Comparison of results of thoracic radiography, cytologic evaluation of bronchoalveolar lavage fluid, and histologic evaluation of lung specimens in dogs with respiratory tract disease: 16 cases (1996–2000)

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Objective—To compare results of thoracic radiography, cytologic evaluation of bronchoalveolar lavage (BAL) fluid, and histologic evaluation of biopsy and necropsy specimens in dogs with respiratory tract disease and to determine whether histologic evaluation provides important diagnostic information not attainable by the other methods.

Design—Retrospective study.

Animals—16 dogs.

Procedure—BAL fluid was classified as normal, neutrophilic, eosinophilic, mononuclear, mixed, neoplastic, or nondiagnostic. Radiographic abnormalities were classified as interstitial, bronchial, bronchointerstitial, or alveolar. Histologic lesions were classified as inflammatory, fibrotic, or neoplastic, and the predominant site of histologic lesions was classified as the alveoli, interstitium, or airway.

Results—The predominant radiographic location of lesions correlated with the histologic location in 8 dogs. Of 11 dogs with histologic evidence of inflammatory disease, 8 had inflammatory BAL fluid. Of the 2 dogs with histologic evidence of neoplasia, 1 had BAL fluid suggestive of neoplasia, and the other had BAL fluid consistent with septic purulent inflammation. Two dogs without any histologic abnormalities had mononuclear or nondiagnostic BAL fluid. Two dogs with histologic evidence of fibrosis had mononuclear or mixed inflammatory BAL fluid.

Conclusions and Clinical Relevance—Results suggest that although thoracic radiography, cytologic evaluation of BAL fluid, and histologic evaluation of lung specimens are complementary, each method has limitations in regard to how well results reflect the underlying disease process in dogs with respiratory tract disease. Lung biopsy should be considered in cases where results of radiography and cytology are nondiagnostic. (*J Am Vet Med Assoc* 2001;218: 1456–1461)

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Disorders of the pulmonary parenchyma are commonplace in dogs, and various methods of obtaining cellular samples from the respiratory tract of affected dogs such as transtracheal washing, bronchoscopy with **bronchoalveolar lavage (BAL)** or bronchial brushing, and transthoracic fine-needle aspiration have been described. These procedures may fail to produce a definitive diagnosis if involved cells are poorly exfoliative, an inadequate sample of cellular material is obtained, or abundant nonspecific inflammation obscures the underlying lesion. If these minimally invasive techniques fail to provide a definitive diagnosis, lung biopsy may be required. An advantage of histologic evaluation of biopsy specimens is that it allows diseases of the interstitium to be characterized.[1,2] In humans, interstitial lung diseases are classified on the basis of results of histologic, microbiologic, immunofluorescence, and electron microscopic analyses of biopsy specimens and analyses of inorganic substances.[3] The purposes of the study reported were to compare results of thoracic radiography, cytologic evaluation of BAL fluid, and histologic evaluation of biopsy and necropsy specimens in dogs with respiratory tract disease and determine whether histologic evaluation provides important diagnostic information not attainable by the other methods.

Criteria for Selection of Cases

Medical records of dogs with clinical signs of respiratory tract disease examined at the University of California-Davis Veterinary Medical Teaching Hospital between January 1996 and April 2000 were reviewed. Dogs were eligible for inclusion in the study if they had undergone thoracic radiography, bronchoscopy with BAL, and histologic examination of lung specimens. Dogs were excluded from the study if histologic examination of lung specimens was performed > 21 days after bronchoscopy, unless there was clinical and radiographic evidence of stable disease. Dogs also were excluded if the radiographic pattern of disease changed between the time of bronchoscopy and the time of lung biopsy.

Procedures

Thoracic radiographs, cytologic preparations of BAL fluid, and histologic specimens were reviewed independently by a radiologist (VFS), clinical pathologist (MMC), and pathologist (SMG), respectively.

Lateral and dorsoventral radiographic views of the thorax were reviewed; when multiple radiographic examinations had been performed, those obtained closest to the time of bronchoscopy were used for analysis. Radiographic abnormalities were categorized on the basis of the predominant pattern (bronchial, interstitial, bronchointerstitial, or alveolar). Other features such as cardiomegaly, hyperinflation or hypoinflation, pleural effusion or pneumothorax, bronchiectasis, hilar lymphadenopathy, and lobar consolidation were also recorded.

Dogs were prepared for bronchoscopy by withholding food for 12 to 24 hours. For all dogs, anesthesia was maintained with isoflurane. For dogs weighing < 10 kg (22 lb), bronchoscopy was performed with a 55-cm-long flexible fiber-optic endoscope[a] with an outer diameter of 5 mm; for dogs weighing > 10 kg, a 90-cm-long flexible fiber-optic endoscope[b] with an outer diameter of 5.3 mm was used. After a complete visual bronchoscopic examination, multiple lobes were lavaged with 10- to 25-ml aliquots of warm sterile saline (0.9% NaCl) solution through the biopsy channel of the endoscope. Lavage sites and size and number of aliquots of fluid lavaged were determined by the bronchoscopist on the basis of clinical experience and radiographic and gross bronchoscopic lesions. Gentle suction was applied to the channel with a 35-ml syringe immediately after fluid was instilled to recover BAL fluid. Samples were combined for analysis and immediately placed on ice. Total nucleated cell count was determined within 60 minutes, using a standard hemocytometer. Differential cell counts were performed on cytocentrifuged preparations[c] and, in some instances, on direct smears stained with Wright-Giemsa stain. Cell morphology, the appearance of background mucus or infectious agents, and any other microscopic findings were also recorded. Neutrophilic inflammation was considered septic if bacteria were observed within neutrophils. Published reference values for differential cell fractions in BAL fluid from healthy dogs[4] were used to define normal BAL fluid in the dogs of this study. Abnormal BAL fluid was classified as neutrophilic if > 5% of cells were neutrophils and minimal numbers of other inflammatory cells were seen; eosinophilic if > 5% of cells were eosinophils and minimal numbers of other inflammatory cells were seen; mononuclear if > 70% of cells were macrophages (activated) or > 5% of cells were lymphocytes; mixed if percentages of neutrophils and macrophages (activated) were increased, with or without an increase in the percentage of eosinophils; neoplastic if cells with multiple criteria of malignancy were seen; and nondiagnostic if the sample was acellular or poorly cellular.

An aliquot of BAL fluid from each dog was submitted for microbiologic culture. Samples were centrifuged at approximately 5,000 × g at 25 C for 5 minutes. Portions of the sediment were inoculated onto aerobic blood agar plates (5% bovine RBC) and incubated at 37 C in an atmosphere of 10% CO_2 in air or onto anaerobic blood agar plates (prereduced, anaerobically sterilized 5% laked sheep RBC and vitamin K_1 in a brucella agar base) and placed in an anaerobic chamber and incubated at 37 C in an atmosphere of 90% N_2, 5% CO_2, and 5% H_2 in the presence of a palladium catalyst. For *Mycoplasma* culture, samples were inoculated on *Mycoplasma* media (PPLO agar base) containing 15% horse serum, 15% yeast extract, 10,000 units of penicillin G/ml, and 0.01% thallium acetate and incubated at 37 C in an atmosphere of 8% CO_2 at 100% humidity.

For each dog, the method by which lung tissue specimens were obtained (surgical biopsy or necropsy) and the time between bronchoscopy and surgery or necropsy was recorded. Histologic specimens were immersed in neutral-buffered 10% formalin, processed by routine methods, and embedded in paraffin. Specimens were sectioned to a thickness of 5 µm and stained with H&E stain. Specimens were classified according to the type of pathologic lesion (inflammatory, fibrotic, or neoplastic). Additional lesions such as pulmonary edema, emphysema, bronchiectasis, vascular smooth muscle hypertrophy, osseous metaplasia, pneumoconiosis, and thromboembolism were recorded. When appropriate, lesions also were anatomically localized as predominantly affecting 1 of the following regions: airways, interstitium, or alveoli. The pathologist attempted to predict the type of cells likely to be present in the BAL fluid on the basis of his assessment of the amount and type of airway cellularity seen in histologic specimens. Aerobic, anaerobic, and mycoplasmal cultures were also performed on lung tissue specimens from some dogs.

A comparison between the major radiographic pattern (bronchial, interstitial, bronchointerstitial, or alveolar) and the predominant anatomic location of lesions on histologic examination (airways, interstitium, or alveoli) was made. Comparisons also were made between the type of BAL fluid and the type of histologic lesion (inflammatory, fibrotic, or neoplastic) and between the type of BAL fluid and the pathologist's prediction of the type of cells likely to be seen in BAL fluid.

Results

Sixteen dogs met the criteria for inclusion in the study. Mean age was 7.7 years (range, 1 to 15 years). There were 11 female (1 sexually intact) and 5 male (2 sexually intact) dogs. Breeds that were represented included the German Shepherd Dog (n = 3), Cocker Spaniel (2), West Highland White Terrier (2), and the Golden Retriever, Labrador Retriever, Tibetan Terrier, Australian Shepherd, Dandie Dinmont Terrier, English Springer Spaniel, Basenji, and Alaskan Malamute (1 each). One dog was of mixed breeding. Histologic specimens were obtained by means of surgical biopsy (n = 11) or at the time of necropsy (5). Biopsy specimens were collected by means of open thoracotomy (n = 4), thoracoscopy (3), key-hole biopsy (3), or bronchoscopy (1). For 14 dogs, the median time between bronchoscopy and procurement of histologic specimens was 7.9 days (range, 0 to 18 days). The remaining 2 dogs had clinically and radiographically stable disease, and lung biopsy or necropsy was performed 4 and 10 months after bronchoscopy.

All dogs had abnormalities identified on thoracic radiographs. The major radiographic patterns were interstitial (n = 8), bronchial (4), bronchointerstitial

(2), and alveolar (2). The distribution of these patterns was diffuse (n = 12), multifocal (2), or focal (2). Other features included cardiomegaly (n = 3), bronchiectasis (3), pleural effusion (3), hilar lymphadenopathy (3), hypoinflation (2), lobar consolidation (2), pneumothorax (1), and hyperinflation (1).

Bronchoalveolar lavage fluid from 15 dogs was submitted for microbiologic culture. For 10 dogs, culture did not yield any growth. Bacteria isolated from the BAL fluid from the remaining 5 dogs included the gram-positive organisms *Streptococcus viridans*, *S canis*, and *Staphylococcus intermedius*; the gram-negative organisms *Pasteurella canis*, *Salmonella* serotype Senftenberg, and *Escherichia coli*; and the anaerobic organisms *Bacteroides* spp, *Porphyromonas* spp, *Acinetobacter baumannii*, *Fusobacterium* spp, and *Prevotella* spp. Two of the dogs from which organisms were isolated had small numbers of mixed bacteria. Lung specimens from 6 dogs were submitted for microbiologic culture. For 3 dogs, culture did not yield any growth. Bacteria isolated from the lung specimens from the remaining 3 dogs included small numbers of *Bacillus* spp, a coagulase-negative *Staphylococcus* spp from an enrichment broth, and anaerobic organisms (*Prevotella* spp, *Porphyromonas* spp, and *Fusobacterium* spp) in 1 dog each. Results of microbiologic culture were positive for all dogs with septic neutrophilic BAL fluid but were positive for only 1 dog with nonseptic neutrophilic BAL fluid.

Cytologically, BAL fluid was classified as normal (n = 2), nondiagnostic (2), inflammatory (11), or suggestive of neoplasia (1). Inflammatory BAL fluid was further characterized as neutrophilic in 6 dogs (nonseptic in 3 and septic in 3), mixed (3), or mononuclear (2). One dog had large epithelial cells that fit the criteria for malignancy, although there was also nonseptic purulent inflammation in the background that precluded a definitive diagnosis of carcinoma. In this dog, a mass protruding into the bronchus leading to the right caudal lung lobe was seen during bronchoscopy, and a bronchoscopically guided biopsy of this mass confirmed the diagnosis of pulmonary adenocarcinoma.

Histologic evaluation revealed inflammatory (n = 11), fibrotic (2), and neoplastic (2) disease. One dog had foreign body pneumonia and pulmonary carcinoma. An additional 2 dogs did not have any clinically significant histologic abnormalities. Miscellaneous pathologic lesions included smaller amounts of fibrosis (n = 3), emphysema (3), edema (3), bronchiectasis (2), vascular smooth muscle hypertrophy (2), osseous metaplasia (1), pneumoconiosis (1), and pulmonary thromboembolism (1).

The predominant location of radiographic lesions correlated with the location of histologic lesions in 8 of the 16 dogs (**Table 1**). Other radiographic features correlated with histologic findings to a greater or lesser extent. For instance, of 3 dogs with radiographic evidence of bronchiectasis, only 2 had bronchiectasis on histologic examination. All 3 dogs with hilar lymphadenopathy on thoracic radiographs had histologic evidence of inflammatory disease: 1 had foreign body pneumonia and secondary bacterial pneumonia, 1 had severe bronchiolitis obliterans and pneumoconiosis, and 1 had severe eosinophilic bronchiolitis. Two dogs with radiographic evidence of hypoinflation had histologic evidence of idiopathic pulmonary fibrosis; both of these dogs were related West Highland White Terriers. The dog with pneumothorax, compensatory hyperinflation of the left caudal lung lobe, and consolidation of the right caudal lung lobe had a histologic diagnosis of pulmonary adenocarcinoma.

Table 1—Cross-tabulation of the predominant pattern of radiographic abnormalities and the anatomic location of lesions, determined on the basis of histologic evaluation of biopsy or necropsy specimens, for 16 dogs with respiratory tract disease

Pattern of radiographic abnormalities	Histologic location of lesions			
	Airway	Interstitium	Alveoli	No lesions
Bronchial	XXXX*	—	—	—
Interstitial	X	XX*	XXX	XX
Alveolar	—	—	XX*	—
Bronchointerstitial	—	—	XX	—

*For these dogs, results of thoracic radiography agreed with results of histologic evaluation of lung specimens.
Each X indicates an individual dog.

Two dogs had clinical signs of respiratory tract disease, abnormalities on thoracic radiographs, and mononuclear or nondiagnostic BAL fluid but did not have any apparent histologic pulmonary parenchymal lesions (**Table 2**). For 1 of these dogs, the lung biopsy specimen was obtained by means of thoracoscopy, and the specimen was collected only from the periphery of 1 lung lobe. Although no histologic abnormalities were found, the dog responded to anti-inflammatory doses of glucocorticoids. The other dog did not have any histologic evidence of inflammatory or neoplastic cells, and the edema that was evident on histologic examination was potentially an agonal change. Of 11 dogs with histologic evidence of inflammatory disease (bronchitis, bronchiolitis, or bronchopneumonia), 8 had BAL fluid classified as inflammatory, 2 had BAL fluid classified as normal, and 1 had BAL fluid classified as nondiagnostic. One dog with normal BAL fluid had clinical signs referable to the respiratory tract associated with pulmonary thromboembolism as well as histologic evidence of fibrosis and bronchiectasis without active concurrent inflammation. The other dog with normal BAL fluid and the dog with the nondiagnostic

Table 2—Cross-tabulation of classification of the cytologic appearance of bronchoalveolar lavage (BAL) fluid and the type of pathologic lesion seen on histologic examination of lung specimens from 16 dogs with respiratory tract disease

Cytologic appearance of BAL fluid	Pathologic lesion			
	None (normal)	Inflammatory	Neoplastic	Fibrotic
Normal	—	XX	—	—
Neutrophilic	—	XXXXXX*	X	—
Eosinophilic	—	—	—	—
Mononuclear	X	—	—	X
Mixed	—	XX*	—	X
Neoplastic	—	—	X*	—
Nondiagnostic	X	X	—	—

*For these dogs, cytologic appearance of the BAL fluid correlated with the pathologic lesion seen in lung specimens.
Each X represents an individual dog; 1 dog with neutrophilic BAL fluid had histologic evidence of foreign body pneumonia (inflammatory lesion) and pulmonary adenocarcinoma (neoplastic lesion) and is indicated twice.

Table 3—Cross-tabulation of types of cells seen during cytologic examination of BAL fluid from 14 dogs with respiratory tract disease and cells that were predicted to be seen on the basis of results of histologic examination of lung specimens

Classification of BAL fluid	Cells expected on the basis of histologic examination					
	None	Neutrophils	Eosinophils	Mononuclear cells	Mixed	Neoplastic cells
Normal	—	—	—	X	X	—
Neutrophilic	—	XXX*	—	X	XX	—
Eosinophilic	—	—	—	—	—	—
Mononuclear	XX	—	—	—	—	—
Mixed	X	—	X	—	X*	—
Neoplastic	—	—	—	—	—	X*

*For these dogs, the pathologist's prediction matched the cells seen cytologically in BAL fluid.
Each X represents an individual dog. Two dogs in which BAL fluid was nondiagnostic were not included. None indicates that the pathologist predicted that cells would not be seen in the BAL fluid.

BAL fluid had severe bronchomalacia on bronchoscopic examination, with poor retrieval of the instilled lavage fluid. In both dogs, the BAL fluid grossly lacked the characteristic foamy nature of normal surfactant-containing lavage fluid, suggesting that surfactant was functionally altered or decreased in these 2 dogs. Two dogs with interstitial pulmonary fibrosis as the predominant lesion on histologic examination of biopsy specimens had inflammatory BAL fluid (mononuclear or mixed inflammation). The dog with histologic evidence of neoplasia (adenocarcinoma) had cells in the BAL fluid suggestive of carcinoma.

The pathologist's predictions of cells likely to be present in BAL fluid, made on the basis of type and amount of cellularity on histologic specimens, correlated poorly with the cells that were actually seen in the BAL fluid (**Table 3**).

Discussion

The safety and clinical usefulness of BAL in the diagnosis of respiratory tract diseases in dogs has been established.[4-9] Although a definitive diagnosis can be reached if infectious (bacterial, fungal, protozoal, or parasitic) organisms or cells with criteria of malignancy are present, it is common for BAL to only provide supportive information or information of no use in the diagnosis of certain types of respiratory tract disease.[9] For example, in dogs with chronic bronchitis, systemic histiocytosis and other histiocytic proliferative disorders, lymphomatoid granulomatosis, bronchiolitis obliterans with organizing pneumonia, neoplasia, and other interstitial lung diseases, BAL fluid may only show signs of nonspecific inflammation.[2,4,9-13] Presumptive diagnoses can often be made on the basis of signalment, history, clinical signs, radiographic findings, cytologic examination of BAL fluid, and response to treatment. However, a definitive diagnosis may require histologic examination of the pulmonary parenchyma.

Most reports of lung biopsy as a diagnostic tool in dogs have involved dogs with neoplasia or foreign body, bacterial, or fungal pneumonia.[14-17] However, there are sporadic case reports demonstrating the benefit of histologic examination of the lungs of dogs with unusual or poorly characterized respiratory tract diseases for which less invasive diagnostic techniques were unrewarding. Examples include bronchial cartilage aplasia or dysplasia with bullous emphysema,[18,19] chronic obstructive pulmonary disease,[20] pulmonary eosinophilic granulomatosis,[21] lymphomatoid granulomatosis,[11,22] bronchiolitis obliterans with organizing pneumonia,[10] alveolar microlithiasis,[23] and idiopathic pulmonary fibrosis.[2] Definitive evidence of pathologic changes such as bronchiectasis, fibrosis, emphysema, vascular smooth muscle hyperplasia, and thromboembolic disease can be found on histologic examination, although certain radiographic features may be suggestive of these changes. In dogs, antemortem lung biopsy has traditionally been considered invasive and associated with considerable risk.[24] Recent advances in lung biopsy techniques, however, may make the procedure less invasive, less expensive, and less risky and may decrease the morbidity rate.[25,26]

Thoracic radiography plays a fundamental role in the documentation and localization of pulmonary parenchymal lesions and allows for selection of subsequent diagnostic tests. Thoracic radiography is beneficial in providing information on the distribution (focal, multifocal, or diffuse) and location (bronchial, interstitial, or alveolar) of lesions. However, one cannot determine whether radiographic densities are a result of cellular infiltrates, edema fluid, or fibrosis. Dogs with similar predominant radiographic patterns in the present study often had very different histologic diagnoses. Several reasons could explain this discrepancy. First, lesions that appeared prominent on histologic examination may have been too small to be appreciated radiographically. Second, radiographs provide a more global view of the lungs, whereas histologic examination evaluates smaller sections of the lung. Third, for the present study, the radiologist and the pathologist each had to select only 1 major region of anatomic involvement, even if multiple anatomic regions were affected.

In addition to providing a global view of the cardiopulmonary structures, thoracic radiography can also illustrate changes in the architecture of the lung. The use of thoracic radiography to detect changes compatible with bronchiectasis,[27,d] pulmonary thromboembolism,[28,29] hilar lymphadenopathy,[21,22] emphysema,[19,30] and interstitial fibrosis[31] in dogs and cats has been described. Bronchiectasis, hilar lymphadenopathy, and interstitial fibrosis were detected radiographically in some dogs described in the present report, and

these changes may provide additional clues to the underlying disease or alter the prognosis. Computed tomography may prove to be more sensitive than thoracic radiography,[10,32] and additional studies are warranted.

Bacteria isolated from BAL fluid from dogs in the present study included gram-positive, gram-negative, and anaerobic organisms. In a previous report of bacterial organisms isolated from the lower respiratory tract in dogs,[33] the most common isolates included those belonging to the family Enterobacteriaceae (especially *E coli*), followed by *Pasteurella* spp, obligate anaerobes, β-hemolytic *Streptococcus* spp, *Bordetella bronchiseptica*, nonhemolytic *Streptococcus* spp and *Enterococcus* spp, and coagulase-positive *Staphylococcus* spp. Similar to our results, a single bacterial species was isolated from most (57%) of the dogs in that study, but 43% of the dogs had mixed growth. Because of routine administration of antibiotics to many dogs prior to referral to the veterinary teaching hospital, interpreting the negative results for microbiologic culture of BAL fluid samples was difficult.

Even in dogs with clinical and radiographic evidence of respiratory tract disease, BAL fluid may be cytologically normal or nondiagnostic if the sample obtained is relatively acellular. Possible reasons for this discrepancy include a lack of active inflammation or neoplastic cells in the lavaged segments of lung (ie, the regions sampled were normal), poorly exfoliative cells resulting in a poor yield of lavaged fluid (eg, mesenchymal neoplasia, fibrosis, or bronchomalacia), and errors in technique of collection, processing, or examination of specimens. Two dogs in this study had BAL fluid with no cytologic abnormalities, 1 of which had a histologic diagnosis of pulmonary thromboembolism, bronchiectasis, and fibrosis; none of these conditions would necessarily be expected to result in alterations in BAL fluid. The other dog with BAL fluid without cytologic abnormalities and an additional dog in which BAL fluid was nondiagnostic had severe bronchomalacia evident during bronchoscopy. Not only was there a poor yield of BAL fluid, but the lavage fluid was not grossly foamy. Grossly foamy BAL fluid is an indication that the fluid contains surfactant and was collected through deep lung lavage.[4]

Two dogs in the present study had interstitial pulmonary fibrosis (with negligible inflammatory changes) as their predominant histologic lesion and had inflammatory BAL fluid. These related West Highland White Terriers presumptively had idiopathic pulmonary fibrosis, similar to the syndrome in humans.[2,34] This disease is characterized by patchy regions of alveolitis intermixed with interstitial fibrosis. In this disease, as with other types of interstitial lung disease, lung biopsy specimens may not be representative of the disease process in the whole lung, and BAL, which collects cells from more than 1 lung segment, may be the preferred method for detecting active alveolitis.[35] However, until interstitial lung disease in dogs is further characterized, cytologic examination of BAL fluid and histologic examination of biopsy specimens will continue to play complementary roles in the diagnosis of these disorders.

Few dogs in this study had infectious pneumonia or pulmonary neoplasia, possibly because of the restrictive inclusion criteria (eg, the requirement that cytologic and histologic specimens be available). In a previous study of dogs with respiratory tract disease,[9] BAL alone provided a definitive diagnosis in 7 of 13 dogs with bacterial infection and in 8 of 21 dogs with neoplasia. Caution must be taken when evaluating cytologic criteria of malignancy in samples with marked inflammation, as inflammation can cause dysplastic or anaplastic changes.[6,8,36] If the diagnosis of neoplasia cannot be made with certainty, lung biopsy may be indicated.

In the dogs of this report, there was a poor correlation between the pathologist's prediction of the cell type likely to be seen in BAL fluid and the cells actually seen. In fact, the pathologist's prediction matched with results of cytologic examination of BAL fluid in only 5 of 16 dogs. One reason for this discrepancy is that histologic specimens reflect pathologic abnormalities in one area of the lung, whereas BAL fluid reflects abnormalities in multiple regions of different lobes. This discrepancy could also have been a result of treatment or disease progression between the time of bronchoscopy and lung biopsy. Regardless, one should not expect equivalent results from the 2 methods. Although cytologic examination of BAL fluid provides important contributions in the characterization of respiratory tract diseases in dogs, results of the present study demonstrate the role of histologic examination of lung specimens in determining the cause and, therefore, the treatment and prognosis of these diseases.

[a]Olympus BF PD20, 5 mm × 55 cm, America Inc (Endoscope Division), Melville, NY.

[b]Pentax FG-16X neonatal gastroscope, Pentax Precision Instruments Inc, Orangeburg, NY.

[c]Cytospin 2, Shandon Inc, Astmoor, Runcorn, Cheshire, UK.

[d]Hawkins EC, Ferris KM, Berry CR. Risk factors and objective radiographic criteria associated with bronchiectasis in dogs (abstr), in *Proceedings*. 15th ACVIM Forum, 1997;688.

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