Lung lobe torsion in dogs: 22 cases (1981–1999)

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Objective—To identify breed disposition, postoperative complications, and outcome in dogs with lung lobe torsion.

Design—Retrospective study.

Animals—22 client-owned dogs.

Procedure—Information on signalment; history; clinical findings; results of clinicopathologic testing, diagnostic imaging, and pleural fluid analysis; surgical treatment; intra- and postoperative complications; histologic findings; and outcome were obtained from medical records.

Results—All 22 dogs had pleural effusion; dyspnea was the most common reason for examination. Fifteen dogs were large deep-chested breeds; 5 were toy breeds. Afghan Hounds were overrepresented, compared with the hospital population. One dog was euthanatized without treatment; the remaining dogs underwent exploratory thoracotomy and lung lobectomy. Eleven dogs recovered from surgery without complications, but 3 of these later died of thoracic disease. Four dogs survived to discharge but had clinically important complications within 2 months, including chylothorax, mediastinal mesothelioma, gastric dilatation, and a second lung lobe torsion. Six dogs died or were euthanatized within 2 weeks after surgery because of acute respiratory distress syndrome, pneumonia, septic shock, pneumothorax, or chylothorax. Chylothorax was diagnosed in 8 of the 22 dogs, including 4 Afghan Hounds.

Conclusions and Clinical Relevance—Results suggest that lung lobe torsion is rare in dogs and develops most frequently in large deep-chested dogs, particularly Afghan Hounds. Other predisposing causes were not identified, but an association with chylothorax was evident, especially in Afghan Hounds. Prognosis for dogs with lung lobe torsion was fair to guarded. (*J Am Vet Med Assoc* 2000;217:1041–1044)

Lung lobe torsion is rare in dogs, and details of only 25 cases have been reported in the veterinary literature.[1-10] Historically, large deep-chested breeds appear to be overrepresented, although Lord et al[2] described lung lobe torsion in Miniature Poodles and a Dachshund. Historical features of lung lobe torsion reportedly included coughing, progressive dyspnea, and, in some instances, anorexia, vomiting, and diarrhea.[1-10] On physical examination, the predominant abnormalities were respiratory signs with coughing, dyspnea, and dull heart and lung sounds on thoracic auscultation. Thoracic radiography demonstrated pleural effusion and evidence of consolidation of the affected lung lobe.[1,2,4-6,8,10] In several dogs, lung lobe consolidation was accompanied by an abnormal orientation of the bronchovascular structures of the affected lobe.[2,5,6] Exploratory thoracotomy confirmed the diagnosis of lung lobe torsion in 21 dogs, and removal of the affected lung lobe in 19 of these dogs resulted in a successful recovery in 12.[1,2,5,6,8,10] A diagnosis of lung lobe torsion was made at necropsy in 4 dogs.[3,4,7,9] In 5 dogs, torsion of a second lung lobe developed at a later date.[2,6,8] Causes of morbidity and mortality were reported to include chylothorax, aortic embolism, respiratory insufficiency, and acute postoperative death.[2,6]

Analysis of published cases provides some information about lung lobe torsion in dogs, but data from a large group of dogs with this disease has not, to our knowledge, been published previously. Therefore, the purpose of the study reported here was to identify a large group of dogs with lung lobe torsion and determine breed disposition, postoperative complications, and overall outcome.

Criteria for Selection of Cases

Medical records of all dogs with lung lobe torsion examined at the University of Pennsylvania Veterinary Hospital between January 1981 and March 1999 were reviewed. A medical record was included in the study if there was surgical or postmortem confirmation of lung lobe torsion. Data recorded included details of breed, age, sex, duration of clinical signs, clinical findings, and results of CBC and serum biochemical analyses. In addition, details of preoperative diagnostic imaging, pleural fluid analyses, intra- and postoperative complications, pathologic findings, and overall outcome were recorded.

Procedures

Statistical analyses—Descriptive statistics were calculated for numerical data. Prevalence of lung lobe torsion in Afghan Hounds was compared with prevalence in other breeds by use of the Fisher exact test.

Results

Signalment—Twenty-two dogs met the criteria for inclusion in the study. Median age of the dogs at the time of initial examination at the veterinary teaching hospital was 3 years (range, 0.5 to 14 years; mean, 6 years). Thirteen (59%) were male. Five (23%) were Afghan Hounds, and Afghan Hounds were significantly overrepresented, compared with the hospital population (odds ratio, 133.4; $P < 0.001$). Twenty of the dogs were purebred dogs representing 13 breeds; the remaining 2 dogs were of mixed breeding. Including the Afghan Hounds, 15 (75%) of the 20 purebred dogs were of breeds with a deep chest conformation: 2 Borzois, 2 German Shepherd Dogs, and 1 each of Great

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Dane, Golden Retriever, Irish Setter, Standard Poodle, English Setter and Old English Sheepdog. The other 5 purebred dogs were toy breeds, including 2 Pugs, 1 Pekingese, 1 Yorkshire Terrier, and 1 Shih Tzu.

Clinical abnormalities—Median duration of clinical signs prior to examination at the teaching hospital was 5 days (range, 1 to 90 days; mean, 18 days). One small dog (Pug) had a history of trauma, having rolled off the bed 3 weeks prior to examination. Dyspnea or tachypnea were evident in 18 (82%) dogs. Lethargy was reported for 13 (59%), anorexia or weight loss for 12 (55%), and pyrexia for 5 (23%). Four (18%) dogs were reported to have been coughing, and vomiting was reported for 4 (18%) dogs.

Physical examination findings at the time of initial examination were recorded for 21 dogs. Seventeen (77%) dogs had dull cardiopulmonary sounds on thoracic auscultation. Fourteen (63%) were febrile (rectal temperature > 39.4 C [103 F]), and 4 (18%) had evidence of cardiovascular instability (ie, tachycardia and a capillary refill time > 2 seconds with poor pulse quality [n = 1] or capillary refill time < 1 second with bounding pulse [3]).

Clinicopathologic findings—A CBC and serum biochemical analyses were performed at the time of initial examination in all 22 animals. Thirteen (59%) dogs had neutrophilia (> 12×10^3 neutrophils/μl); 5 of the 13 had band neutrophilia, and the other 8 had mature neutrophilia. Toxic neutrophils were seen in samples from all 5 dogs with band neutrophilia. Six dogs had anemia (PCV < 35%). Serum cholesterol concentration was high (> 359 mg/dl) in 4 dogs and low (< 126 mg/dl) in another 4. Serum alkaline phosphatase activity was high (> 155 U/L) in 7 dogs, and serum alanine aminotransferase activity was high (> 50 U/L) in 2. Bilirubinemia (> 0.7 mg/dl) was detected in 7 dogs. Serum creatinine concentration was high (> 1.0 mg/dl) in 3.

Pleural fluid was obtained preoperatively by means of thoracocentesis from 19 (86%) dogs. The fluid was determined to be chylous in 6 dogs because of a milky-white opaque appearance and triglyceride concentration greater than that of serum. Pleural fluid from 13 dogs was examined cytologically and typically was reported as a modified transudate with high numbers of neutrophils, lymphocytes, and a few modified mesothelial cells. Cytologic evaluation revealed abnormal cells in samples from 4 (30%) dogs; 3 of the 4 contained large, reactive mesothelial cells, and the fourth contained possible carcinoma cells. Pleural fluid samples from 10 dogs were submitted for bacterial culture, and 6 yielded bacterial growth. Bacteria identified included *Pseudomonas* spp, *Enterococcus* spp, *Proteus* spp, *Staphylococcus* spp, *Enterobacter* spp, and *Serratia* spp.

Diagnostic imaging—Thoracic radiography was performed in all 22 dogs and revealed pleural effusion in all 22. All dogs had evidence of one (n = 19) or more (3) consolidated lung lobes; the right middle lobe was involved in 10, the left cranial lobe in 9, the right cranial lobe in 4, the right caudal lobe in 1, and the left caudal lobe in 1. Lung lobe torsion was tentatively diagnosed in all dogs, but abnormal bronchial positioning consistent with torsion was evident in only 10 dogs. Thoracic ultrasonography was performed in 9 dogs; a tentative diagnosis of lung lobe torsion was made in 7 of these dogs, and findings correlated with the radiographic findings in 6.

Treatment—One dog was euthanatized after cytologic examination of pleural fluid revealed abnormal cells suspected to be neoplastic. Torsion of the left cranial lung lobe was confirmed at necropsy. Exploratory thoracic surgery was performed in the remaining dogs, and lung lobe torsion was confirmed in all 21. Lung lobectomy was performed in all dogs without attempting to return the lung lobe to its normal position and orientation. The affected lung lobe correlated with radiographic diagnosis in 18 of 21 (86%) dogs and with the ultrasonographic diagnosis in all 7 dogs in which the affected lobe was specified. The lobes removed at the time of surgery or necropsy included the right middle lobe in 10 dogs, the left cranial lobe in 8, the right cranial lobe in 3, the right caudal lobe in 1, and the left caudal lobe in 1. Additional procedures were performed in 4 dogs and included pericardiectomy in 1 dog, biopsy of a mediastinal mass in 1 dog, and thoracic duct ligation in 2 dogs with a preoperative diagnosis of chylothorax.

Histologic lesions—For 20 dogs, the resected lung lobe was examined histologically. Seventeen dogs did not have signs of lung lesions other than lung lobe torsion; histologic abnormalities in these dogs included hemorrhage, necrosis, and thrombosis. Three dogs had evidence of pathologic processes in addition to lung lobe torsion. These included malignant fibrous histiocytosis in 1 dog, granulomatous lymphangitis in 1 dog, and mediastinal mesothelioma in the dog with the mediastinal mass.

Outcome—All 21 dogs that underwent surgery survived the procedure. Eleven (55%) had an uncomplicated recovery and were discharged from the hospital between 2 and 7 days (mean, 4 days) after surgery. Three of these dogs died later of recurrent thoracic disease; 1 developed pneumothorax 6 years later, 1 developed chylopyothorax 3.5 years later, and 1 developed dyspnea of an unknown cause 6 months later.

Two (10%) dogs died within 24 hours after surgery; an Irish Setter developed acute respiratory distress syndrome, and a Standard Poodle developed cardiopulmonary arrest. Histologic examination of the affected lung lobes in these 2 dogs revealed granulomatous lymphangitis and malignant fibrous histiocytosis, respectively.

Four (19%) dogs were euthanatized or died within 14 days after surgery. One Afghan Hound developed chylothorax and was euthanatized 4 days after surgery because of a poor prognosis, a German Shepherd Dog developed pneumonia and chylothorax and died 8 days after surgery, a Borzoi developed septic shock and died 12 days after surgery, and a second Borzoi suffered from persistent pneumothorax, despite a second exploratory thoracotomy and lung lobectomy, and died 4 days after surgery. Perforation of a third lung lobe by a chest tube was found at necropsy in this dog.

The remaining 4 (19%) dogs survived to discharge but later developed substantial complications. The dog with the mediastinal mesothelioma, a mixed-breed dog, began chemotherapy after surgery (intracavitary administration of carboplatin); however, pleural fluid had redeveloped by 6 months later, and cytologic examination of the pleural fluid revealed malignant histiocytosis. Chemotherapy was discontinued 9 months after surgery, and the dog was euthanatized 2 months later. An Afghan Hound had chylothorax prior to surgery and a history of chronic intermittent vomiting. Thoracic duct ligation was performed, and a gastrotomy tube was placed at the time of surgery. A nonchylous effusion was evident after surgery, but this gradually resolved over 10 days. The vomiting, however, continued, and gastric dilatation developed 14 days after surgery. A belt-loop gastropexy was performed. The vomiting gradually resolved over 8 weeks, and there were no problems at the time of follow-up 8 months after surgery. Another Afghan Hound developed chylothorax 4 weeks after undergoing lung lobectomy. Medical management was attempted for 1 month, until a second lung lobe torsion occurred. The second surgery included lung lobectomy (left cranial lung lobe), pericardiectomy, and thoracic duct ligation. Lymphocytic nonchylous pleural effusion persisted and was treated with placement of a pleuroperitoneal shunt after 2 months. The effusion became chylous and increased in volume 5 months after the second thoracotomy, and the dog was euthanatized 1 month later. One other Afghan Hound with preoperative chylothorax continued to produce chylous fluid after surgery, and a pleuroperitoneal shunt was placed 7 days after the initial surgery. The dog was doing well 3 months after lung lobectomy.

Long-term follow-up was available for 12 of the 15 dogs that survived longer than 1 month after surgery. Five were euthanatized for reasons related to thoracic disease; 2 had a recurrence of chylothorax (8 months and 5.5 years), 1 had pneumothorax (6 years), 1 had progression of neoplasia (11 months), and 1 developed dyspnea of unknown cause (6 months). One dog developed gastric dilatation 2 years after lung lobectomy was performed but recovered well after corrective surgery and gastropexy. The remaining 6 dogs were healthy at the time of final follow-up 2 months to 7.5 years after surgery.

Discussion

Lung lobe torsion occurs when a lung lobe rotates about its longitudinal axis, twisting the bronchus and pulmonary vessels at the hilus. The thin-walled pulmonary vein collapses easily, whereas the more muscular artery continues to allow some blood flow into the lung. This leads to congestion and consolidation, as fluid moves into the interstitial tissue and airways, and eventually to pleural effusion, as fluid leaks into the pleural cavity. There is considerable debate as to why a lung lobe would twist about its axis. Lung lobe torsion has been reported to be associated with accidental and surgical trauma, pleural effusion, and pneumothorax in humans.[11-14] It has been proposed that the combination of lung consolidation or atelectasis (caused by pleural effusion, pneumothorax, trauma, pneumonia, or manipulation during surgery) with increased air or fluid around the lobe may predispose it to rotate about its axis.[2,3,6,7] However, lung lobe torsion has been identified in dogs in which no predisposing factors were discovered,[2,8] and the torsion is presumed to be spontaneous.

The predominant feature of the clinical history of most of the dogs in the present study was dyspnea or tachypnea that was accompanied by lethargy and anorexia in many dogs. Only 1 dog had a history of trauma. Physical examination revealed dull cardiopulmonary sounds in most dogs, and pleural effusion was confirmed by means of radiography in all dogs. Radiography performed after thoracocentesis revealed lung lobe consolidation in all dogs, and a diagnosis of lung lobe torsion was supported on the basis of abnormal bronchial alignment in 10 dogs. These findings are consistent with findings given in previous reports of this condition.[1-10] Ultrasonography proved to be a valuable imaging modality in several dogs in the present study and may be a useful adjunct to radiography in the diagnosis of lung lobe torsion.

Pleural fluid from 19 dogs in the present study was submitted for cytologic evaluation. Reactive mesothelial cells were seen in 3 samples, and 1 of these dogs was found to have a mediastinal mesothelioma at surgery. However, the finding of reactive mesothelial cells should not be overinterpreted, because reactive mesothelial cells commonly have many features of malignancy, and mesothelioma is rare. Pleural fluid samples from 10 dogs were submitted for bacterial culture, and 6 yielded bacterial growth. Although 3 of these dogs developed clinically important postoperative complications and died, complications were a result of sepsis in only 1. The remaining 3 dogs recovered without complications.

Exploratory thoracotomy and removal of the affected lobe was the treatment of choice for dogs in the present study. The distribution of lung lobes was similar to the distribution in previous reports,[1-10] except that the left cranial lung lobe was affected more frequently (38 vs 23%) in the present study.

Eleven of 21 dogs in the present study had an uncomplicated recovery from surgery and returned home within a few days. This is consistent with survival of 12 of the 25 dogs reported previously.[1-10]

Three of the 22 dogs in this study had underlying thoracic disease; the pleural effusion associated with thoracic neoplasia in 1 dog and lymphangitis in another may have contributed to lobe atelectasis and predisposed the lung lobe to torsion. Although all of the remaining 19 dogs without histologic evidence of an underlying thoracic disease had pleural effusion at the time of initial examination at the teaching hospital, the absence of underlying disease suggests that the pleural effusion may have developed secondary to lung lobe torsion, and that the lobe may have torsed spontaneously. However, although this hypothesis seems reasonable for dogs with a hemorrhagic pleural effusion, it is more questionable for dogs with a chylous effusion. Chylothorax is thought to develop after disruption or impedance of the thoracic duct or thoracic lymphatics, resulting in lymphangiectasia.[15] Inciting caus-

es include trauma, neoplasia, fungal infection, heartworm disease, and diaphragmatic hernia,[15-17] but in many dogs, chylothorax is idiopathic.

Six dogs in the present study had a chylous pleural effusion prior to surgery. There was no apparent underlying disease accompanying lung lobe torsion in these 6 dogs; therefore, a diagnosis of idiopathic chylothorax was made. It remains unclear whether the chylous effusion occurred first, resulting in lung lobe torsion, or the lung lobe torsion occurred first, resulting in lymphatic injury and chylothorax. However, dogs with chylothorax typically have a poor prognosis. Fossum et al,[15] for instance, found that only 17% of dogs available for follow-up had survived beyond 6 months. In the present study, on the other hand, chylothorax resolved in 5 of the 6 dogs after surgery, and thoracic duct ligation had been performed in only 2 of the 5 dogs in which chylothorax resolved. Also in the present study, 2 dogs (both Afghan Hounds) that had a nonchylous pleural effusion before surgery developed chylothorax within 1 month after surgery. Development of chylothorax in dogs after treatment of lung lobe torsion has been reported previously[2,6] and may be a result of trauma to the thoracic lymphatic system during surgery.

Findings in the present report support the previous suggestion that lung lobe torsion is more common among large deep-chested dogs. Afghan Hounds were overrepresented in the present study, accounting for 5 of the 22 (23%) dogs, and analysis of our data indicated that Afghan Hounds were 133 times as likely to develop lung lobe torsion as were dogs of other breeds. Similarly, 9 of the 25 (36%) dogs with lung lobe torsion previously reported were Afghan Hounds.[2,6,7,10] Two of the Afghan Hounds in the present study had chylothorax prior to surgery, and another 2 developed chylothorax after surgery. Because Afghan Hounds are overrepresented in reports of chylothorax secondary to lymphangiectasia,[15] it could be proposed that their thoracic lymphatic system has a lower tolerance for insults of any kind, increasing their likelihood of developing chylothorax in association with lung lobe torsion. In a review of the medical records at the University of Pennsylvania veterinary hospital from 1981 through 1999, we were able to identify only 1 other Afghan Hound that underwent thoracic surgery and did not have chylothorax either before or after surgery. Only 4 of the 9 Afghan Hounds described in previous reports of lung lobe torsion in dogs developed chylothorax, but 6 of the 9 were euthanatized or died (2 because of chylothorax, 2 because of recurrence of lung lobe torsion, and 2 because of cardiac arrest after surgery). Of the 7 dogs in the present study that did not have evidence of an underlying thoracic disease and developed clinically important complications after surgery or died, 4 were Afghan Hounds, and 2 were Borzois. Apart from breed disposition, other preoperative predictors of an unsuccessful outcome were not identified.

Although lung lobe torsion is generally considered a disease of large deep-chested dogs, Lord et al[2] described lung lobe torsion in Miniature Poodles and a Dachshund, and Brown and Zontine[18] described 3 cats with the disorder. In the present study, several dogs were toy breeds, including a Yorkshire Terrier, a Shih Tzu, a Pekingese, and 2 Pugs. Thus, lung lobe torsion should not be excluded in the differential diagnosis of thoracic disease in smaller breeds of dog. All 5 toy-breed dogs in the present study had a successful outcome, without any clinically important postoperative complications.

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