Primary Tracheal Tumors in Dogs and Cats

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ABSTRACT: Primary neoplasms of the trachea are uncommon in dogs and cats. Patients are often middle aged or older, except dogs with osteochondromas. Clinical signs consistent with tracheal obstruction, including dyspnea, wheezing, stridor, and cough, are common. Caution should be used during diagnostics and therapeutics to prevent respiratory embarrassment. Survey radiography often reveals the mass, and bronchoscopy allows direct visualization and sampling of the lesion. Options for treatment include surgical excision, chemotherapy, radiation therapy, or some combination of these methods. Most tumors respond well to complete surgical excision, although lymphoma responds best to chemotherapy, with or without adjunctive radiation therapy. Data on long-term follow-up are not available, but prognosis most likely depends on tumor type and stage.

Primary neoplasms of the trachea are uncommon in animals and humans, and both benign and malignant tumor types occur.1–5 Most patients are older, although young dogs with active osteochondral ossification sites are at a higher risk of benign tracheal osteochondromas.5,6 Clinical signs of upper airway obstruction, including dyspnea, stridor, wheezing, exercise intolerance, and cough, should raise the clinician’s suspicion of this problem, and radiography often supports the diagnosis.2 Treatment options include surgical removal, chemotherapy, radiation therapy, and various combinations of these modalities. Treatment recommendations depend on tumor type and staging. Prognosis for these patients must be considered guarded because long-term follow-up of large case series has not been reported. Prognosis most likely depends on tumor type.2

SIGNALMENT

Canine primary tracheal tumors often present in a bimodal age distribution1,2,6–16 (Table 1). Of the reported ages in the literature, eight dogs were 2 years of age and younger, and 10 were 6 years of age and older, with osteochondroma and echondroma/osteochondromal dysplasia occurring in younger dogs.13–16 Both males and females are affected, with various breeds represented (Table 1).

Cats are often older, with the mean age of reported cases being 9.5 years1,7–27 (Table 2). Both sexes are represented, with domestic short-haired and Siamese most commonly affected. Of the 19 reported cases of feline tracheal tumors, feline leukemia virus (FeLV) status was reported in seven cats, and one had
Table 1. Reported Primary Tracheal Tumors in Dogs

<table>
<thead>
<tr>
<th>Study</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Breed</th>
<th>Sign(s)</th>
<th>Tumor Type</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlisle et al⁴</td>
<td>12</td>
<td>FS</td>
<td>Miniature poodle</td>
<td>Cough</td>
<td>Adenocarcinoma</td>
<td>None</td>
<td>Euthanized</td>
</tr>
<tr>
<td>Hill et al⁷</td>
<td>10</td>
<td>M</td>
<td>Spitz</td>
<td>Dyspnea</td>
<td>Carcinoma</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Harvey and Sykes¹¹</td>
<td>8</td>
<td>M</td>
<td>Siberian husky</td>
<td>Dyspnea</td>
<td>Mast cell tumor</td>
<td>Surgery</td>
<td>—</td>
</tr>
<tr>
<td>Carlisle et al⁴</td>
<td>13</td>
<td>F</td>
<td>German shepherd</td>
<td>Dyspnea</td>
<td>Mast cell tumor</td>
<td>None</td>
<td>Euthanized</td>
</tr>
<tr>
<td>Bryan et al¹⁰</td>
<td>“Aged”</td>
<td>F</td>
<td>Mix</td>
<td>Dyspnea</td>
<td>Leiomyoma</td>
<td>Surgery</td>
<td>Alive after 6 months</td>
</tr>
<tr>
<td>Black et al⁵</td>
<td>10</td>
<td>M</td>
<td>Miniature poodle</td>
<td>Panting</td>
<td>Leiomyoma</td>
<td>Surgery</td>
<td>Alive after 7 months</td>
</tr>
<tr>
<td>Chaffin et al²</td>
<td>10</td>
<td>FS</td>
<td>Mix</td>
<td>Dyspnea</td>
<td>Extramedullary plasmacytoma</td>
<td>Surgery</td>
<td>Alive after 3 months</td>
</tr>
<tr>
<td>Brodey et al¹²</td>
<td>7</td>
<td>F</td>
<td>Mix</td>
<td>Cough</td>
<td>Osteosarcoma</td>
<td>None</td>
<td>Euthanized</td>
</tr>
<tr>
<td>Carlisle et al⁴</td>
<td>10</td>
<td>F</td>
<td>Collie</td>
<td>Dyspnea</td>
<td>Chondroma</td>
<td>Surgery</td>
<td>—</td>
</tr>
<tr>
<td>Aron et al⁸</td>
<td>6</td>
<td>M</td>
<td>German shepherd</td>
<td>Dyspnea.Cough</td>
<td>Chondrosarcoma</td>
<td>Surgery</td>
<td>Alive after 12 months</td>
</tr>
<tr>
<td>Carlisle et al⁴</td>
<td>1</td>
<td>FS</td>
<td>Doberman</td>
<td>Dyspnea.Dyspnea</td>
<td>Chondrosarcoma</td>
<td>Surgery</td>
<td>Alive, but metastasis after 9 months</td>
</tr>
<tr>
<td>Hough et al¹⁵</td>
<td>0.5</td>
<td>F</td>
<td>Labrador retriever</td>
<td>Dyspnea</td>
<td>Osteochondroma</td>
<td>Surgery</td>
<td>Alive after 6 months</td>
</tr>
<tr>
<td>Withrow et al⁶</td>
<td>0.25</td>
<td>M</td>
<td>Old English sheepdog</td>
<td>Wheeze</td>
<td>Osteochondroma</td>
<td>Surgery</td>
<td>Alive after 7 months</td>
</tr>
<tr>
<td>Dubielzig and Dickey¹⁴</td>
<td>0.5</td>
<td>—</td>
<td>Alaskan malamute</td>
<td>Dyspnea</td>
<td>Osteochondroma</td>
<td>None</td>
<td>Died during diagnostics</td>
</tr>
<tr>
<td>Gourley et al¹⁶</td>
<td>0.9</td>
<td>F</td>
<td>Alaskan malamute</td>
<td>Collapse</td>
<td>Osteochondroma</td>
<td>Surgery</td>
<td>Alive after 8 months</td>
</tr>
<tr>
<td>Carlisle et al¹</td>
<td>0.5</td>
<td>M</td>
<td>German shepherd</td>
<td>Wheeze</td>
<td>Osteochondroma</td>
<td>Surgery</td>
<td>—</td>
</tr>
<tr>
<td>Carb and Halliwell¹³</td>
<td>0.9</td>
<td>M</td>
<td>Siberian husky</td>
<td>Dyspnea</td>
<td>Ecchondroma</td>
<td>Surgery</td>
<td>Alive after 5 months</td>
</tr>
<tr>
<td>Carb and Halliwell¹³</td>
<td>2</td>
<td>F</td>
<td>Mix</td>
<td>Dyspnea</td>
<td>Ecchondroma</td>
<td>Surgery</td>
<td>Alive after 1 year</td>
</tr>
</tbody>
</table>

FS = female spayed; dashes indicate unknown data.
Table 2. Reported Primary Tracheal Tumors in Cats

<table>
<thead>
<tr>
<th>Study</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Breed</th>
<th>FeLV/FIV Status</th>
<th>Sign(s)</th>
<th>Tumor Type</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown and Rogers²⁵</td>
<td>10</td>
<td>FS</td>
<td>DLH</td>
<td>—</td>
<td>Cough Wheeze</td>
<td>Lymphoma</td>
<td>Medical</td>
<td>Euthanized after 38 days</td>
</tr>
<tr>
<td>Brown and Rogers²⁵</td>
<td>11</td>
<td>CM</td>
<td>DSH</td>
<td>FeLV−, FIV−</td>
<td>Dyspnea</td>
<td>Lymphoma</td>
<td>Medical</td>
<td>Alive after 21 months</td>
</tr>
<tr>
<td>Brown and Rogers²⁵</td>
<td>4</td>
<td>CM</td>
<td>DSH</td>
<td>FeLV−, FIV−</td>
<td>Cough Wheeze</td>
<td>Lymphoma</td>
<td>Medical</td>
<td>Alive after 23 months</td>
</tr>
<tr>
<td>Brown and Rogers²⁵</td>
<td>13</td>
<td>CM</td>
<td>DSH</td>
<td>FeLV−, FIV−</td>
<td>Wheeze Cyanosis</td>
<td>Lymphoma</td>
<td>Medical</td>
<td>Alive after 17 months</td>
</tr>
<tr>
<td>Schnieder et al²³</td>
<td>7</td>
<td>M</td>
<td>Siamese</td>
<td>FeLV+</td>
<td>Dyspnea</td>
<td>Lymphoma</td>
<td>Medical</td>
<td>Alive after 8 months</td>
</tr>
<tr>
<td>Zimmerman et al²²</td>
<td>9</td>
<td>M</td>
<td>Siamese</td>
<td>—</td>
<td>Dyspnea</td>
<td>Lymphoma</td>
<td>Surgical</td>
<td>Recurred Euthanized after 10 days</td>
</tr>
<tr>
<td>Beaumont¹⁷</td>
<td>11</td>
<td>CM</td>
<td>DSH</td>
<td>FeLV−, FIV−</td>
<td>Dyspnea</td>
<td>Lymphoma</td>
<td>Surgical</td>
<td>Systemic after 4 months</td>
</tr>
<tr>
<td>Kim et al²¹</td>
<td>13</td>
<td>FS</td>
<td>Siamese</td>
<td>FeLV−, FIV−</td>
<td>Dyspnea</td>
<td>Lymphoma</td>
<td>None</td>
<td>Euthanized</td>
</tr>
<tr>
<td>Cain and Manley¹⁹</td>
<td>10</td>
<td>—</td>
<td>Siamese</td>
<td>—</td>
<td>Dyspnea</td>
<td>Adenocarcinoma</td>
<td>None</td>
<td>Euthanized</td>
</tr>
<tr>
<td>Evers et al²⁰</td>
<td>12</td>
<td>CM</td>
<td>DSH</td>
<td>FeLV−</td>
<td>Dyspnea</td>
<td>Adenocarcinoma</td>
<td>Surgical</td>
<td>Recurred Euthanized after 12 months</td>
</tr>
<tr>
<td>Zimmerman et al²²</td>
<td>12</td>
<td>M</td>
<td>Persian</td>
<td>—</td>
<td>Dyspnea</td>
<td>Adenocarcinoma</td>
<td>Surgical</td>
<td>Alive after 12 months</td>
</tr>
<tr>
<td>Evers et al²⁰</td>
<td>12</td>
<td>FS</td>
<td>DSH</td>
<td>—</td>
<td>Dyspnea</td>
<td>Adenocarcinoma</td>
<td>Surgical</td>
<td>Alive after 3 months</td>
</tr>
<tr>
<td>Neer and Zeman¹⁶</td>
<td>7</td>
<td>—</td>
<td>DLH</td>
<td>—</td>
<td>Wheeze Dyspnea</td>
<td>Adenocarcinoma</td>
<td>Surgical</td>
<td>Recurred Euthanized after 17 months</td>
</tr>
<tr>
<td>Carlisle et al¹</td>
<td>6</td>
<td>FS</td>
<td>Domestic</td>
<td>—</td>
<td>Stridor</td>
<td>Seromucinous carcinoma</td>
<td>None</td>
<td>Euthanized</td>
</tr>
<tr>
<td>Glock²¹</td>
<td>6</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Weight loss</td>
<td>Adenoma</td>
<td>None</td>
<td>Euthanized</td>
</tr>
<tr>
<td>Lobetti and Williams³⁶</td>
<td>11</td>
<td>CM</td>
<td>DSH</td>
<td>—</td>
<td>Dyspnea</td>
<td>Squamous cell carcinoma</td>
<td>None</td>
<td>Euthanized</td>
</tr>
<tr>
<td>Carlisle et al¹</td>
<td>9</td>
<td>M</td>
<td>Domestic</td>
<td>—</td>
<td>Wheeze Dyspnea</td>
<td>Carcinoma</td>
<td>Surgical</td>
<td>Died after 15 months</td>
</tr>
<tr>
<td>Veith²⁷</td>
<td>2</td>
<td>CM</td>
<td>DSH</td>
<td>—</td>
<td>Dyspnea</td>
<td>Squamous cell carcinoma</td>
<td>None</td>
<td>Died</td>
</tr>
</tbody>
</table>

*CM = castrated male; DLH = domestic long-haired; DSH = domestic short-haired; FS = female spayed; dashes indicate unknown data.*
positive results on an immunofluorescent antibody test. Of the five cats tested for feline immunodeficiency virus (FIV), all had negative results.

HISTORY AND CLINICAL SIGNS

Acute, intermittent, or chronic and progressive signs of tracheal obstruction may prompt presentation of the patient to the veterinarian. Dyspnea, wheezing, exercise intolerance, and coughing are common complaints. Depression, voice change, intermittent cyanosis, inability to bark, collapse, or weight loss may also be noted. Although some patients present with no overt clinical signs, many are in obvious respiratory distress. Along with the clinical signs already listed, referred upper airway sounds may be auscultated. Patients may become cyanotic with the stress of physical examination. Cats may begin open-mouth breathing or may present in a crouched stance with their head and neck extended. Patients may show a preference for sternal recumbency over lateral recumbency. A 6-month-old Alaskan malamute that presented for osteochondroma of the trachea had obvious hemorrhage at the laryngeal opening.

DIAGNOSTICS

When the patient’s condition permits, radiography is the diagnostic procedure of choice. Tracheal tumors are often discernible on survey radiography because these masses are outlined by tracheal air, which provides a natural contrast medium (Figure 1). If tracheal neoplasia is considered a diagnostic differential and the thoracic radiographs are within normal limits, radiographs of the neck should be obtained. Intratracheal masses may present in a variety of locations within the trachea, from just caudal to the larynx to the carina. Overexpansion of the lungs, flattening of the diaphragm, and prominent pulmonary vasculature secondary to increased air content of the lungs have been noted in cats with intratracheal tumors. If severe respiratory embarrassment is present, oxygen therapy or sedation may be necessary to obtain diagnostic radiographs without endangering the patient.

Bronchoscopy offers direct visualization of the mass(es) (Figure 2), unless substantial hemorrhaging is present. Brush cytology and biopsies may also be obtained for evaluation (Figure 3). Brush cytology offers the clinician the potential to make an immediate diagnosis and provide immediate treatment.

DIFFERENTIAL DIAGNOSIS

Intratracheal mast cell tumor, adenocarcinoma, carcinoma, leiomyoma, chondroma, osteosarcoma, extramedullary plasmacytoma, rhabdomyosarcoma, and chondrosarcoma have been reported in dogs. Five cases of osteochondroma and two cases of ecchondroma/osteochondromal dysplasia have been reported in young dogs. These benign tracheal osteocartilaginous tumors grow in synchrony with the rest of the musculoskeletal system and, therefore, should stop growing with skeletal maturity. Intraluminal adenocarcinoma, lymphoma, squamous cell carcinoma, and adenoma have been reported in cats. Intratracheal neoplasms must be differentiated from nonneoplastic intraluminal masses. Differentials for nonneoplastic intraluminal masses include polyps, eosinophilic granulomas, nodular amyloidosis, tissue reaction to Filarioides osleri, chondromatous hamartoma, papillomatosis, and hyperplastic tracheitis of unknown cause. Stenosis of the tracheal lumen may be iatrogenically induced via excessive inflation of an endotracheal tube or other trauma.

STAGING

Ideally, all dogs and cats with neoplasia should undergo staging before definitive treatment recommendations are made. Intratracheal neoplasms causing respiratory compromise sometimes present an exception to this rule because immediate therapy may need to be initiated. If time permits, clinical pathology and imaging modalities should be performed. For all animals, a complete blood cell count, chemistry profile, and urinalysis should be conducted. FeLV and FIV status should be determined in all cats.
should be evaluated for evidence of metastasis. Abdominal ultrasonography allows evaluation of systemic disease, including systemic neoplasia, when abdominal palpation may not fully define abdominal disease. Cats with heart murmurs should undergo echocardiography before anesthesia, if possible. This not only allows a proper anesthetic induction, protocol to be chosen but also potentially identifies any underlying or complicating disease processes. The acquired information can also guide treatment choices (e.g., Is the animal a good candidate for chemotherapy?).

**TREATMENT**

Treatment options include surgical removal, chemotherapy, radiation therapy, or a combination of these modalities, depending on tumor type and stage. Surgical removal is the only reported treatment attempted in dogs, either by resection of the trachea or endoscopic removal by snaring. Surgery is the treatment of choice for solitary tracheal tumors without evidence of metastatic disease. Surgical therapy may provide short-term palliative relief of airway obstruction for tracheal tumors exhibiting local and metastatic spread. Although outcome was not reported for one dog with a mast cell tumor, follow-up times were reported for most dogs with osteochondroma (6, 7, and 8 months), leiomyoma (6 and 7 months), ecchondroma/osteochondromal dysplasia (5 and 12 months), extramedullary plasmacytoma (3 months), and chondrosarcoma (9 and 12 months). Therefore, short-term survival with surgical resection appears adequate, but long-term prognosis cannot be fully evaluated.

Cats with intratracheal adenocarcinoma have been followed for up to 17 months. Two cats that had surgical resection were clinically well at 3 and 12 months. One cat had an adenocarcinoma suctioned during bronchoscopy twice, affording the cat an additional 17 months of life. Intratracheal lymphoma has not responded well to surgical removal alone. One cat had recurrence of disease within 10 days, and another had systemic lymphoma at 4 months postoperatively.

The main indication for radiation and chemotherapy is for intratracheal tumors of lymphoid origin. This extranodal lymphoma is quite sensitive to radiation therapy and should be considered immediately after the cytologic or histologic diagnosis has been made. Radiation provides a rapid reduction of tumor burden, allowing a more immediate improvement in the patient’s respiratory status. Chemotherapy can also delay local or systemic recurrence of lymphoma. Two cats were tumor free for 17 and 21 months after a combination of chemotherapy and radiation was used to treat intratracheal lymphoma.

**PROGNOSIS**

Prognosis depends on tumor type, stage of disease, and underlying disease. Osteochondromas of young dogs appear to carry the best prognosis. Other canine and feline tracheal tumors have not been followed long-term after surgical resection, but patients appear to respond well to surgery, reportedly with survival times of several months. Cats with tracheal lymphoma may do well after radiation, systemic chemotherapy, or a combination of these two modalities.
CONCLUSION

Primary intratracheal neoplasia is uncommon in dogs and cats, with only 37 cases reported in the veterinary literature. Clinical signs are associated with airway obstruction, including dyspnea, wheezing, and exercise intolerance. Radiography often reveals a soft tissue density within the tracheal lumen. Bronchoscopy allows direct visualization and sampling for cytology and histopathology. Treatment recommendations may include surgical removal, chemotherapy, radiation therapy, or a combination of these methods, depending on the tumor type and stage. Until long-term follow-up is observed and reported, the prognosis for these patients must be considered guarded. Prognosis most likely depends on tumor type.

REFERENCES

1. Because canine tracheal neoplasms present in a bimodal age distribution, dogs 2 years of age or younger are most likely to present with
   a. mast cell tumor.
   b. leiomyoma.
   c. chondrosarcoma.
   d. osteochondroma.

2. Which of the following are reported clinical signs for patients with tracheal tumors?
   a. wheezing and dyspnea
   b. cough and exercise intolerance
   c. voice change or inability to bark
   d. all of the above

3. Which of the following is the diagnostic procedure of choice for confirming suspicions of an intratracheal mass?
   a. contrast radiography
   b. survey radiography
   c. bronchoscopy
   d. exploratory surgery

4. Which of the following parasites may cause intratracheal nodules as a result of tissue reaction against the parasite?
   a. *Oslerus hirthi*
   b. *Aelurostrongylus abstrusus*
   c. *Filaroides osleri*
   d. *Paragonimus kellicotti*

5. An unstable, dyspneic cat has been anesthetized, and bronchoscopy has revealed a mass. Cytology of the mass reveals lymphoma. Before the cat recovers from anesthesia, the therapy that would offer the quickest reduction of the tumor burden would be
   a. chemotherapy.
   b. radiation therapy.
   c. surgical excision.
   d. medical management with prednisone.

6. Surgical resection is the treatment of choice for all of the following except
   a. lymphoma.
   b. adenocarcinoma.
   c. osteochondroma.
   d. leiomyoma.

7. Which of the following is considered a benign osteocartilaginous tumor that grows in synchrony with the rest of the musculoskeletal system and should stop growing at skeletal maturity?
   a. leiomyoma
   b. chondroma
   c. osteochondroma
   d. osteosarcoma

8. When a patient presents with clinical signs consistent with a tracheal tumor, the first priority should be to
   a. obtain plain radiographs to identify the problem.
   b. stabilize the patient with oxygen and other supportive measures.
   c. perform bronchoscopy to obtain a sample for cytology and histopathology.
   d. submit blood for a complete blood cell count and chemistry profile.

9. All of the following have been noted in cats with intratracheal tumors except
   a. overexpansion of the lungs.
   b. flattening of the diaphragm.
   c. underexpansion of the lungs.
   d. prominent pulmonary vasculature.

10. Which of the following statements regarding FIV and FeLV is true?
    a. FIV is common in cats with tracheal neoplasia.
    b. FIV and FeLV are common in cats with tracheal neoplasia.
    c. FIV testing was reported in four of 19 cats, and all cats were negative for the virus.
    d. All cats with tracheal neoplasia are FeLV positive.