



## Radiographic and Bronchoscopic Findings in 28 Dogs with Respiratory Tract Disease

Yusuf Sen, Oytun Okan Senel, Irem Ergin\*, Basak Ozgermen, Ali Bumin

Department of Surgery, Faculty of Veterinary Medicine Ankara University, Dışkapı, Ankara, Turkey

### ABSTRACT

**Background/Aim:** Respiratory tract diseases are common in dogs. Thoracic radiography is very useful in initial stages to focus the diagnosis of upper and lower respiratory tract diseases. Bronchoscopy is used to examine the interior surface of trachea and bronchi, and can be used for further evaluation of respiratory diseases especially in acute and chronic coughs that does not respond to standard therapy. The aim of this retrospective study was to evaluate upper and lower respiratory tract diseases with plain radiography, bronchoscopy in dogs.

**Materials and Methods:** Twenty eight dogs with different age, sex and breeds were presented to clinics with complaints of cough, wheeze and/or respiratory distress. Dogs were evaluated for airway edema, hyperemia, stenosis, mucus accumulation, bronchiectasis and irregularities.

**Results and Conclusion:** Radiograms showed bronchial pattern (n=9), suspected pulmonary masses (n=7), tracheal opacity (n=4), alveolar pattern (n=3), interstitial pattern (n=3) and pneumothorax (n=2). The most seen bronchoscopic findings were bronchial edema and hyperemia. According to radiographic and bronchoscopic findings, respiratory system diseases included pneumothorax (n=2), pneumonia (n=5), bronchopneumonia (n=1), tracheitis (n=3), bronchitis (n=9), tracheal collapse (n=1), lung metastases (n=3) and pulmonary masses (n=4). In conclusion, combination of these two imaging techniques were found very effective and efficient for the evaluation of respiratory tract diseases.

**Keywords:** Bronchoscopy, Cat, Radiography, Respiratory Tract Diseases

## Solum Yolu Hastalığı Olan 28 Köpekte Radyografi ve Bronkoskopi Bulguları

### ÖZET

**Giriş/Amaç:** Solum yolu hastalıkları köpeklerde yaygındır. Alt ve üst solum yolu hastalıklarının tanısının ilk aşamasında göğüs radyografisi oldukça yararlı bir tanı yöntemidir. Bronkoskopi ise trahea ve bronşların iç yüzeyinin değerlendirilmesinde kullanılır ve özellikle sağaltıma yanıt vermeyen akut ve kronik öksürüğe neden olan solum yolu hastalıklarının değerlendirilmesinde kullanılabilir. Bu retrospektif çalışmanın amacı, köpeklerde alt ve üst solum yolu hastalıklarının radyografi ve bronkoskopi ile değerlendirme sonuçlarının sunulmasıdır.

**Materyal ve Metot:** Öksürük, hırıltılı solum ve/veya solum sıkıntısı şikayetleri ile kliniklere farklı yaş, cinsiyet ve ırkta 28 köpek getirildi. Köpekler hava yolunda ödem, hiperemi, stenoz, mukus birikimi, bronşlarda daralma ve düzensizlik yönünden değerlendirildi.

**Bulgular ve Sonuç:** Radyografilerde bronş (n=9), alveol (n=3) ve parenşim (n=3) dansitesinde değişim, akciğerlerde şüpheli kitlesel lezyonlar (n=7), traheada opaklaşma (n=4) ve pnömotoraks (n=2) belirlendi. En fazla görülen bronkoskopik bulgular ise bronşlarda ödem ve hiperemi oldu. Radyografik ve bronkoskopik bulgulara göre, solum yolu hastalığı olarak pnömotoraks (n=2), pnömoni (n=5), bronkopnömoni (n=1), traheitis (n=3), bronşitis (n=9), soluk borusunda kollaps (n=1), akciğer metastazı (n=3) ve akciğer kitleleri (n=4) belirlendi. Sonuç olarak iki görüntüleme tekniğinin birlikte kullanılmasının, solum yollarının değerlendirilmesinde yeterli ve oldukça etkili olduğu görüldü.

**Anahtar kelimeler:** Bronkoskopi, Kedi, Radyografi, Solum Yolu Hastalıkları

**Correspondence to:** Irem Ergin, E-mail: iremerg@gmail.com

## Introduction

Respiratory tract diseases are common in dogs. Congenital abnormalities, tracheal stenosis and collapse, degenerative and inflammatory changes of the airways, neoplastic masses can be seen commonly (Aiello et al., 1998). Thoracic radiography is very useful in initial stages to focus the diagnosis of upper and lower respiratory tract diseases in dogs. Pulmonary diseases mostly result in an increase in opacity, usually characteristic for the pulmonary parenchymal component (alveolar, bronchial, interstitial) involved. These characteristic opacity changes are called lung pattern and lung pattern can be specific for respiratory tract diseases in dogs. Bronchoscopy is used to evaluate the interior surface of trachea and bronchi, and can be used for further evaluation of respiratory tract diseases especially in acute and chronic coughs that does not respond to standard therapy (Bexfield, 2007; Lhermette et al., 2008). It is used to examine radiographical abnormalities like mass, nodule or inflammation in the lung, or evaluate bronchopulmonary inflammations (Johnson, 2001; McKiernan, 2004). Bronchoscopy can also be performed to collect samples from bronchi, to remove foreign bodies, mass or tumors in the airways and to place stent to collapsed trachea, (Bexfield, 2007).

The aim of this study was to evaluate upper and lower respiratory tract diseases of dogs with plain radiography and bronchoscopy, and focusing on bronchoscopic examination of the airways specifically.

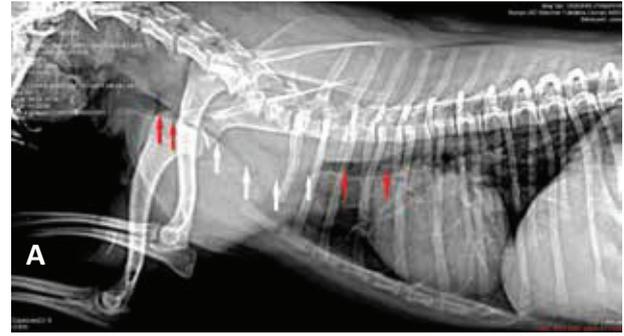
## Materials and Methods

In the study, 28 dogs of different age, sex and breeds, with one or more clinical signs of upper and lower respiratory tract diseases (cough, wheeze, respiratory distress etc.) were brought to the clinics. Plain radiography and bronchoscopy were done in all dogs.

Plain radiographs were taken in right latero-lateral and ventro-dorsal positions in all cases. Presence of any abnormal structures within trachea, thorax or lungs; normal or abnormal bronchial structures, lung density and peribronchial areas were evaluated by radiography.

Bronchoscopy was performed to directly examine the interior surface of airways under general anesthesia. Anesthesia was induced with intravenous administration of 6 mg/kg propofol (Propofol®, Fresenius Kabi, USA) and maintained on a rebreathing circuit system with isoflurane (Forane®, Abbott, UK) and oxygen. Perioperative fluid therapy was provided with 15 mL/kg/h lactated Ringer's solution intravenously (Ringer laktat, Vilsan, Turkey). Bronchoscopy was performed with either a 90 cm x 5.5 mm flexible 4 way endoscope.

Dogs were positioned on sternal recumbency. Bronchoscopic examination was started from larynx and trachea. Interior surface of trachea was evaluated for color, vascularity, size, and position. Bifurcation of trachea, each lobar bronchi, left caudal lung lobe, right cranial, accessory, and right caudal lung lobe was examined. Abnormal findings recorded included the presence of airway hyperemia, edema, hypersecretion, epithelial surface irregularities, lung mass, collapse, stenosis and bronchiectasis. After complete airway evaluation, endoscope was removed and dogs were recovered from anesthesia.



**Figure 1.** (a) A right lateral thoracic radiograph showing tracheal narrowing extending from the mid-cervical area to the mainstem bronchi (white arrows) in a Yorkshire terrier (red arrows show normal trachea), (b) bronchoscopic view of tracheal collaps (white arrows).

**Şekil 1.** (a) Bir Yorkshire terrier'in sağ lateral toraks radyografisinde trakeanın servikal bölgenin ortasından ana bronşlara kadar olan kısımda (beyaz oklar) daralması (kırmızı oklar normal trakeayı göstermektedir), (b) trakeal kollapsın bronkoskopik görüntüsü (beyaz oklar).



**Figure 2.** Radiographic view of alveolar infiltrate due to neoplasia in a German shepherd dog.

**Şekil 2.** Bir Alman kurt köpeğinde neoplaziye bağlı alveolar infiltrasyonun radyografik görüntüsü.

**Table 1.** Radiographic and Bronchoscopic Findings  
**Tablo 1.** Radyografi ve Bronkoskopi Bulguları

Case	Breed	Age	Sex	Respiratory tract disease	Radiographic findings	Bronchoscopic findings
1	Mix	2	Male	Pneumothorax	White visceral pleural line, which was separated from the parietal pleura by a collection of gas, bronchial pattern	Edema, mucosal hyperemia
2	Bulldog	13	Male	Pneumonia	Interstitial pattern; overall increase in hazy, linear opacities	Edema, mucosal irregularity, bronchial hypersecretion
3	Mix	3	Male	Bronchitis	Severe bronchial pattern (thickening of the bronchial walls and increased numbers of visible bronchial walls)	Examination could not be performed because of the severe bronchial hypersecretion
4	Kangal	7	Female	Pneumonia	Alveolar lung pattern; uniform, homogeneous fluid opacity, complete opacification, bronchial walls are not seen.	Edema, pale bronchial mucosa
5	Mix	9	Female	Bronchitis	Bronchial pattern (thickening of the bronchial walls and increased numbers of visible bronchial walls)	Edema, mucosal irregularity, hypersecretion, pale mucosa
6	Mix	7	Male	Tracheitis	Increased tracheal opacity	Tracheal hemorrhage
7	Mix	2	Female	Pneumothorax	White visceral pleural line, which was separated from the parietal pleura by a collection of gas, lung pattern	Edema, mucosal hyperemia
8	Mix	13	Male	Lung metastases	Multiple nodules with irregular margins	Bronchoscopic examination could not be performed
9	Doberman Pinscher	9	Female	Tracheitis	Tracheal deformation and wall thickening	Tracheal ring deformation
10	Mix	8	Female	Bronchitis	Mild increased bronchial opacity	Severe edema and hyperemia in bronchii
11	West Highland Terrier	11	Female	Bronchopneumonia	Lung pattern (increased lung opacity)	Tracheal ring deformation, hypersecretion, edema
12	Dalmatian	2	Male	Bronchitis	Bronchial pattern (thickening of the bronchial walls and increased numbers of visible bronchial walls)	Severe bronchial edema
13	German shepherd	1,5	Male	Bronchitis	Bronchial pattern ( thickening of the bronchial walls)	Bronchial hyperemia
14	Mix	10	Female	Pneumonia	Alveolar pattern (complete opacification, bronchial walls were not seen)	Bronchoscopic examination could not be performed
15	Kangal	1	Male	Bronchitis	Bronchial pattern ( thickening of the bronchial walls)	Bronchial edema and hypersecretion
16	Jack Russel Terrier	12	Female	Pulmonary mass	Well-marginated, rounded opacity approximately 3 cm in diameter	Severe bronchial edema, a mass in the left cranial bronchi
17	West Highland Terrier	13	Female	Pulmonary mass	Multiple, rounded opacities	Tracheal deformation and hypersecretion, bronchial edema and a mass in the left bronchi
18	German shepherd	8	Female	Lung metastases	multiple, rounded opacities in lung parenchyma	Edema, hypersecretion, proliferation in the left caudal bronchi, tracheal hyperemia and ring deformation
19	Mix	12	Female	Lung metastases	Multiple, rounded opacities in lung parenchyma	Laryngeal hyperemia, edema
20	Yorkshire terrier	5	Male	Tracheal collapse	Tracheal collapse suspicion in cervical region ?	Tracheal collapse, edema
21	German shepherd	3	Female	Pulmonary masses	Multiple, rounded opacities	Mass in the right cranial bronchi, hemorrhage,
22	Golden Retriever	8	Male	Pulmonary masses	Multiple, rounded opacities	Mass in the left cranial bronchi, edema
23	Boxer	1	Male	Tracheitis	Increased tracheal ring opacity	Tracheal hemorrhage, edema
24	Mix	4	Male	Bronchitis	Bronchial pattern ( thickening of the bronchial walls)	Bronchial hyperemia
25	Mix	12	Female	Pneumonia	Alveolar lung pattern; uniform, homogeneous fluid opacity, complete opacification.	Edema, pale bronchial mucosa
26	German shepherd	11	Male	Bronchitis	Bronchial pattern (thickening of the bronchial walls and increased numbers of visible bronchial walls)	Severe bronchial edema
27	Yorkshire Border terrier	3	Female	Bronchitis	Bronchial pattern (thickening of the bronchial walls and increased numbers of visible bronchial walls)	Severe bronchial edema, pale mucosa
28	Mix	9,5	Male	Pneumonia	Interstitial pattern; overall increase in hazy, linear opacities	Edema, mucosal irregularity, bronchial hypersecretion

## Results

Mean age of dogs was  $7.14 \pm 4.21$  in the study. There were 14 males and 14 females. The most seen symptom of respiratory tract disease was coughing. Respiratory tract diseases included pneumothorax (n=2), pneumonia (n=5), bronchopneumonia (n=1), tracheitis (n=3), bronchitis (n=9), tracheal collapse (n=1) (Figure 1a, 1b), lung metastases (n=3) (Figure 2) and pulmonary masses (n=4) (Table 1). Radiograms showed bronchial pattern (n=9) (Figure 3), pulmonary masses (n=7) (Figure 4), tracheal opacity (n=4), alveolar pattern (n=3), interstitial pattern (n=3) and pneumothorax (n=2). The most seen bronchoscopic findings were bronchial edema (Figure 5) and hyperemia (Figure 6). Bronchoscopy could not be performed in dogs with severe bronchitis (n=1), pneumonia (n=1) and lung metastases (n=1) (Table 1).

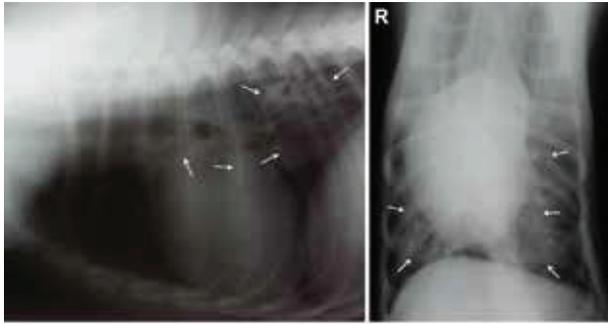


Figure 3. Radiography of bronchial pattern in a mix breed dog.

Şekil 3. Melez ırk bir köpekte belirginleşmiş bronşyal yapılar.



Figure 4. Radiographic view of a well-margined, rounded opacity approximately 3 cm diameter pulmonary mass in a Jack Russel Terrier.

Şekil 4. Bir Jack Russel terrierde yaklaşık 3 cm çaplı, iyi sınırlanmış, opasite veren bir akciğer kitlesinin radyografik görüntüsü.

## Discussion

The clinical history and physical examination provided the essential clues towards the possible underlying respiratory system disease and guiding selection of the appropriate diagnostic techniques. Respiratory tract diseases can be diagnosed with different diagnostic imaging techniques like plain radiography, bronchoscopy, computed tomography (CT) and magnetic resonance imaging (MRI). Plain radiography is the first step for evaluation of small animals with suspected respiratory diseases. For differential diagnosis of tracheal and bronchial diseases, bronchoscopy is an essential endoscopic

method (Johnson, 2001; Bexfield, 2007; Lhermette et al., 2008) In the study, all cases were evaluated and some diseases like pneumothorax, pneumonia were diagnosed with radiography. These animals could not get a good result even though they tried to be treated. Therefore, for the evaluation of bronchial and tracheal mucosa, bronchoscopy was preferred in these animals.

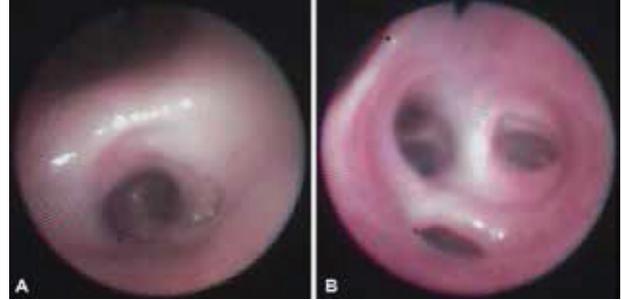


Figure 5. Bronchoscopic view of bronchial edema with pale mucosal surface because of bronchitis in a Kangal dog.

Şekil 5. Kangal ırkı bir köpekte bronşite bağlı bronşial ödem ve bölgenin solgun mukozal yüzeyinin bronkoskopik görüntüsü.

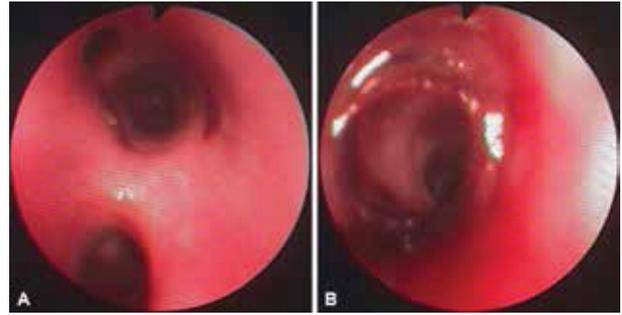


Figure 6. Bronchoscopic view of bronchial severe hyperemia because of severe bronchitis in a mix breed dog.

Şekil 6. Melez ırkı bir köpekte şiddetli bronşite bağlı olarak bronşlardaki hipereminin bronkoskopik görüntüsü.

In radiographic examination of upper and lower respiratory tract, dogs positions and radiograms qualities are very crucial for diagnosis of diseases. For accurate assessment of bronchitis, tracheal and bronchial collapse, radiograms should be taken during inspiration and in the right lateral, ventrodorsal positions (McConnell et al., 2008). In the study, all radiograms were taken in the right lateral and ventrodorsal positions, during inspiration or expiration.

Bronchoscopy requires the animal to be completely asleep under general anesthesia. Also anesthesia can be risky for animals with severe pneumonia, or bronchopneumonia (Dear et al., 2013). In the study, bronchoscopic examination was not performed to dogs with severe bronchitis, lung metastases or pneumonia because of the risks of general anesthesia.

Radiography is an important imaging technique in evaluating pulmonary mass. Also bronchoscopy might be used for masses located in bronchi and taking biopsy (Lamb, 1994). In the study, pulmonary masses with various sizes were detected in radiograms. Although most lung masses are not visualized with bronchoscopy because they are located toward the edge of the lung, rather than in a major bronchus; bronchoscopy was performed to assess the inferior surface of bronchi, and some masses collapsing bronchial lumen was determined.

For dogs with tracheal collapse, radiography is noninvasive and can be performed without the risks about general anesthesia.

However, it can lead a false-positive result. For diagnosing tracheal collapse, trachea and mainstem bronchi must be viewed with bronchoscopy. For quantification of severity and extent of collapse, identification of tracheal inflammation, bronchoscopy is the best choice. In these animals, oxygen must be supplemented via endoscope or intratracheal catheter because ventilation cannot be assisted during the procedure (Deweese et al., 2014). In the study, one dog with tracheal collapse was assessed with bronchoscopy under general anesthesia. Oxygen was supplemented with an intratracheal catheter. Dyspnea or cyanosis was not developed during anesthetic recovery in this dog.

Radiography is often the first step in the evaluation of respiratory tract diseases and remains a crucial adjunct to bronchoscopy. A detail radiograph provides an information to aid in the planning of bronchoscopy. In this study, for the evaluation of respiratory tract diseases, combination of these two imaging techniques were very effective and efficient.

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