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Bronchoscopic Findings in 48 Cats with Spontaneous Lower Respiratory Tract Disease (2002–2009)

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Background: Diagnosis of lower respiratory disease requires collection of airway samples to confirm the etiology of disease. Bronchoscopic evaluation is commonly performed in dogs but less information is available in cats.

Hypothesis: The presence and number of bronchoscopic abnormalities visualized during bronchoscopic evaluation of cats with lower respiratory disease will correlate with the type of disease and total and differential cell counts in bronchoalveolar lavage (BAL) fluid.

Animals: Forty-eight cats prospectively evaluated by a single bronchoscopist.

Methods: Bronchoscopy was performed during clinical evaluation of cats presenting with cough, respiratory distress, or both. Cats were evaluated for airway hyperemia, stenosis, or collapse, mucus accumulation, bronchiectasis, and epithelial irregularities. Cats were placed into groups of bronchitis/"asthma," pneumonia, or neoplasia based on BAL findings, histopathology, and response to appropriate medical therapy. Summation of bronchial abnormalities and total and differential cell counts were compared among groups.

Results: Endobronchial abnormalities were common in cats with feline bronchitis/asthma, pneumonia, and neoplasia and no differentiating features were found. Excessive mucus accumulation was common (83%), followed by stenosis of bronchial openings and nodular epithelial irregularities (56%), airway hyperemia (54%), airway collapse (48%), and bronchiectasis (27%). Total bronchoscopic score and total cell count did not differ among groups, although differential cell counts were significantly different. A weak correlation ($R^2 = 0.16$, $P = .006$) between age and total bronchoscopic score was noted.

Conclusions and Clinical Relevance: Bronchoscopic abnormalities are common in cats with lower respiratory tract disease, and visualization of the airways provides additional nonspecific clinical information in cats.

Key words: Asthma, Cytology; Pneumonia; Pulmonary neoplasia; Respiratory tract endoscopy.

Bronchoscopic investigation of feline lower respiratory tract disease is challenging because of the small size of feline airways and the high prevalence of reactive airway disease with the tendency for bronchoconstriction to develop because of airway hyperresponsiveness.[1,2] Clinical and radiographic features of infectious and inflammatory lower airway disease do not allow discrimination of the underlying cause of clinical signs,[3] and evaluation of airway cytology is required to confirm a diagnosis. Currently, most reports of both experimental and naturally occurring lower airway disease in cats have relied on cytologic assessment of a lavage sample collected from the distal airways with a long catheter placed blindly,[3–8] and reports of endobronchial lesions are lacking.

Inflammatory and structural diseases result in obvious visual changes within the airways of dogs with lower respiratory tract disease. Canine chronic bronchitis has been characterized by epithelial irregularity and airway hyperemia in ~90% of dogs, and airway collapse during respiration was reported in over 50% of cases.[9] Dogs with eosinophilic bronchopneumopathy had yellow-green mucus accumulation and mucosal irregularities in over 50% of cases, and 1/3 of these dogs also displayed airway collapse during expiration,[10] indicating that some bronchoscopic findings are shared among different diseases. Tracheal collapse viewed endoscopically has been extensively described in the dog, and recently bronchoscopy allowed characterization of both bronchial collapse and bronchomalacia in a substantial proportion of dogs evaluated.[11,12] Similar information on bronchoscopic findings in cats with naturally occurring lower respiratory disease is not available.

The purpose of this study was to describe the nature and frequency of endobronchial lesions in cats with lower respiratory disease and to correlate these with bronchoalveolar lavage (BAL) findings. In addition, this study was designed to identify endoscopic and cytologic features that would be clinically useful for differentiating pneumonia, neoplasia, and idiopathic inflammatory lower airway disease (feline bronchitis/"asthma"). We hypothesized that visual changes within the airways would be common in cats with lower respiratory disease and that the presence and number of bronchoscopic abnormalities visualized during bronchoscopic evaluation of cats with lower respiratory disease would correlate with both the type of lower respiratory disease and total and differential cell counts in BAL fluid.

Abbreviation:

BAL bronchoalveolar lavage

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Materials and Methods

All cats that had bronchoscopy performed by one of the authors (L.R.J.) between 2002 and 2009 were prospectively included in this study. A standard diagnostic work-up was performed in all cats that included a CBC, biochemical panel or azostick and PCV/TP, and cervical/3-view thoracic radiographs. Bronchoscopy was performed under intravenous propofol anesthesia with an induction dose of 6 mg/kg followed by 0.1–0.4 mg/kg/min as a continuous rate infusion. All cats breathed air with increased FiO_2 before the procedure and oxygenation was maintained with jet ventilation at 180 breaths/min. Pulse oximetry, EKG, and blood pressure were monitored throughout the procedure in all cats. Bronchoscopy was performed with either a 2.8 mm × 70 cm fiberoptic endoscope with a 1.2 mm channel[a] or a 3.8 mm × 55 cm videoendoscope with a 1.2 mm channel.[b] Beginning in February 2003, all cats undergoing bronchoscopy were pretreated with terbutaline (0.01 mg/kg SQ q8–12h or 0.625 mg/cat PO q12h) 12–24 hours before the procedure. Complications were scored as mild (hemoglobin desaturation, abrupt termination of the procedure, or prolonged recovery from anesthesia), moderate (requiring recovery in oxygen or in the intensive care unit), severe (requiring continued ventilation or other intervention), and life threatening (the animal did not survive or was euthanized as a result of the procedure or as a result of failure to recover from anesthesia).

Bronchoscopy was performed in sternal recumbency and each cat was evaluated in identical fashion. All accessible airways were scrutinized beginning in the left cranial lung lobe (cranial and caudal segment), continuing into the left caudal lung lobe, right cranial, right middle, accessory, and right caudal lung lobe.[13] Dorsal and ventral branches were accessed off each lobar bronchus as encountered. Normal feline airways were characterized by a pale-pink to yellowish epithelial surface with a mild glistening sheen and ovoid airway openings (Fig. 1) and the absence of epithelial irregularity, airway collapse, or stenosis. Abnormal findings recorded included the presence of excessive bronchial mucus, airway hyperemia, epithelial irregularities or nodular regions, airway collapse at rest or with suction during BAL, stenosis of airway openings, and bronchiectasis (Fig. 2). Each feature was assigned a score of 1, resulting in a maximal total bronchoscopic score of 6 for visualized abnormalities. Airway collapse was defined as a flattening of the airways, while airway stenosis was recognized as circumferential narrowing of the airway that precluded bronchoscopic interrogation of more distal airways. After complete airway evaluation, the bronchoscope was withdrawn from the airways, the exterior surface was wiped with sterile saline-soaked gauze sponges, and the biopsy channel was flushed with sterile saline in preparation for lavage. On re-entry to the airways, care was taken to avoid upper airway contamination and the site chosen for BAL was immediately accessed.

BAL was performed by instilling 3–5 mL of warmed, sterile saline through the biopsy channel of the endoscope, flushing the channel with 2–3 mL of air, and immediately applying hand suction to recover fluid that had been in contact with the bronchoalveolar space. Lavage was performed in at least 2 sites, and location, volume of fluid instilled, and volume of fluid recovered were recorded for each site.

BAL fluid was submitted for cytologic examination and microbiologic culture. Distinct sites within the lung were analyzed separately for determination of total and differential cell counts based on a count of 200 cytocentrifuged cells.[c] Reference intervals used for BAL cell and differential counts were 300–400 cells/μL comprised of up to 7% neutrophils or lymphocytes, up to 20% eosinophils, and 65–85% macrophages.[4,5,8,14] The lavage sample containing the highest number of cells and/or the highest percentage of inflammatory cells was used for classification into disease categories. The percentage of each type of inflammatory cell was tabulated, and cytology reports were scrutinized for documentation of the presence of intracellular bacteria, parasites, foreign debris, or cytologic changes in epithelial cells (hyperplasia, dysplasia, neoplasia). A pooled BAL sample was submitted for aerobic, anaerobic, and *Mycoplasma* cultures. In some cases, a definitive diagnosis was not achieved with clinical and bronchoscopic data, and histopathologic evaluation of lung tissue obtained surgically or postmortem was used to confirm the diagnosis.

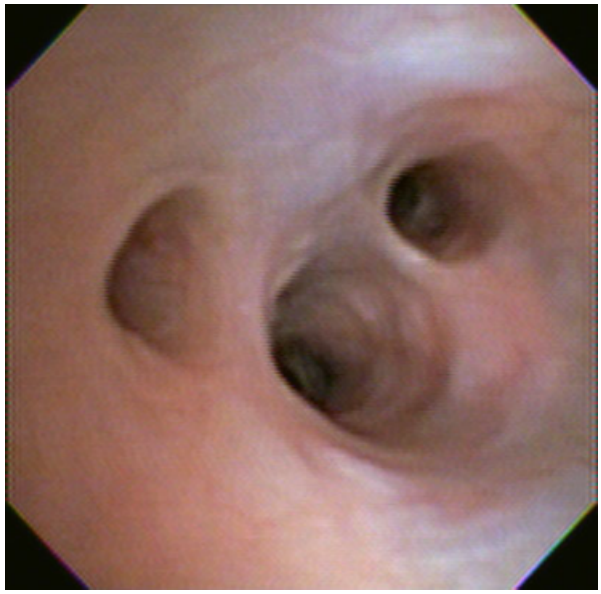

Fig 1. Normal feline airways are characterized by a pale pink, smooth epithelial surface, round to ovoid airway openings separated by relatively thin bifurcations, and an absence of mucus accumulation.

Cats with sterile inflammatory airway disease that demonstrated clinical improvement with corticosteroid therapy were defined as idiopathic inflammatory airway disease (feline bronchitis/asthma). These cats were subdivided into those with predominantly eosinophilic inflammation (>20% eosinophils and neutrophil% within reference limits or >50% eosinophils), predominantly neutrophilic inflammation (>7% neutrophils with eosinophil% within reference limits or >50% neutrophils), or mixed inflammation (concurrent increases in both eosinophil and neutrophil percentages or absolute numbers) for correlation with bronchoscopic findings. A 2nd group of cats was diagnosed with pneumonia. This included cases with intracellular bacteria observed in BAL cytology and positive bacterial culture results that responded to appropriate antimicrobial therapy, cats with foreign material or aspiration pneumonia, and cats with histologic evidence of interstitial pneumonia. A 3rd group of cats was diagnosed with neoplasia based on histopathologic results obtained by lung lobectomy or necropsy.

Statistics

Normally distributed data are presented as mean ± SD and nonparametric data are presented as median with range. Complication rate before and after use of terbutaline was compared by a χ^2 analysis. Clinical characteristics and total bronchoscopic score were compared among groups of cats with feline bronchitis/asthma, pneumonia, and neoplasia by analysis of variance for normally distributed data. Chi-square analysis was used to compare the number of cases in each group of cats with each bronchoscopic abnormality detected. Total cell counts, age, and duration of clinical signs were

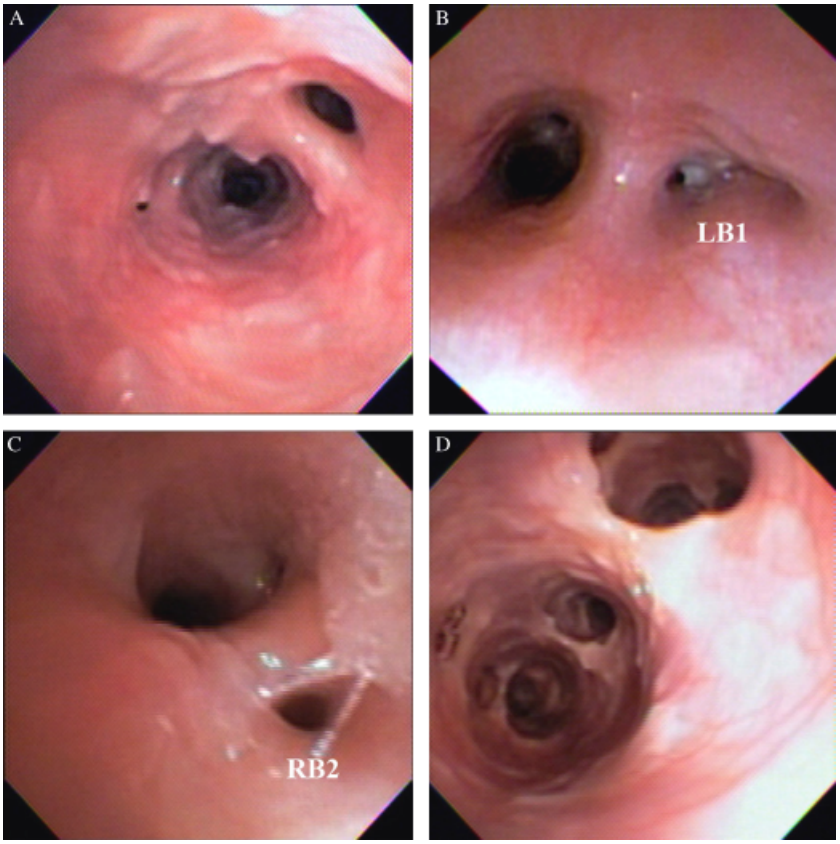

Fig 2. Bronchoscopic abnormalities identified in feline airways included hyperemia (A, B, C, D), nodular irregularities in the epithelium (**A**, **D**), mucus accumulation (**B**, **C**), airway collapse (B; left cranial lung lobe, LB1), airway stenosis (C; right middle lung lobe, RB2), and bronchiectasis (D).

compared among groups by a Kruskal Wallis analysis for nonparametric data. Percentage inflammatory cells was compared among groups by a Kruskal Wallis analysis for nonparametric data with posthoc analysis by use of Dunn's multiple comparisons test. Linear regression was used to evaluate the correlation of age and duration of clinical signs with each bronchoscopic abnormality and bronchoscopic score across all cats. All statistical analyses were performed by a commercially available statistical software package.[d] Significance was set at $P < .05$.

Results

From 2002–2009, 1 endoscopist (L.R.J.) performed bronchoscopy in 48 cats. Cats were diagnosed with idiopathic inflammatory disease/feline bronchitis/asthma (n = 23, with eosinophilic [n = 8], neutrophilic [n = 6], and mixed [n = 9] inflammation), pneumonia (n = 14 [bacterial in 7, foreign material related in 4, interstitial in 2, and aspiration in 1]), and tracheobronchial neoplasia (n = 7 [adenocarcinoma in 6 and squamous cell carcinoma in 1]). Four cats were placed in a category designated as unknown because the etiology of respiratory disease could not be clearly defined based on bronchoscopy, BAL cytology and culture results, and clinical response. As an example, 1 cat in this group had primarily eosinophilic airway cytology (77% eosinophils) with negative bacterial cultures but responded clinically and radiographically to amoxicillin-clavulanic acid and enrofloxacin (prescribed while cultures were pending) and has had no recurrence of cough in 5 years.

Cats were presented for cough and/or respiratory difficulty. There was a slight preponderance of male cats (29/48; 60%), and most (38/48: 79%) cats were domestic short-, medium-, or long-haired cats. Age ranged from 0.5 to 14.2 years and weight ranged from 2.2 to 8.5 kg. Duration of clinical signs ranged from 12 days to 10 years. No significant differences in age, sex, body weight, or duration of signs were present among the different diagnostic groups (Table 1).

Excessive mucus accumulation including airway obstruction by mucus was the most common finding in cats examined here (83%), followed by stenosis of bronchial openings and nodular epithelial irregularities (56%) (Table 2). Cats that had airway stenosis typically had multiple lobar bronchi affected with the caudal segment of the left cranial lobar bronchus, right middle lobar bronchus, and accessory bronchus affected most commonly. Airway hyperemia was recognized in 54% of cats, and 4 cats in each group had bronchoscopically detectable bronchiectasis (total of 12 of 48 [27%] cats). Airway collapse was visualized in 23 (48%) cats overall, with static collapse of airways in 14 of 23 and collapse during expiration or lavage in 9 of 23 cats. Tracheal collapse was documented in 3 cats (cervical in 1 cat, intrathoracic in 2

Table 1. Clinical characteristics of cats with spontaneous inflammatory airway disease (bronchitis), pneumonia (bacterial, aspiration, foreign body related or interstitial), pulmonary neoplasia, and unknown disease.

	Age (years)	Sex	Weight (kg)	Duration of Clinical Signs (days)
Bronchitis/asthma (n = 23)	6.5 ± 4.3	FS: 9 MC: 14	5.1 ± 1.3	450 (30–3,650)
Pneumonia (n = 14)	7.8 ± 4.1	FS: 6 MC: 8	4.5 ± 1.7	240 (12–1,277)
Neoplasia (n = 7)	10 ± 2.4	FS: 5 MC: 2	4.9 ± 1.1	400 (30–1,095)
Unknown (n = 4)	4.7 ± 2.4	FS: 0 MC: 4	5.1 ± 0.6	420 (360–1,400)
P-value	.10	.31	.52	.27

Data are presented as mean ± standard deviation.

cats) and graded as a severity of 1 or 2 on a scale of 1–4.[15] All cats with tracheal collapse had inflammatory airway disease and 2 of 3 had concurrent static collapse of the left cranial bronchus. Of the remaining cats with bronchitis/asthma that exhibited airway collapse, it was static in 7 and occurred with lavage in 4. Overall, in 12 cats with static airway collapse, it occurred at the level of the left cranial lobar bronchus in 10 cats and at the right middle lobar bronchus in 2 cats. Four cats with neoplastic disease exhibited airway collapse; however, it was noted in distal airways and with suctioning in 3 of 4; only 1 cat with neoplastic disease had static collapse and this was at the right middle lobar bronchus. In 6 cats with pneumonia and airway collapse, 4 of 6 had distal collapse noted and in 2 of 6, static collapse at the left cranial bronchus was detected.

Complication rate was higher in cats that did not receive terbutaline in the perioperative period (4/10) in comparison with those that did (3/38), $P = .03$. All complications before routine use of terbutaline were encountered in cats with a final diagnosis of neoplasia (n = 4), while the remaining complications occurred in cats with interstitial or bacterial pneumonia and bronchitis/asthma.

BAL fluid total cell count did not differ among groups, although differential cell counts did (Table 3). Neutrophils were a greater percentage of the total cell count in cats with pneumonia compared with those with bronchitis/asthma or neoplasia. Eosinophils were more prevalent in cats with bronchitis/asthma and neoplasia than those with pneumonia. In 4 of 7 cats with respiratory neoplasia, cytologic characteristics of epithelial cells were considered suggestive of neoplasia but because of the presence of concurrent inflammation, none of these could be definitively diagnosed as neoplasia via BAL cytology alone. One cat with neoplasia had a visible endobronchial mass lesion and 2 cats had a compressive mass effect within the airways. Epithelial hyperplasia (increased nuclear to cytoplasmic ratios, increased cytoplasmic basophilia) was reported in 2 of 14 cats with pneumonia and 7 of 23 cats with bronchitis/asthma, while dysplasia (increased nuclear to cytoplasmic ratios, increased cytoplasmic basophilia, moderate anisocytosis, and anisokaryosis) was reported in 2 of 14 cats with pneumonia and 1 of 23 bronchitic cats.

In 7 cats with bacterial pneumonia, various bacteria were isolated, including *Mycoplasma* (n = 2), *Pasteurella* (n = 2), *Streptococcus* (n = 1), *Corynebacterium* (n = 1), and *Escherichia coli* with *Pseudomonas* (n = 1). Anaerobes were isolated concurrently in 1 cat with *Pasteurella* and 1 with *Corynebacterium*. The presence of intracellular bacteria, and therefore septic inflammation, was reported in the BAL cytology of 4 of 7 cats with bacterial pneumonia, while bacteria were not visualized in the remaining 3 cats with culture positive and antibiotic-responsive pneumonia. In 4 cats with foreign body pneumonia, septic inflammation was reported in the BAL cytology of 2 cats, 1 of which had positive growth of anaerobic bacteria on culture. Both cats with interstitial pneumonia and the cat with aspiration pneumonia had neutrophilic airway cytology and negative airway cultures.

The mean total bronchoscopic score was 3.2 ± 1.3 (range 1–6) in cats with bronchitis/asthma, 3.3 ± 1.6 (range 1–6) in cats with pneumonia, and 3.9 ± 0.9 (range 1–5) in cats with neoplasia. Cats in the unknown group

Table 2. Summary of bronchoscopic findings in cats with spontaneous inflammatory airway disease (bronchitis/asthma), pneumonia (bacterial, aspiration, foreign body related or interstitial), pulmonary neoplasia, and unknown disease.

	Mucus	Hyperemia	Epithelial Irregularities	Airway Collapse	Airway Stenosis	Bronchiectasis
Bronchitis/asthma (n = 23)	21	10	13	13	14	4
Pneumonia (n = 14)	12	7	7	6	9	4
Neoplasia (n = 7)	6	6	5	4	2	4
Unknown (n = 4)	1	3	2	0	2	1
Total (n = 48)	40 (83%)	26 (54%)	27 (56%)	23 (48%)	27 (56%)	13 (27%)
P-value	.77	.20	.61	.25	.42	.23

Table 3. Bronchoalveolar lavage characteristics in cats with spontaneous inflammatory airway disease (bronchitis/asthma), pneumonia (bacterial, aspiration, foreign body related or interstitial), pulmonary neoplasia, and unknown disease (not included in statistical analysis).

	Total Cell Count/μL	% Neutrophils	% Lymphocytes	% Macrophages	% Eosinophils
Bronchitis/asthma (n = 23)	950 (400–3,000)	30 (1–92)[b]	4 (0–15)	26 (4–64)[a,b]	29.5 (0–72)[b]
Pneumonia (n = 14)	1,600 (500–12,700)	84 (12–98)[a]	6 (1–18)	9 (0–69)[a]	0.5 (0–21)[a]
Neoplasia (n = 7)	1,550 (400–12,000)	17 (8–91)[a,b]	3 (0–10)	57 (4–92)[b]	2 (0–38)[a,b]
Unknown (n = 4)	830 (540–1,320)	4.5 (4–7)	1.5 (2–11)	76.5 (18–93)	10.5 (1–77)
P-value	.27	.01	.42	.03	.001

Data are presented as medians with ranges. Values that do not differ significantly are labeled with the same superscripted letter.

had scores of 0, 2, 3, and 4. No significant difference was noted in total bronchoscopic score among groups (P = .33). In cats with bronchitis/asthma, no significant correlation was detected between bronchoscopic score and total cell count or percentage of any inflammatory cell type. Specific bronchoscopic abnormalities had no correlation with duration of clinical signs. Total bronchoscopic score was significantly (P = .006) but weakly (R^2 = 0.16) correlated with age (Fig 3) but not with duration of clinical signs (P = .92).

Two cats with inflammatory airway disease and 1 cat with foreign body pneumonia had repeat bronchoscopy performed 7, 15, and 31 months after initial evaluation. Each animal had responded to appropriate treatment, had been tapered off therapy, and suffered an exacerbation of disease requiring additional testing. Interestingly, each cat had a total bronchoscopic score of 4 on initial bronchoscopy and a score of 3 on follow-up evaluation. All cats had inflammation on BAL cytology, and no foreign material was seen in the previously affected cat.

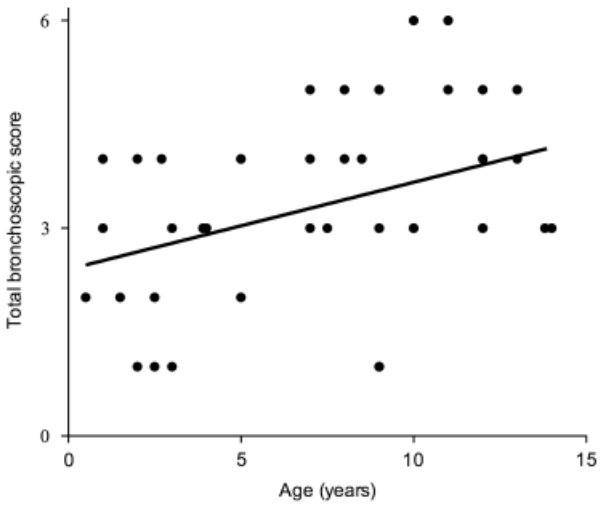

Fig 3. Effect of age on total bronchoscopic score across all cats. There was significant but weak positive correlation (R^2 = 0.16, P = .006), suggesting that increasing age was associated with visualization of more bronchoscopic abnormalities in cats with lower respiratory tract disease.

Discussion

In this study, visualized bronchoscopic abnormalities were common in cats with lower respiratory tract disease and were similar in nature regardless of the underlying etiology of disease. Contrary to our hypothesis, no specific visual changes could be ascribed to idiopathic inflammatory airway disease in cats, in comparison with dogs, where airway hyperemia, mucus, and mucosal irregularities were reported in all dogs with bronchitis.[9] In this study, infectious, inflammatory, and neoplastic airway diseases resulted in mucus accumulation, airway hyperemia, nodular mucosal irregularities, and airway collapse or stenosis in the majority of cases examined, indicating a lack of specificity of bronchoscopic abnormalities in cats with a variety of lower respiratory tract diseases. This might be considered a contrast to bronchoscopic findings in dogs; however, no studies in the dog have directly compared visualized airway changes with various diagnoses.

Interestingly, airway collapse was noted in many cats in this study, and this represents the 1st report of this finding in cats. In dogs, airway collapse has been associated with both inflammatory disease, in the case of eosinophilic bronchopneumopathy[10] and chronic bronchitis,[9] and as part of a structural disease that may or may not be associated with concurrent inflammation.[11,12] All cases of tracheal collapse (3) were found in cats with bronchitis, and the grade of collapse was relatively mild. In contrast, collapse of bronchi was relatively common in cats examined here, and the left cranial lobar bronchus was most commonly affected, similar to what has been reported in both brachycephalic and other breeds of dogs.[11,12] An additional subset of cats (11/44; 25%) in the group examined here demonstrated dynamic collapse of airway during expiration or aspiration of lavage fluid. This finding suggests excessive collapsibility of airways, although the cause and the pathophysiologic implications of this finding are unknown at this time.

Another unexpected finding in this study was the presence of airway stenosis in a large percentage of cats, regardless of the underlying cause of disease. At the outset of this study, the presumption was made that airway stenosis was a result of chronic inflammation associated with feline bronchitis. It was anticipated that this change would be more prevalent in cats with bronchitis and could represent an extension of airway remodeling

changes that have been reported in distal airways of cats with experimentally induced feline asthma.[6,16] Narrowing of the right middle lobar bronchus could be partly responsible for atelectasis of this lung lobe, which is variably reported in feline bronchial disease. However, visible bronchial narrowing at various sites was found in all groups of cats examined here. It is possible that airway stenosis was caused by airway remodeling because of epithelial edema, bronchial smooth muscle thickening, or connective tissue deposition in cats with bronchitis and by infectious, inflammatory, or neoplastic infiltration in the remainder of cats. Unfortunately, histopathology samples were not available for evaluation in cats with a final diagnosis of bronchitis, and histopathology samples obtained to confirm neoplasia or interstitial pneumonia did not specifically evaluate the site deemed to be abnormal bronchoscopically. The degree of reversibility of these changes is difficult to determine without bronchoscopic evaluation after clinically successful treatment. Prospective studies on airway pathology in cats with a variety of naturally occurring lower respiratory tract diseases are needed to provide further insight into the etiopathogenesis of this finding.

Total cell counts in BAL fluid were not helpful in distinguishing among disease categories in cats. Although direct comparisons are not available, this is somewhat dissimilar to studies in dogs, where counts of ~700 cells/μL have been reported for chronic bronchitis,[17] ~1,200 cells/μL in dogs with pulmonary lymphoma,[18] ~8,000 cells/μL in cases with lower respiratory tract infection,[17] and ~13,000 cells/L with eosinophilic bronchopneumopathy.[10] Results in these 2 species may not be directly comparable because studies in dogs were performed by a variety of bronchoscopists by varied techniques and endoscopes, while in this study, these confounding factors were not present.

BAL differential cell cytology is the gold standard for noninvasive categorization of lower respiratory tract disease.[4,19] Cytologic evidence of inflammation was present in all disease categories for cats examined here, with the highest median percentage of neutrophils being present in cats with pneumonia and the highest median percentage of eosinophils being present in cats with bronchitis. However, cats with neoplasia had airway neutrophilia and eosinophilia that did not differ from cats with bronchitis, and there was considerable overlap in cytologic characteristics among the 3 categories, including the presence of cytomorphologic epithelial cell changes. Therefore, clinical, radiographic, and histopathologic correlations with disease status are needed to distinguish neoplasia from inflammatory disease.

In dogs, guidelines for the diagnosis of bacterial pneumonia include the presence of >2 neutrophils containing bacteria in evaluation of 50 high power fields and quantitative cultures with $>1.7 \times 10^3$ CFU/mL.[17] In this study, diagnosis of bacterial pneumonia was confirmed by a combination of clinical findings, BAL cytology qualitative microbiology results, and response to antibiotics in 7 cats. Similar criteria have been used to define lower respiratory tract infection in other studies.[3,7] In cats examined here, 4 of 7 had both intracellular bacteria and positive bacterial cultures identified, while the remaining 3 lacked intracellular bacteria but had positive growth on microbial culture. In 2 of these 3 cats, *Mycoplasma* species were isolated on *Mycoplasma*-specific growth medium. *Mycoplasma* spp. were reported as a common cause of pneumonia in cats in 1 study,[7] and this study would suggest that these organisms can be difficult to identify cytologically. Therefore, the criteria used to define pneumonia need to be specifically determined for the cat.

The diagnosis of neoplasia was not definitively confirmed on cytology in any cat in this study, in contrast to an earlier study in which lavage fluid was considered confirmatory of carcinoma in 2 of 4 cases with pulmonary neoplasia.[3] While most cats with neoplasia had some degree of epithelial hyperplasia or dysplasia noted in their BAL cytology, this was also a characteristic of cats with bronchitis. Interpretation of epithelial cell cytologic characteristics is problematic in the presence of inflammation, which can induce changes in epithelial cells that mimic neoplasia. In other studies of BAL cytology in dogs and cats, findings indicative of carcinoma have been reported in a minority of cases examined,[19–21] perhaps because of the frequent presence of concurrent inflammation that complicates the diagnosis, because pulmonary neoplasia in animals is rarely endobronchial (Fig. 4) or exfoliates poorly, or because bronchoscopy is less commonly performed in the diagnostic workup of animals suspected of neoplastic disease. BAL cytology can be valuable in documenting hematopoietic malignancies[18,22] but is sometimes considered of lesser value in the diagnosis of neoplastic disease than in infectious disease in humans.[23] False-positive reports of neoplasia on BAL cytology are also a concern in animals and humans.[18,22]

In this study, the summation of bronchoscopic abnormalities found in cats with infectious, inflammatory,

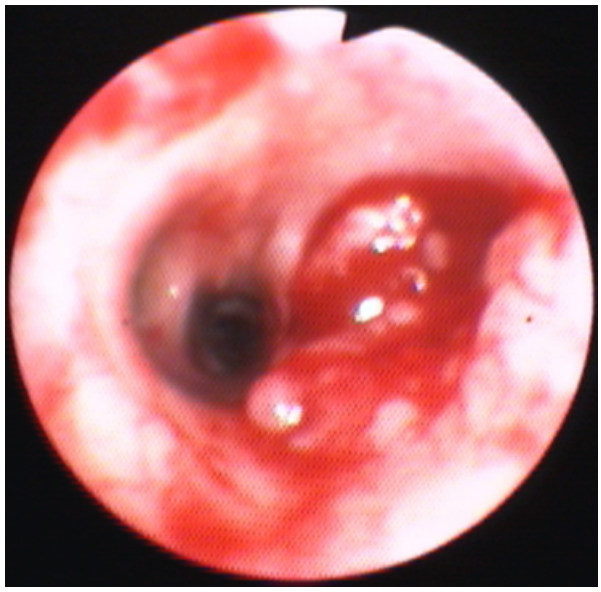

Fig 4. Bronchoscopic image after biopsy of an endobronchial mass lesion obstructing the opening of the left cranial lung lobe.

and neoplastic disease did not differ among groups, and bronchoscopic score did not differ in cats with eosinophilic, neutrophilic, or mixed primary inflammatory disease. In cats with asthma experimentally induced through sensitization to allergen or antigen, an increase in bronchoscopic score was reported with enhanced hyperemia, edema, or mucus accumulation in comparison with baseline assessment[24] although no specific findings were described. All cats in the current study had some respiratory disease present, so it may not be surprising that abnormalities were present in all cats; however, the similarity of findings among groups was unexpected. Across all cats, a significant but weak correlation was noted for age and bronchoscopic score. In healthy Beagle dogs, total bronchoscopic score and findings of airway vascularity, mucosal irregularity, and bronchiectasis were increased in older dogs compared with middle-aged and younger animals,[25] and it is possible that findings in cats examined here represent a combination of aging changes superimposed on inflammatory injury.

There are some limitations to the clinical utility of this study. The grading scheme used was subjective and based solely on experience with feline bronchoscopic findings. Thus, results could be difficult to duplicate in a separate study, although in equine endoscopy, interobserver agreement on mucus scoring is high.[26] Total bronchoscopic score did not take into account the severity of each variable or the physiologic consequence of each findings and was not weighted to assign a higher number to changes that were likely irreversible, such as airway dilation or stenosis. Instead, mucus accumulation and hyperemia that could likely be reversed by treatment of the underlying condition weighed equally in construction of the total bronchoscopic score and few repeat bronchoscopic examinations were available to assess the effect of therapy on visualized abnormalities or cytologic findings. This study lacked histopathologic correlation with endobronchial lesions that could provide valuable information on the etiology and reversibility of the changes noted.

Bronchoscopy is a safe diagnostic tool for evaluating lower airway disease in cats.[2] Analysis of BAL fluid collected through an endotracheal tube, a blind approach, or with bronchoscopic visualization provides valuable clinical information; however, only bronchoscopy allows visualization of airway changes that might prove useful in assessing the severity or potential reversibility of the underlying disease process and ultimately in determining prognosis for recovery.

Footnotes

[a] Karl Storz 60003VB, Karl Storz Veterinary Endoscopy, Goleta, CA
[b] Olympus BF3C160, Olympus Endoscopy Corp, Melville, NY
[c] Cytospin3, ThermoShandon, Pittsburgh, PA
[d] GraphPad Prism version 5, San Diego, CA

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