



Surgical Removal of Intrathoracic Lipoma from Herniated Omentum through the Diaphragmatic Defect in an Abyssinian Cat

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Abstract A nine-year-old neutered male cat was presented with chronic cough and vomiting. Thoracic radiography showed regions of fatty opacity in the right caudoventral region. On positive contrast celiography, contrast agent did not move into thoracic cavity. Computed tomography revealed 7-mm diameter of defect at the right diaphragmatic crus and a 2-mm diameter defect at the left ventral diaphragmatic crus. Through the right diaphragmatic defect omental herniation was confirmed by the presence of contrast enhanced omental vessel running across the diaphragm. On exploratory thoracotomy, the omentum protruded into the thorax through the right diaphragmatic defect, and it contained a yellowish lipomatous mass. The protruded omentum containing a mass in the thorax was removed, and the right diaphragmatic defect was closed. Histopathologic examination revealed that the protruded omentum showed normal omental structure and the adipose mass showed lipoma surrounded by fibrous tissue. In conclusion, a thorough examination is necessary to confirm the origin of the mass located near the diaphragm.

Key words cat, congenital defect, diaphragmatic herniation, lipomatous mass, omentum herniation.

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Introduction

The diaphragm is a musculotendinous septum between the thoracic and abdominal cavities. Its tendinous cupola located ventrally project considerably into the thoracic cavity. The diaphragm works a major respiratory muscle, as its contractions flatten the cupola laterally. The crown of the cupola is fixed at the caval foramen, and during respiration, its position remains largely constant (5).

A diaphragmatic hernia occurs when the stability of the diaphragm is tampered with, such that abdominal organs can migrate into the thoracic cavity. Diaphragmatic hernias may be congenital or occur secondary to trauma (2). Trauma is the most common cause of diaphragmatic hernias. Such trauma is usually the result of motor vehicle accidents (9). Trauma has been reported as the cause of diaphragmatic hernia in 77-85% of the cases reported (12). Orthopedic injury has been reported in up to 33% of dogs and 14% of cats with diaphragmatic hernia. In cases of traumatic diaphragmatic injury, 41% of cats and 27% of dogs sustained other soft-tissue injuries (4). The most frequently observed congenital type of hernia is peritoneopericardial hernia. Congenital pleuroperitoneal hernias are rarely diagnosed in small animals because many of the affected animals die at birth or shortly after (2). Hernias occur following the creation of a large pleuroperitoneal pressure gradient, with trauma to the abdominal wall increasing abdominal pressure and rapid deflation of the lungs lowering pleural pressure (1). The liver is the most frequently herniated organ (64-82%), followed by the intestines or stomach (47-56%), spleen (32-44%), omentum (26-44%), and pancreas (4-8%) (4,6,8,13). However, the isolated herniation of the omentum is very rare in humans (11). In one study,

16 cats with chronic diaphragmatic hernia were examined, and there was no case of herniation with omentum alone (6).

Even if there are no pathognomonic signs of diaphragmatic hernia, most animals present with acute signs and symptoms associated with respiratory distress. Animals with more chronic symptoms have also been reported (4,6,8,10,13). With a chronic diaphragmatic hernia, the clinical signs are most often referable to either respiratory (e.g., dyspnea, exercise intolerance) or gastrointestinal systems (e.g., anorexia, vomiting, diarrhea, weight loss, pain after ingestion of food), or they may be nonspecific (e.g., depression). Many animals with chronic hernias are not dyspneic at the time of diagnosis (2).

In this case, we report that a cat with chronic cough and vomiting, which was diagnosed with congenital omental herniation through a diaphragmatic defect using various imaging techniques.

Case Report

A nine-year-old neutered male Abyssinian cat was presented with chronic cough and chronic vomiting. The cough began about two years ago and was observed once a day, and vomiting began about a year ago and was observed about once a week. Coughing and vomiting were identified separately over time. On physical examination, nothing was observed except a mild tenderness on the right elbow joint. Laboratory examination revealed no abnormal finding except for thrombocytopenia [11, Reference interval (RI): 151-600 ($\times 10^9/L$)], hyperglycemia [181, RI: 71-159 (mg/dL)], hyperlactatemia [2.6, RI: 0-2 (mmol/L)], and low $PvCO_2$ [22.9, RI: 32.7-44.7 (mmHg)].

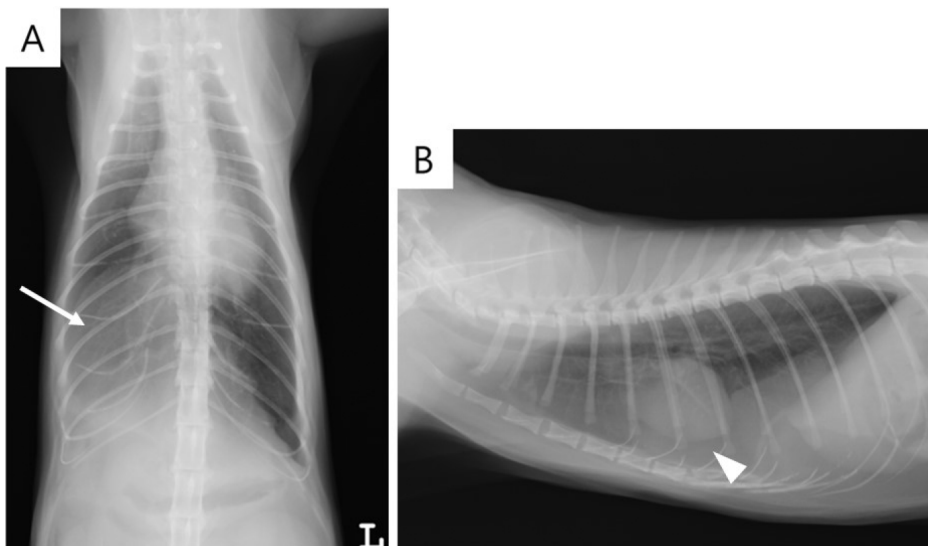


Fig. 1. Thoracic radiographic findings in the cat. (A) Ventrodorsal view. A fat opacity region in the right caudoventral aspect is observed (arrow). (B) Right lateral view. The cardiac apex is elevated dorsally from the sternum (arrowhead).

Thoracic radiography showed a lesion of fat opacity mass in the right caudoventral lung field and the cardiac silhouette was displaced dorsally due to the mass. In addition, border obliteration was identified in the diaphragm margin and in part of the heart silhouette (Fig. 1). Positive contrast celiography was performed to identify the presence of diaphragmatic defect. Iohexol (OMNIAQUE™, GE Healthcare) was administered at a dose of 2 ml/kg body weight into the peritoneal cavity through the umbilicus (7). No contrast agent was observed in the thoracic cavity (Fig. 2). Right forelimb radiography showed an old fracture lesion on the elbow joint.

Computed tomography (CT) examination was performed using two-row multidetector helical CT scanner (Siemens Medical System, Erlangen, Germany), and the acquisition parameters were as follows: 110 kV, 50 mA, and 3 mm slice thickness. Contrast study was performed after intravenous administration of 3 ml/kg iohexol (OMNIAQUETM, GE Healthcare) injected using power injector, obtaining portal venous phase images 60 seconds after start of contrast material. CT showed a 7-mm defect lesion at the right diaphragmatic crus (Fig. 3C) and a 2-mm defect at the left ventral diaphragmatic crus. Through the right diaphragmatic defect omental herniation was confirmed by the presence of contrast enhanced omental vessel running across the diaphragm, which caused a left shift of the cardiac apex. In addition, a 9- × 7.5- × 13- mm hyperattenuating heterogeneous nodule with an average of -70 to -40 HU showed no contrast enhancement effect (Fig. 3A, B). The connection between the mediastinal fat and the mesenteric fat in the thoracic cavity based on the imaging results is considered to be due to the diaphragmatic hernia. Also, the possibility of the inflated mediastinal fat being a lipoma was also considered. In the case of an internally identified heterogeneous nodule, the possibility of fat necrosis is considered. However, the probability of liposarcoma or other tumoral changes could not be excluded. Adhesion was suspected between the herniated omentum

and the mediastinum. Therefore, mass removal through exploratory thoracotomy was performed.

The patient was premedicated with glycopyrrolate 0.01 mg/kg (Mobinul Injection; Myungmoon Pharm Co.), butorphanol 0.2 mg/kg (Butorphan injection; Myungmoon Pharm Co.), diazepam 0.2 mg/kg (Samjin Diazepam Injec-

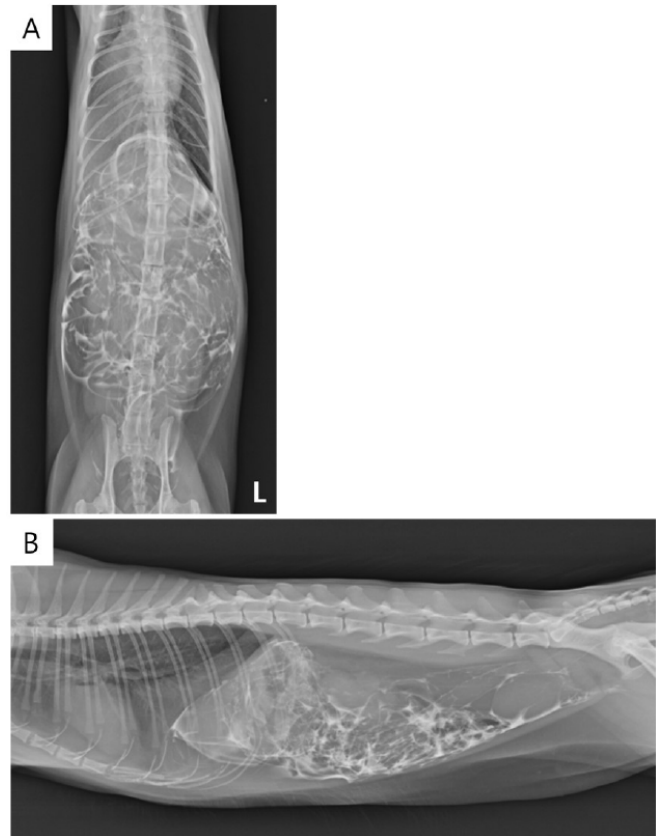


Fig. 2. Positive contrast celiographic images in a cat obtained after administration of iohexol. A radiopaque contrast agent is all over the abdominal cavity, and no contrast agent in the thoracic cavity. (A) Ventrodorsal view. (B) Right lateral view (after 10 minutes).

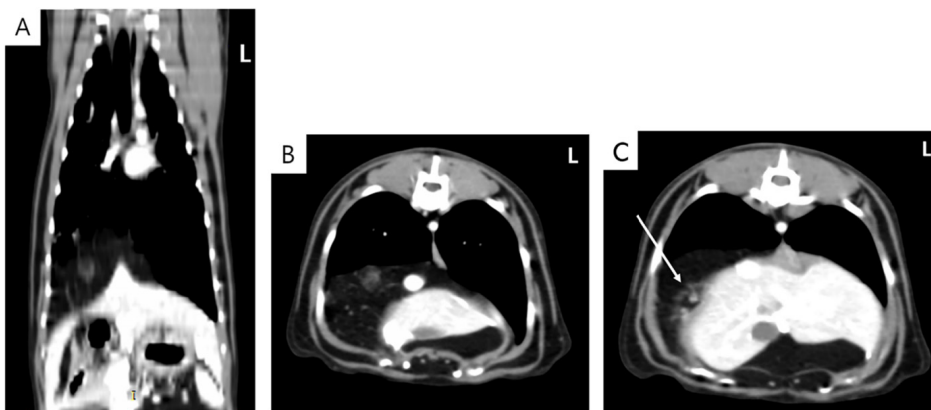


Fig. 3. A 9- × 7.5- × 13-mm heterogeneous nodule showed no contrast enhancement effect on mediastinal fat (arrow). (A) Dorsal and (B) axial plane. Contrast-enhanced computed tomographic images of diaphragmatic defects in a cat. (C) Axial planes at the right diaphragmatic defect level.

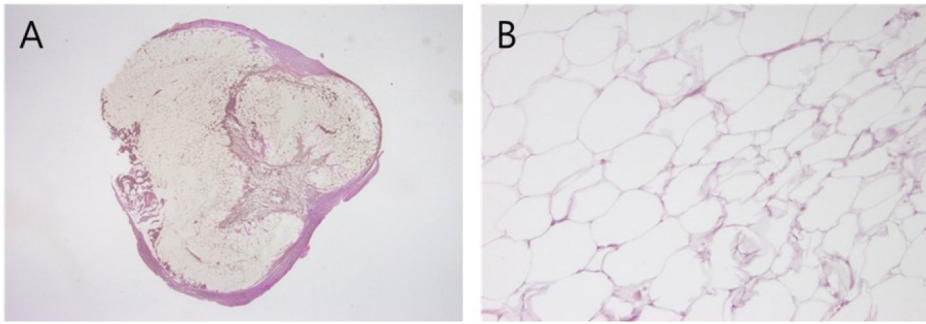


Fig. 4. Histopathology of the lipomatous mass from the omentum that protruded through the diaphragmatic herniation. (A) Adipose mass surrounded by fibrotic tissues ($\times 12.5$). (B) High magnification of the lipomatous mass ($\times 200$, H&E stain).

tion; SamJin Pharm Co.), and cefazolin 25 mg/kg (Cefozol; Hankook Korus Pharm Co.); then, anesthesia was induced with alfaxalone 5 mg/kg IV (Alfaxan; Jurox) and maintained with a combination of isoflurane (Ifran; Hana Pharm Co.) and oxygen. The cat was placed in the left recumbency position for an intercostal incision, after which surgical procedure was performed. Exploratory thoracotomy was performed at the eighth intercostal space on the right side and greater omentum with a yellow mass was found. Mesenteric fat adhered to mediastinum was removed. No herniation of the stomach or intestines was observed. The stay suture was applied at the omentum area to be cut, and the protruded omentum in the chest cavity was excised. After excision of the omentum, the defects were visually identified in the muscle area of the diaphragm, and no fibrous adhesion was observed in its surroundings. The remaining omentum was restored to the abdominal cavity, and the diaphragmatic hernia defect was closed with 4-0 monofilament polyglyconate Maxon (COVID-IEN; Dublin, Ireland). Histopathological examination revealed that the mass found in the omentum was a simple lipomatous lesion. It consisted of the inner hyperplastic adipocytes and outer fibrotic capsules. There were no inflammatory or malignant changes (Fig. 4).

Thoracic wall was closed by apposition of the normal anatomical structures. Musculature and subcutaneous sutures were performed using 4-0 monofilament polyglyconate (Maxon[®], COVIDIEN; Dublin, Ireland) and skin suture was performed using 4-0 polyamide blue nylon (AILEE Co.; Busan, Korea). A temporary chest tube was inserted for the evacuation of the thoracic cavity. The cat was maintained in an O₂ cage for a day and treated with antibiotics for 14 days postoperatively. On the day following surgery, a thoracic radiogram showed a satisfactory correction of the diaphragmatic herniation and the patient discharged day after tomorrow from surgery. The cough and vomiting had disappeared 10 days after surgery. As a result of follow-up after 11 months, no recurrence or side effects were confirmed.

Discussion

This case shows solitary omental herniation through a diaphragmatic defect in a cat. In the history, the owner could not identify any trauma the cat had suffered. However, when considering the old fracture lesion on the elbow joint, we could presume that a traumatic event might have occurred resulting in a diaphragmatic hernia. That notwithstanding, the possibility of congenital disease cannot be ruled out as the defects are in the same position on both sides.

The definitive diagnosis of pleuropertitoneal diaphragmatic hernia is usually made by radiography or ultrasonography. Radiographic signs of diaphragmatic hernia may include the loss of the diaphragmatic line, loss of the cardiac silhouette, lateral or dorsal displacement of the lung fields, presence of gas or a barium-filled stomach or intestines in the thoracic cavity, pleural effusion, and/or failure to observe the stomach or liver in the abdomen (2). Ultrasonography examination of the diaphragmatic line may be considered when herniation is not radiographically obvious. Ultrasonography accurately identifies diaphragmatic hernia in most patients (2). Ultrasonography may be particularly difficult if severe pulmonary contusions are present, if only the omentum is herniated, or if adhesions between the liver and lung are present. Positive contrast celiography has been recommended if ultrasound is not diagnostic. However, contrast-enhanced CT is now more commonly performed (2). In this case, we could not distinguish between diaphragmatic herniation and neoplasm initially in positive contrast celiography and had no remarkable findings in ultrasonography. Eventually, bilateral defects of the diaphragm were detected on CT imaging and confirmed through exploratory thoracotomy. In a human study, they identified that the fact that a difficult evaluation of the diaphragmatic continuity in CT suggests that the coronal and sagittal planes of MRI are greatly useful. Also, angiography was not essential since the omental vessels were absent on angiography in one case reported by Tamura et al. (11).

A midline anterior abdominal laparotomy is the preferred

References

approach for most diaphragmatic hernia unless adhesion between herniated viscera and intrathoracic structure is not identified (3,12). The right lateral intercostal surgical approach was chosen because of the following; first, a mass which could be lipoma or liposarcoma was detected in the chest cavity on CT images. Second, in this case, the diaphragmatic defect was found on both sides, but since the size of the right defect was larger than the left defect and herniation of the omentum was only found on the right side. Lastly, as we mentioned above, CT findings suggested that the cranial part of the omentum adhered to the mediastinum. So, the exploratory thoracotomy was chosen rather than the laparotomy.

One study reported a 17% mortality in 34 cats with traumatic diaphragmatic hernia. Postoperative complications developed in 50% of the cats (8). The mortality rate was not associated with the duration of the herniation but was associated with concurrent injuries (rib fractures and abdominal herniation) (8). In this case, nothing was observed except a mild pain response on the right elbow joint, chronic cough, and chronic vomiting. Also, according to the histopathological examination, the long-term prognosis of surgical management is desirable.

Conclusions

A nine-year-old neutered male cat was presented with chronic cough and vomiting.

Bilateral diaphragmatic herniation was detected on radiography, abdominal celigraphy, and CT. The omentum protruded through the diaphragmatic defect on the right side, and a mass within the omental fat was removed surgically. The omental mass was identified as a lipomatous mass, and the prognosis is expected to be good.

This case report describes the possibility of a protruded omentum through a diaphragmatic hernia when diagnosing any mass in the thoracic cavity. In addition, a thorough examination is necessary to confirm the origin of the mass located near the diaphragm.

Conflict of Interest

The authors have no conflicting interests.

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