Transdiaphragmatic extension of a retroperitoneal lipoma into the intrathoracic extrapleural space via the lumbocostal trigone in a dog

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Case Description—An 8-year-old 12.2-kg (26.9-lb) spayed female American Cocker Spaniel was referred for evaluation of abdominal discomfort and a suspected intra-abdominal lipoma with possible invasion into the thorax.

Clinical Findings—Physical examination revealed a tense abdomen, and the margins of a large abdominal mass could be appreciated. Abdominal imaging revealed a mass of fat opacity in the abdominal and thoracic cavities. Computed tomography with precontrast and postcontrast peritoneograms was used to determine whether the masses connected via a diaphragmatic defect.

Treatment and Outcome—Exploratory laparotomy revealed a retroperitoneal lipomatous mass that had focally invaded the hypaxial musculature and had extended across the dorsolateral aspect of the diaphragm via the lumbocostal trigone into the intrathoracic extrapleural space. Surgical resection required transdiaphragmatic thoracotomy. Histologic examination of excised tissue confirmed the preoperative diagnosis of a lipoma. The dog recovered from surgery with no complications and had no disease recurrence for at least 32 months after surgical resection.

Clinical Relevance—The defect of the lumbocostal trigone is also called the foramen of Bochdalek in humans, and it is recognized as a common location for congenital diaphragmatic hernia. A lumbocostal trigone hernia may be considered as a differential diagnosis for bicavitary masses in dogs, particularly in the absence of a history of trauma. (*J Am Vet Med Assoc* 2012;240:978–982)

An 8-year-old 12.2-kg (26.9-lb) spayed female American Cocker Spaniel was referred to the Purdue University Veterinary Teaching Hospital for further evaluation of thoracic and abdominal masses. The dog had been initially evaluated by the referring veterinarian because of groaning and possible abdominal pain. Abdominal radiographs showed a pronounced mass effect in the right lateral abdominal cavity caused by the presence of a fat opacity. Radiographs also revealed an intrathoracic fat opacity mass. It was not possible to determine whether this represented a second lesion or an extension of the abdominal fat opacity mass. Results of hematologic evaluation and serum biochemical analysis were within reference limits. The dog had been treated with deracoxib[a] (2 mg/kg [0.9 mg/lb], PO, q 12 h) for analgesia, but the owner reported minimal improvement.

On examination, the dog was tense upon abdominal palpation and a large, smooth mass could be palpated in the abdomen just cranial to the right paralumbar fossa. Respiratory rate and effort were normal. Repeat thoracic and abdominal radiography were performed. This confirmed the presence of a fat opacity mass in the right cranial abdomen, which displaced the right side of the liver, right kidney, and small intestines caudally, medially, and ventrally, respectively. The outline of the right crus of the diaphragm was not well defined on the ventrodorsal, dorsoventral, and right lateral views. A fat opacity mass was also present in the right caudodorsal aspect of the thoracic cavity and displaced the right crus of the diaphragm caudally. It was suspected that the masses were connected, possibly via invasion or extension through the right crus of the diaphragm (**Figure 1**).

Abbreviations

BH	Bochdalek hernia
LT	Lumbocostal trigone

Abdominal ultrasonographic examination was performed to better determine the extent of the masses and to obtain a cytologic sample from the mass. The echogenicity and echotexture of the abdominal mass were consistent with fat. The mass displaced the right kidney and other abdominal contents caudomedially. A communication between the intrathoracic and intra-abdominal masses could not be confirmed ultrasonographically. Ultrasound-guided fine-needle aspirate of the abdominal mass was performed. Grossly, the sample appeared to be lipid. Cytologic examination revealed rare erythrocytes in a clear background. Cytopathologic interpretation was consistent with a lipoma.

Surgical resection of the mass occurred approximately 3 weeks later. The dog received acepromazine maleate[b] (0.01 mg/kg [0.005 mg/lb], IM) and hydromorphone[c]

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(0.07 mg/kg [0.03 mg/lb], IM) as preanesthetic medication, and general anesthesia was induced with propofol[d] (4 mg/kg [1.8 mg/lb], IV). The dog was intubated, and inhalation anesthesia was maintained with isoflurane in oxygen.[e]

Computed tomography was performed with the dog under anesthesia prior to the surgery. A 5-mm-thick helical mode was used for CT with examination from the cranial thorax through the caudal abdomen. A fat-attenuating intrathoracic mass measuring approximately 7 × 10 cm was present in the right caudodorsal thoracic cavity, displacing the caudal mediastinum to the left and the caudal vena cava ventrally. Hypostatic congestion of the right caudal lung lobe was also present. Additionally, a large fat-attenuating mass measuring approximately 15 × 10 cm was present in the right cranial abdomen. It displaced the right kidney ventromedially and the right liver lobes medially. The mass was presumed to be located in the retroperitoneal space. Multiplanar reconstruction of the CT images showed good definition of the left crus of the diaphragm. However, the right crus of the diaphragm was not well-defined (**Figure 2**).

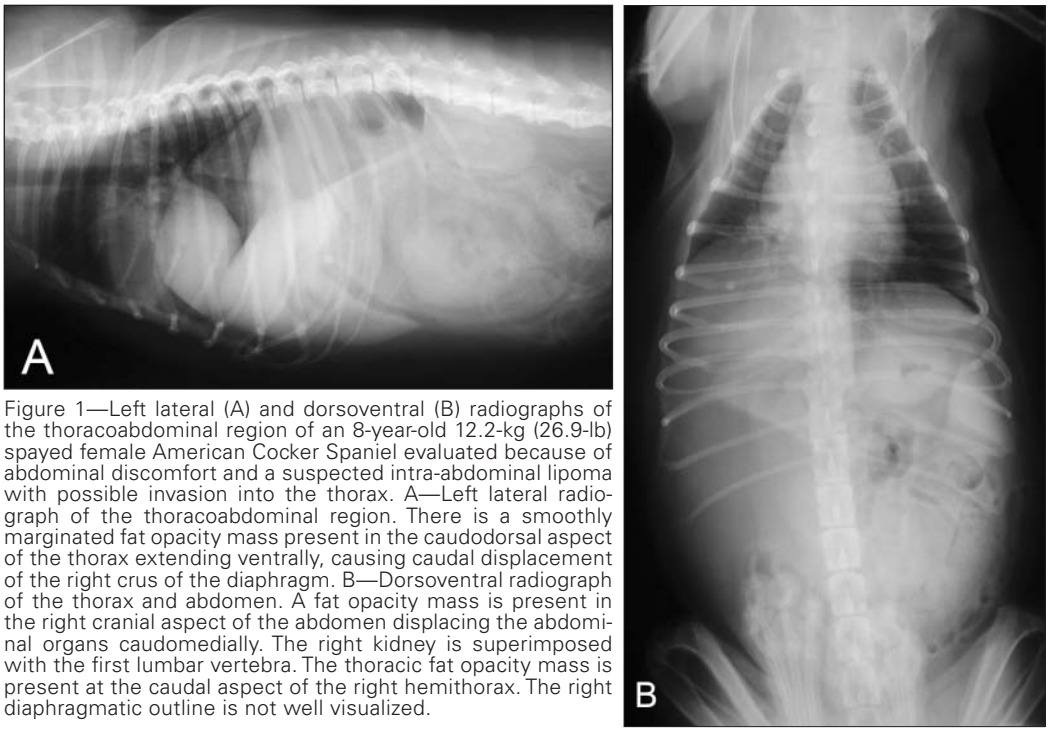

Figure 1—Left lateral (A) and dorsoventral (B) radiographs of the thoracoabdominal region of an 8-year-old 12.2-kg (26.9-lb) spayed female American Cocker Spaniel evaluated because of abdominal discomfort and a suspected intra-abdominal lipoma with possible invasion into the thorax. A—Left lateral radiograph of the thoracoabdominal region. There is a smoothly marginated fat opacity mass present in the caudodorsal aspect of the thorax extending ventrally, causing caudal displacement of the right crus of the diaphragm. B—Dorsoventral radiograph of the thorax and abdomen. A fat opacity mass is present in the right cranial aspect of the abdomen displacing the abdominal organs caudomedially. The right kidney is superimposed with the first lumbar vertebra. The thoracic fat opacity mass is present at the caudal aspect of the right hemithorax. The right diaphragmatic outline is not well visualized.

A positive contrast peritoneogram was performed after CT to further investigate the suspected discontinuity of the diaphragm. Thirteen milliliters of a nonionic, iodinated radiologic contrast agent[f] was injected into the peritoneal cavity. Postcontrast peritoneogram radiographs and CT images did not reveal accumulation of the contrast agent within the pleural space.

The imaging findings indicated the presence of a retroperitoneal and an intrathoracic lipoma. Although there was lack of intrathoracic contrast agent accumulation after the peritoneography, the possibility of a diaphragmatic defect that led to communication or continuity of the mass could not be ruled out.

Exploratory laparotomy was then performed via a standard ventral midline approach. The right kidney was displaced ventrally by a large lipomatous mass in the right side of the abdominal cavity. The mass originated in the right retroperitoneal space and extended dorsally toward the left side of the abdomen. The retroperitoneum was incised with electrocautery, and the mass was gently dissected from the retroperitoneal space. After the bulk of the mass was removed, further examination revealed focal invasion of the hypaxial muscles dorsally by the lipomatous mass, and portions of these muscles were resected. A small portion of the mass was still present within the hypaxial muscles following surgical excision. Further examination revealed the presence of a small opening (diameter, approx 2 cm) at the dorsolateral aspect of the diaphragm where a stalk of the lipoma extended into the thoracic cavity (**Figure 3**). A 5-cm incision with electrocautery was made at the right dorsal aspect of the opening in the diaphragm. The stalk of the lipoma expanded to become a large mass,

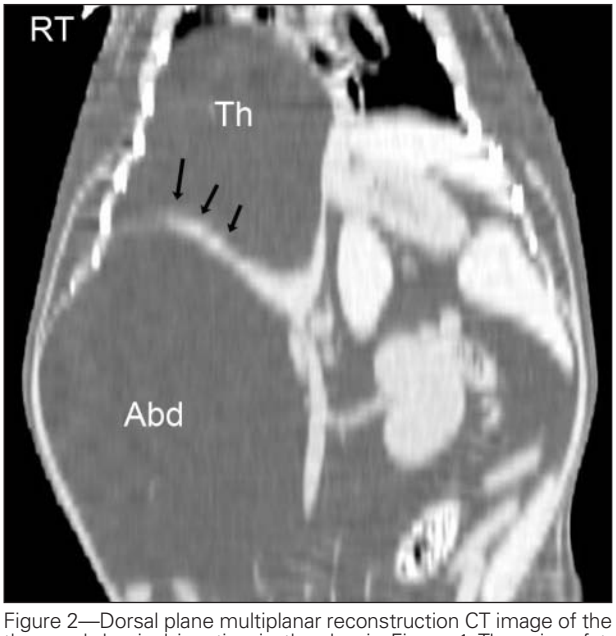

Figure 2—Dorsal plane multiplanar reconstruction CT image of the thoracoabdominal junction in the dog in Figure 1. There is a fat-attenuating mass in the right side of the thoracic (Th) and abdominal (Abd) cavities. The right crus of the diaphragm (black arrows) is displaced caudally, compared with the left crus. The lateral aspect of the right crus of the diaphragm is not well-defined. RT = Right.

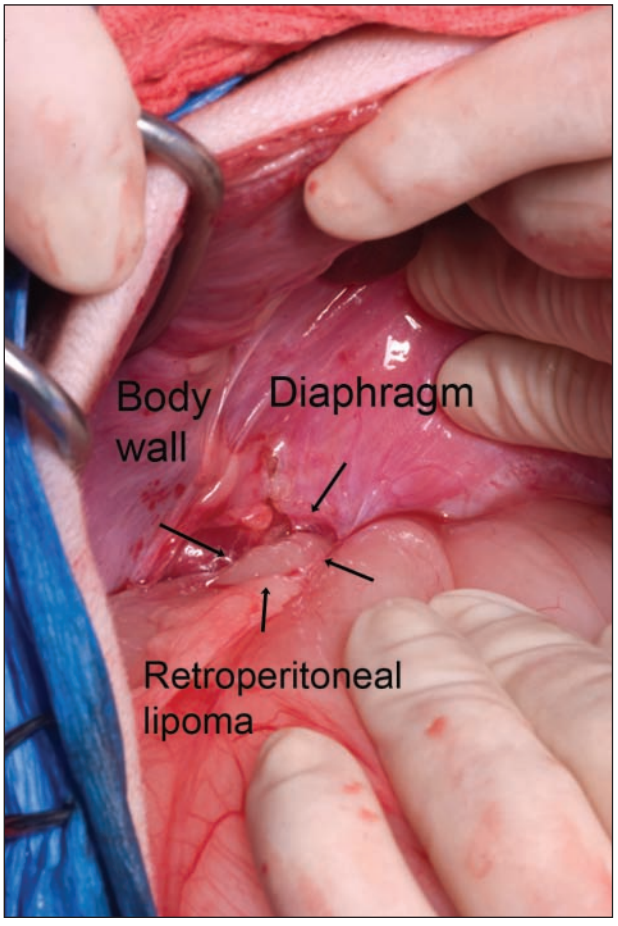

Figure 3—Intraoperative photograph of the right cranial aspect of the abdomen of the dog in Figure 1. The retroperitoneal lipoma is retracted caudally, showing the body wall, right crus of the diaphragm, and the lipoma in the LT (foramen of Bochdalek; black arrows).

which was located in the extrapleural space. The mass was dissected and excised from the intrathoracic extrapleural space in a similar manner to that used to excise the retroperitoneal mass.

The diaphragmatic incision was closed with 2-0 polydioxanone in a simple continuous pattern. A 12F chest tube was placed through the abdominal body wall and through the lateral aspect of the diaphragmatic closure site into the thoracic cavity. The chest tube was held in place with a purse string suture pattern with 2-0 polydioxanone on the peritoneal surface of the diaphragm and a Chinese finger trap suture pattern at the skin. A nephropexy was performed on the right kidney with 2 simple interrupted sutures with 2-0 polydioxanone. The linea alba was closed with 2-0 polydioxanone in simple continuous pattern. The subcutaneous tissues were sutured with 3-0 polydioxanone in a simple continuous pattern, and the skin was closed with staples.

The dog recovered routinely from anesthesia, and postoperative analgesia was provided with topical lidocaine patches[g] and hydromorphone[c] (0.1 mg/kg [0.05 mg/lb], IV, q 5 h). The chest tube was removed approximately 16 hours after surgery. The dog was discharged 2 days after surgery in good condition and was prescribed tramadol (4 mg/kg, PO, q 12 h) for 7 days for pain control. Recommendations were made to the owner for staple removal in 14 days and for long-term monitoring for signs of possible tumor recurrence (eg, signs of abdominal pain).

The excised mass weighed 0.9 kg (2.0 lb) and was bilobed, with the 2 lobes joined by a small stalk of tissue that had traversed the diaphragm. Histologic examination revealed the mass was composed of well-differentiated adipocytes; the morphological diagnosis was lipoma. The dog was reexamined at the Purdue University Veterinary Teaching Hospital approximately 1 year after surgery. Abdominal and thoracic radiographs were obtained, and no evidence of tumor recurrence was noted. The referring veterinarian last examined the dog 32 months after surgery for a routine dental prophylaxis, and at that time, there were no clinical signs referable to recurrence of the lipoma.

Discussion

The patient in the present report had a large retroperitoneal lipoma that extended to the intrathoracic extrapleural space via the right LT. Lipomas are among the most common subcutaneous tumors in dogs, accounting for 6% to 17% of tumors at this site.[1–4] In contrast, few reports have described lipomas occurring in nonsubcutaneous locations. Visceral and intracavitary lipomas are considerably rarer than their subcutaneous counterparts. In a study[5] of lipomas in dogs, only 4 of 179 (2%) tumors occurred at nonsubcutaneous locations.[5] Visceral lipomas have been reported in the vagina, spleen, ovary, and heart.[5,6] Intracavitary lipomas may occur in the thoracic and abdominal cavities as well as the pelvic canal, retroperitoneal space, and pericardial space.[7–13] These tumors appear to arise from visceral adipose tissue and frequently form loose adhesions to serosal surfaces.

Infiltrative lipomas have been sporadically reported in dogs since their initial description in the veterinary literature. These neoplasms are similar to simple lipomas because of the well-differentiated appearance of the adipocytes, but are differentiated from simple lipomas by their infiltrative nature and high rate of local recurrence following incomplete surgical extension.[14] Most infiltrative lipomas have been described on the appendages or the subcutaneous tissues of the head, thorax, or abdomen.[14–16] In 1 case series, 2 cases of intra-abdominal lipomas were apparently infiltrative on the basis of their description; however, they were not explicitly identified as infiltrative lipomas. Both of these masses were noted to infiltrate the body wall, and both were histologically described as simple lipomas.[7] Although there was no histologic examination of the area of infiltration, some degree of infiltration of the hypaxial muscle was present; thus, the possibility of infiltrative lipoma in this patient could not be ruled out. Although there was no recurrence of disease after 32 months, this does not preclude the possibility that this was an infiltrative lipoma because tumor recurrences at > 2 years following surgical removal have been reported.[15]

Dogs with intracavitary lipomas develop different clinical signs, typically referable to the location of the tumor. Dogs with intrathoracic lipomas may be examined for cough, dyspnea, or exercise intolerance,[9–11] whereas dogs with intrapericardial lipomas may be ex-

amined with signs related to cardiac tamponade,[11] including lethargy, exercise intolerance, jugular venous distension, and ascites. Dogs with intra-abdominal lipomas may be examined for abdominal pain or distension, inappetence, or signs referable to obstruction of the gastrointestinal or urinary tracts.[7–13] Intracavitary lipomas are often presumed to be slow growing because many of these tumors do not cause clinical signs until they have reached a size great enough to compress and limit the function of surrounding organs. Several reports[7,8,11] describe intracavitary lipomas > 10 to 20 cm in maximal diameter and weighing ≥ approximately 4 kg (8.8 lb). To our knowledge, this is the first report of a bicavitary lipoma in veterinary medicine.

Most reported retroperitoneal tumors in dogs are sarcomas. A retrospective study of 14 dogs with retroperitoneal masses reported 9 hemangiosarcomas, 2 osteosarcomas, and 1 each of leiomyosarcoma, myxoid-type peripheral nerve sheath tumor, and hemangiopericytoma.[17] Nonmesenchymal retroperitoneal tumors are very rare in dogs, but retroperitoneal seminoma, teratoma, and apocrine gland adenocarcinoma of the anal sac have been described.[18–21] Most retroperitoneal tumors in humans are sarcomas with liposarcomas, accounting for an estimated 25% to 45% of tumors at this site.[22,23] Retroperitoneal lipomas are rarely reported in animals. This condition has been reported in a dog[7] and a calf.[24] Similarly, retroperitoneal lipomas are uncommon in people and are more often reported in children.[25–28]

The lipoma in the dog in the present report entered the intrathoracic, extrapleural space through the right LT. The LTs are found at both the right and the left dorsolateral margins of the diaphragm. The right LT is an area composed of the fascia of the diaphragmatic musculature, whereas the composition of the left LT is muscular, attributable to a lateral division of the left lumbar diaphragmatic crus that is found only on the left side.[29] In humans, failure of closure of the pleuroperitoneal canal produces a foramen of Bochdalek where the LT is normally located. This is a common cause of congenital diaphragmatic hernia in children.[30–34] This type of congenital hernia is also called BH. Late onset of BH in adult patients has also been reported.[32,35,36] Most BHs occur on the left side (78%), compared with the right (18%), and bilateral occurrence has been reported (2%).[32] Bochdalek hernia can be asymptomatic or patients may present with symptoms secondary to mass effect in the thoracic cavity (respiratory symptoms), obstruction, and strangulation of the gastrointestinal tract and symptoms of pain not related to obstruction or strangulation of the gastrointestinal tract.[32] The abdominal discomfort and signs of pain in the dog in the present report may have been due to the mass effect of the lipoma, considering that no gastrointestinal organs were herniated through the LT.

We do not believe that the dog in this report had a congenital hernia. We suspect that the retroperitoneal lipoma exerted direct pressure on the right LT, caused a defect at this weak point of the diaphragm, and extended through the diaphragm into the intrathoracic extrapleural space. Extension of a retroperitoneal lipoma and fat through the foramen of Bochdalek has been reported in humans.[37–39] Naturally occurring, congenital, left dorsolateral diaphragmatic hernias have been reported in juvenile dogs, and induced LT hernias in experimental studies of rats and mice have been reported, with both occurring as a result of a defect in the pleuroperitoneal fold during the development of the diaphragm.[40,41] These reports describe congenital hernias that are in the same anatomic location as BH, but to our knowledge, this is the first clinical report of late onset of a similar hernia in small animals.

Diagnostic imaging can be valuable in the clinical assessment of body cavity lipomas and in the diagnosis of BH in humans. Radiography remains the most commonly used diagnostic imaging modality in diagnosing intracavitary lipomas in animals.[7] Presence of a fat opacity mass is the hallmark finding.[7,8] One of the disadvantages of plain radiography is difficulty in differentiating lipomas from other lipomatous tumors such as infiltrative lipoma. Thus, CT is recommended if other lipomatous tumors are suspected.[42,43] Computed tomography has been shown to be useful in determining the extent of infiltrative lipomas in dogs, although the tumor margins may be difficult to distinguish from normal body fat.[42] Computed tomography or magnetic resonance imaging is often used in the evaluation of lipomatous tumors in humans. In addition to defining tumor margins, these imaging modalities may also serve to distinguish lipoma from liposarcoma. In human patients, it has been reported that lipomas may be differentiated from liposarcomas in that the former are notably more likely to be < 10 cm in diameter, to lack thick septae, and to be composed of > 75% fat.[43] Radiography followed by CT is the most commonly used imaging approach for diagnosing BH in humans.[37] In the patient in this report, the radiographic evaluation confirmed the presence of a bicavitary lipoma. Computed tomography and positive contrast peritoneography were performed to evaluate the possibility of infiltration or extension of the lipoma through the diaphragm. Because of the small diameter of the LT and the retroperitoneal location of the lipoma, CT and positive peritoneography failed to demonstrate the defect of the diaphragm at the LT.

Surgery remains the most effective treatment for body cavity lipomas. In most patients, surgical resection is curative, and in patients where follow-up is available, recurrence is reportedly rare in dogs.[7] Laparotomy and thoracotomy are the 2 most common approaches for the surgical repair of BH in humans, followed by laparoscopy, thoracoscopy, or a combined approach.[32] The mass in this patient was removed via a laparotomy and transdiaphragmatic thoracotomy because it was too big to remove via laparascopy or thoracoscopy. Reported cases of surgical removal of lipomas or fat extension via the foramen of Bochdalek in humans are associated with an uneventful recovery.[38,39]

To our knowledge, the patient described in the present report had the first reported transdiaphragmatic extension of retroperitoneal lipoma via the LT in a dog. On the basis of our findings in this patient, an LT hernia may be considered as a differential diagnosis for bicavitary masses. This is especially true when there is no history of trauma.

a. Deramaxx, Novartis Animal Health, Greensboro, NC.
b. Acepromazine maleate injection, Vedco Inc, Saint Joseph, Mo.

c. Hydromorphone HCl injection USP, Baxter Healthcare Corp, Deerfield, Ill.
d. PropoFlo, Abbott Laboratories Inc, Abbott Park, Ill.
e. IsoFlo, Abbott Laboratories Inc, Abbott Park, Ill.
f. Ultravist, Bayer HealthCare Pharmaceuticals, Wayne, NJ.
g. Lidocaine patch 5%, Endo Pharmaceuticals Inc, Chadds Ford, Pa.

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