections (e.g., mycobacteria, fungi) can also cause lung abscesses in patients with varied degrees of immunosuppression [12].

Now a day, aspiration from the oral cavity as well as the poor oral and dental hygiene is considered as the chief cause of pulmonary abscesses in human patients [10]. In some of the earlier case reports, the causes of the pulmonary abscesses were suspected to be pneumonia and unintentional foreign body inhalation, but in the majority, etiology was still unknown [15]. Strong immunologic status of the patient and adequate and extended antibiotic therapy are mandatory to control the sepsis during abscessation. Pulmonary abscesses are mainly treated with antimicrobials for a prolonged period in human medicine [10], whereas they are usually managed surgically in veterinary patients [16] because they are often presented as nodular, focal or diffuse lesions. The present study reveals a case of chronic, multiple pulmonary abscesses in a Greyhound dog which was referred to the university hospital after 2 months of field treatment.

Case Presentation and Clinical Findings

A 4-year old female Greyhound, weighing 20.6 Kg, was presented at Small Animal Clinics of the university with a complaint of non-productive cough, exercise intolerance, bilateral serous nasal discharge, weight loss and dyspnea from two months. Dog was dull, emaciated and dehydrated on presentation. On examination, physiological parameters indicated as normal rectal temperature

(102.6°F) and heart rate (156 bpm) and tachypnea with respiratory rate 56 breaths/ min. Inducible cough reflex on palpation of larynx and trachea was negative. Auscultation of thorax revealed crackles on both sides.

Blood sample was collected in EDTA coated vials and clot activator for haematological (Siemens ADVIA® 2120 Hematology system) and biochemical examination (Ortho Clinical Diagnostics Vitros DT 350 Chemistry system), respectively. Whereas Differential Leukocytes Count (DLC) was calculated through microscopic examination of Leishman stained blood smears. Hematological findings revealed absolute neutrophilia and increased PCV (50.8%) (Table 1). Plasma fibrinogen (mg/dl) was estimated from the whole blood sample taken in EDTA vials by heat precipitation method using hand held refractometer [7] and an increase in level of fibrinogen (0.6 mg/dl) was observed. Biochemical tests demonstrated concentration of total serum protein and albumin as 7.5g/dl and 2.6g/dl, respectively, while globulin (4.9 g/dl) level was raised as compared with normal reference range i.e., 1.6-3.6g/dl (Table 1).

Parameters	Dog with Pulmonary abscesses	Reference Range[1]
Hb (g/dl)	16.8	12-18
TEC (count/ μ l \times 10 ⁶)	5.6	5.5-8.5
TLC (count/ μ l)	16600	6000-17000
PCV (%)	50.8	33-55
Platelets (count/ μ l \times 10 ³)	189	200-900
Absolute neutrophils (count/ μ l)	14608	3600-12240
Absolute lymphocytes (count/ μ l)	1992	720-5100
Absolute eosinophilia (count/ μ l)	0	120-1700
Total protein (g/dl)	7.5	5.5-7.5
Albumin (g/dl)	2.6	2.6-4.0
Globulin (g/dl)	4.9	1.6-3.6
A : G ratio	0.53	0.8-2.0
Fibrinogen (g/dl)	0.6	0.13-0.48

Table 1: Comparison of hemato-biochemical parameters between dog with pulmonary abscesses and reference range.

Blood (1 ml) was collected from femoral artery of dogs in heparinized syringe for estimating blood gas parameters at 37°C using IDEXX VetSTAT Electrolyte and blood gas analyzer, USA, within 1 hour of sample collection to avoid alteration in blood gas tension. Partial pressure of oxygen in the diseased dog was considerably

lower (Table 2). Hypoxemia and hypercapnia were the main alterations noticed on blood gas analysis.

Parameters	Dog with Pulmonary abscesses	Reference values [11]
pH	7.37	7.37-7.44
PaCO ₂ (mmHg)	46	22.62-34.52
HCO ₃ (mmol/L)	24.4	14.06-22.10
AnGap (mmol/L)	23.2	5.49-19.67
tCO ₂ (mmol/L)	25.8	14.87-23.06
BE (mmol/L)	-0.9	-9.7- 0.46
stHCO ₃ (mmol/L)	24.2	16.59-24.74
st pH	7.41	7.37-7.44
ch+ (nmol/L)	42.9	35-45
PaO ₂ (mmHg)	64	91.35-106.05
tHb (g/dL)	13.3	8.46-16.61
SO ₂ (%)	88	94.31-100
Na+ (mmol/L)	150	125.10-146.10
K+ (mmol/L)	3.8	3.57-4.81
Cl- (mmol/L)	104	96.60-115.60

Table 2: Comparison of blood gas parameters between diseased dog and reference values.

PaCO₂: Partial Pressure of carbon dioxide; AnGap: Anion Gap; tCO₂: Total Carbon dioxide; BE: Base Excess; PaO₂: Partial Pressure of Oxygen; SO₂: Saturation of Oxygen

Thoracic radiographs were taken by Small animal X-ray machine (Siemens India, Mumbai) which showed severe nodular interstitial pattern in all lung lobes on both thoracic radiographs (lateral and ventrodorsal) (Figure 1 (a, b)). Cardiac silhouette was not clearly visible. These radiographic findings were correlated with the cytological findings of the transtracheal wash fluid obtained.

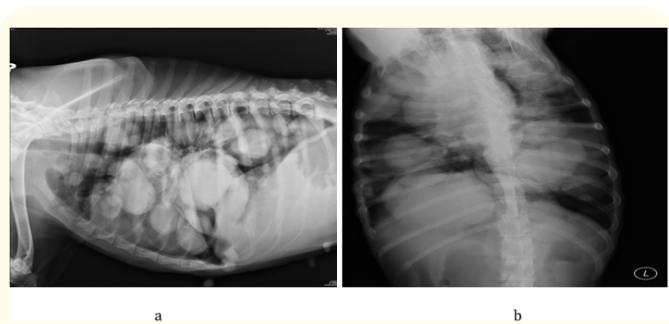


Figure 1: a: Lateral thoracic radiograph of dog showing severe nodular interstitial pattern in all lung lobes. Cardiac silhouette not clearly visible. b: Ventro-dorsal thoracic radiograph of a dog showing severe nodular interstitial pattern in all lung lobes. Cardiac silhouette not clearly visible.

Trans-tracheal wash (TTW) was performed in the dog by the standard method outlined by Taylor (2020) [19]. TTW was performed using 14 gauge IV cannula and disposable dog catheter (4FG, OD 1.30 MM) (SURU International Pvt. Ltd.) [9]. Strict asepsis was maintained throughout the procedure. Approximately 15 percent of the infused volume was recovered and then the two ml aliquots of TTW fluid obtained from the dog was transferred from the syringe into EDTA vials for cytological analysis. The sample was then centrifuged (1000 rpm, 5 minutes) and smears were prepared from the sediment and stained with Leishman’s stain. Two hundred cells from sample were counted for differential cell counts. TTW cytology of dog revealed markedly increased cellularity with most of foci showing preponderance of neutrophils whereas only few foci have macrophages as dominant cells, confirming the presence of largely suppurative inflammation with foci of chronic/ chronic active inflammation (Figure 2). In the present case, mean cell number in TTW (90.25 cells/HPF) was significantly higher (Table 3).

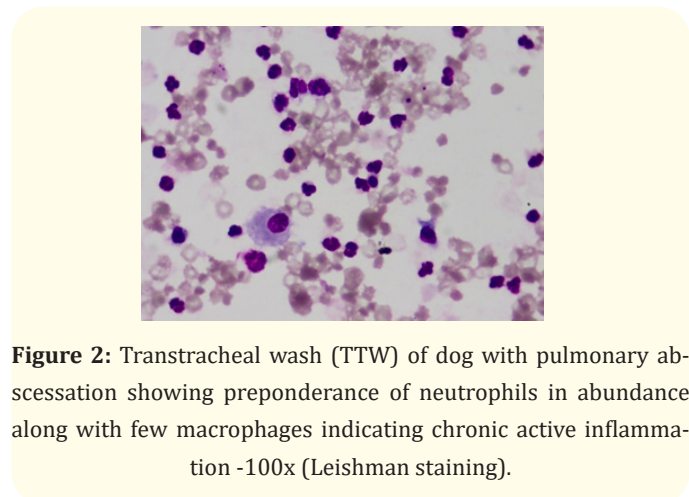


Figure 2: Transtracheal wash (TTW) of dog with pulmonary abscessation showing preponderance of neutrophils in abundance along with few macrophages indicating chronic active inflammation -100x (Leishman staining).

Parameters	Dog with Pulmonary abscessation	Reference range [4]	Reference value [9]
Macrophages (%)	13	70-80	49.57 ± 5.28
Neutrophils (%)	80	5-8	11.43 ± 1.00
Lymphocytes (%)	1	5-14	7.71 ± 2.25
Eosinophils (%)	0	<5	0.14 ± 0.14
Respiratory epithelial cells (%)	6	0-15	29.14 ± 7.13
Others (%)	0	<2	2 ± 0.79
Mean cell number (cells/HPF)	90.25	Low cellular count	8.35 ± 2.68

Table 3: Comparison of tracheal wash cytology between dog with pulmonary abscessation and reference range.

For further confirmation transthoracic fine needle aspiration from the large nodular masses was performed in the dog, with 22 gauge needle through the left seventh and eighth intercostal space which demonstrated large number of neutrophils along with few macrophages suggestive of predominant suppurative inflammation confirming the pulmonary abscessation (Figure 3).

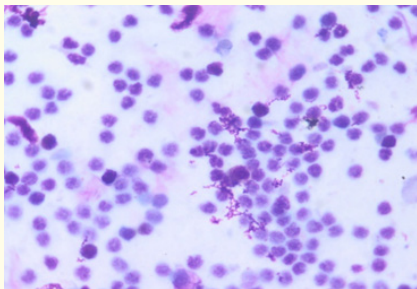


Figure 3: Large number of neutrophils and few macrophages (confirming predominant suppurative inflammation) were seen in the fine needle aspirate taken from left 7th and 8th ICS (nodular lesion) -100x (Leishman staining).

Approx. 2 ml aliquot of TTW was transferred into sterile containers for bacteriology and was processed within 1-2 hours of collection. The sample was then cultured on 5 per cent defibrinated sheep blood agar and was incubated overnight at 37 °C in aerobic conditions and for fungal isolation, the sample was cultured on Sabouraud's Dextrose Agar (SDA) and was incubated for one week at 37 °C. The isolate was characterized using the staining, growth and biochemical characteristics. In this dog suffering with pulmonary abscessation, *E.coli* resistant to many antibiotics was observed. *Escherichia coli* organisms were further isolated on MacConkey agar and appeared as pink colored, circular, moist and smooth lactose fermenting colonies. On gram staining, pink colored rods were observed which are catalase positive and oxidase negative and green metallic sheen was observed on the EMB agar (Figure 4).

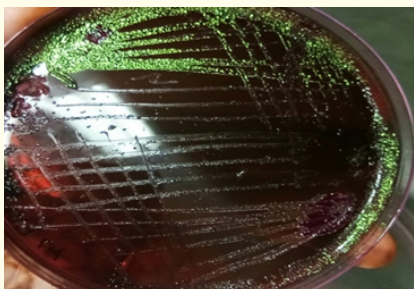


Figure 4: EMB agar showing typical small round convex colonies of *E.coli* giving greenish metallic sheen.

Dog was treated empirically with antimicrobials but due to severe pulmonary abscessation and resistance to commonly used antibiotics, dog did not respond and died within 3 days of treatment before CST results. Necropsy could not be performed due to emotional attachment of the owner with the dog otherwise results could be better correlated.

Discussion

Respiratory tract disease in dogs has been frequently linked with bacterial pneumonia so the identification of an underlying cause (e.g. aspiration pneumonia, congenital abnormality, megaesophagus or fungal, viral or parasitic infection) is very important [14]. The possible cause of multiple pulmonary abscesses in the present case study seems to be bacterial pneumonia because of previous history of fever, cough, dyspnea and depression at the start of illness. Contrarily, aspiration pneumonia was considered as the most common cause of lung abscess formation in human patients secondary to a large inoculum of relatively potent bacteria leading to the necrosis and cavitation [21].

Most of the clinical signs in the present dog resemble that in human patients with lung abscesses [5,6,12] except fever which might have subsided due to chronic nature of disease and prolonged field treatment. Robinson., *et al.* (2003), also noticed exercise intolerance in an English Mastiff dog diagnosed with 6.5 to 9.0 cm massive pulmonary abscess whereas tachypnea and dyspnea was seen in another study. Crackles on both sides of thorax on auscultation indicated the hindrance to the normal flow of air into the lung tissue [16].

Diagnostic assessment of respiratory tract diseases mainly includes CBC, serum biochemical analyses, thoracic radiographs (left and right lateral, dorsoventral) and transtracheal wash cytology along with microbial culture and susceptibility testing [13]. Neutrophilia was recorded as the main haematological finding in dogs suffering from respiratory diseases in a recent study [2]. Higher hemoglobin (16.8g/dl) concentration in the dog could be due to long duration of inappetence, dehydration and weight loss. Plasma fibrinogen was considered as a potent biomarker of the respiratory diseases due to the association between plasma fibrinogen and pulmonary function. Increase in fibrinogen level was also recorded in case of infection, stress, inflammation, trauma and neoplasia [17]. The marked obliteration to the pulmonary function in the present case could be a cause of increased fibrinogen and globulin levels.

Tumor infiltration in the lungs could lead to hindrance in the oxygenation, causing increased respiratory effort and exercise intolerance.

erance [14]. Similar interference could be the cause of low partial pressure of oxygen in pulmonary abscessation. Hypoxemia can be caused by low inspired oxygen fraction, hypoventilation, thickened respiratory barrier, shunting of pulmonary blood and physiologic dead space. Hypercapnia occurred as a result of hypoventilation and ventilation-perfusion mismatch in the diseased dog [13,14].

Pulmonary abscesses are occasional in dogs but are usually described on the basis of radiographic findings and are mostly observed as nodular or cavitary, focal or diffuse as well as with or without a fluid line [16]. Common causes of nodular pattern on radiographs include mycotic infections, tumors and abscesses [14]. Radiographic findings of abscess comprised of solitary or multiple thick-walled cavities with irregular margins that exist as isolated or within a consolidation area. Cavitation occurs due to the lung parenchyma erosions that lead to connection with a bronchus, causing the drainage of necrotic material, entrance of air and establishment of air-fluid level [12].

Most efficient methods for obtaining specimens from lung abscesses are transtracheal aspiration, fiberoptic bronchoscopy (using protected brushing) and transthoracic aspiration [3,15]. In majority of dogs with bacterial infection, neutrophilic (suppurative or purulent) inflammation, with marked preponderance of neutrophils (i.e., greater than 70%), is commonly observed on TTW fluid analysis [8]. Fine needle aspiration cytology (FNAC) has proved to be an inexpensive, simple, accurate and reasonably safer procedure which provides a direct approach, with a high degree of accuracy, towards all kinds of non-resolving pneumonias [18]. Most common bacterial agents, leading to lung abscesses in immunocompromised human patients, include *Enterobacteriaceae*, *P. aeruginosa* and anaerobes [5]. Bacteriologic culture of the purulent abscess contents in our case revealed *Escherichia coli* organisms that were seen resistant to several antimicrobials previously [16]. However, a mixed population of *Escherichia coli* and an *Enterococcus* sp. was observed in another dog [20].

Lung abscesses are generally managed on the basis of prolonged antibiotic treatment for 3-6 weeks but in case of incompetence of medical treatment, it demands percutaneous, endoscopic or surgical drainage or through removal of lung lesion by open surgical method in patients with good performance and satisfactory respiratory reserve [6]. Some experts take radiological resolution response into consideration for deciding the duration of therapy [12]. Prognosis is considered rather poor for older, emaciated, debilitated and immunocompromised patients. However, a worse outcome has been observed in large abscesses and infection with aerobic bacteria [3].

Conclusion

To the author's knowledge, pulmonary abscessation is the first report of its kind in dogs in India and can be diagnosed based on chest radiography, TTW cytology and transthoracic fine needle aspiration cytology.

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Conflict of Interest

The authors do not have any conflict of interest.

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