

A retrospective study on diaphragmatic hernia in cats

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Article Info	Abstract
<p>Article history:</p> <p>Received: 27 January 2021 Accepted: 13 March 2022 Available online: 15 December 2022</p> <p>Keywords:</p> <p>Cat Diaphragmatic hernia Radiology Surgery</p>	<p>Diaphragmatic rupture is introduced as one of the most common injuries occurring in small animals. In our retrospective report, 14 cats with a mean age of 12 months (male = 8, female = 6) that underwent diaphragmatic herniorrhaphy were studied. The data included the following: age, sex, breed, and clinical signs. The cause of diaphragmatic hernia, diaphragmatic rupture area, herniated organs, concomitant injuries, and survival rate after surgical treatment were detailed. The cats included 11 domestic shorthair (DSH) and three Persian. Trauma was the most common cause of rupture in these patients and one 3-month old Persian cat had peritoneopericardial diaphragmatic hernia (PPDH). The most common clinical sign was dyspnea. Concurrent disorders included fractures of pelvic, long bones and ribs and mild pneumothorax. One of the five cats survived with concurrent disorders. In this study, the frequency of rupture sites was as follows: the right-side (11 cats), left-side (2 cats), and dorsal side of diaphragm in one case. The most frequently inserted organ into the chest was liver. In our study, the survival rate after surgical treatment was 71.00%. In conclusion, we suggested that stabilization of the patient was important before herniorrhaphy. Based on our study, the concurrent damages affected the survival rate.</p>

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Introduction

The diaphragm is a musculotendinous structure that plays an important role in ventilation.^{1,2} Diaphragmatic hernia is one of the most common injuries occurring in small animals and may be congenital or secondary to trauma.^{3,4} Trauma, specially the motor vehicle damage as the most common cause of diaphragmatic hernia in small animals, accounting for up to 85.00% of cases.²⁻⁵ Diaphragmatic hernias can be acute or chronic, the interval between trauma and diagnosis may range from a few hours to 6 years, with a mean of several weeks.²

The survival rate after surgical treatment is 54.00 - 90.00%,^{4,6-11} with many factors affecting it such as: duration of anesthesia and surgical procedure, concomitant injuries, and perioperative oxygen dependence.⁴ But surgical intervention time has been reported as a major risk factor.^{4,6,7} It has been shown the mortality rate rises significantly when surgery is done within one day or more than 1 year after trauma.^{4,6,7}

The aim of this paper was to study retrospectively 14 cats with diaphragmatic hernias referred to the Veterinary Teaching Hospital, Ferdowsi University of Mashhad, Iran.

Case Description

Medical records of cats with traumatic diaphragmatic rupture or peritoneopericardial diaphragmatic hernia (PPDH), and their subsequent surgical intervention at the department of Veterinary Surgery and Radiology from 2013 to 2015 were recruited. In suspected animal, after history taking and complete clinical examination, radiography (Fig. 1) which in debatable cases barium sulfate contrast radiography was performed, and ultrasonography was used for definitive diagnosis of possible diaphragmatic hernia and concurrent disorders.

Animals with diaphragmatic hernia received oxygen during stabilization by face mask or oxygen cage 10-20 min on average before general anesthesia.

We injected 22.00 mg kg⁻¹ cefazolin (Exir Pharmaceutical Co., Borujerd, Iran) intravenously (IV) as a prophylactic antibiotic, and 0.50 mg kg⁻¹, methylprednisolone sodium succinate (Exir Pharmaceutical Co.) IV to prevent re-expansion damage of lungs. The animals with minimal dyspnea were pre-anesthetized with a benzodiazepine. After IV injection anesthetic with a combination of 0.20 mg kg⁻¹ diazepam (Caspian Tamin,

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pharmaceutical Co, Rasht, Iran) and 6.00 mg kg⁻¹ ketamine hydrochloride (Bremer Pharma GmbH, Bremerhaven, Germany), the patients were intubated and laid down in dorsal recumbency with elevated thoracic area. Anesthesia was maintained with inhalation anesthesia using isoflurane (Piramal Critical Care, Bethlehem, USA) and maintained under intermittent positive-pressure ventilation (IPPV) with manual ventilation (child Ambu bag, Winner, China). Heart rate, respiratory rate, concentration or partial pressure of carbon dioxide (capnography; Sairan, Esfahan, Iran) and noninvasive measure of oxygen saturation (pulse oximetry; Sairan, Esfahan, Iran) were done after induction of anesthesia, depth of anesthesia and oxygen administration were controlled by above mentioned findings.



Fig. 1. Lateral radiograph with barium sulfate contrast media of a cat with a traumatic diaphragmatic rupture.

After aseptic preparation of surgical area, an incision was made from the xiphoid to the area between the umbilicus and pubis in abdominal midline. Adhesions between the herniated organs and diaphragm or thoracic were separated carefully by dissection. Herniated abdominal structures were positioned into the abdominal cavity (Fig. 2). The pericardial sac was not closed in PPDH. Herniorrhaphy was performed with using 2-0 absorbable Vicryl® suture (Ethicon, Somerville, USA) in simple continuous pattern. Prior to the last knot, a feeding tube was brought into the thorax cavity, air was evacuated from the thorax by using of a three-way stopcock and a 60.00 mL syringe. Therefore, a negative pressure within thoracic cavity was re-established. Midline and skin incision were sutured routine. All of the animals were closely monitored for 24 hr after surgery. Post-operative care consisted of administration 0.20 mg kg⁻¹ meloxicam (orally, q24hr for two days; Rooyan Darou Pharmaceutical Co., Tehran, Iran) and 22.00 mg kg⁻¹ cefazolin (IV, q12hr for three consecutive days). The data included: age, sex, breed, and clinical signs. The etiology of rupture, location of diaphragmatic hernia, herniated structures, concurrent injuries, and survival rate after surgical treatment (at least up to two months after surgical intervention) were reported.

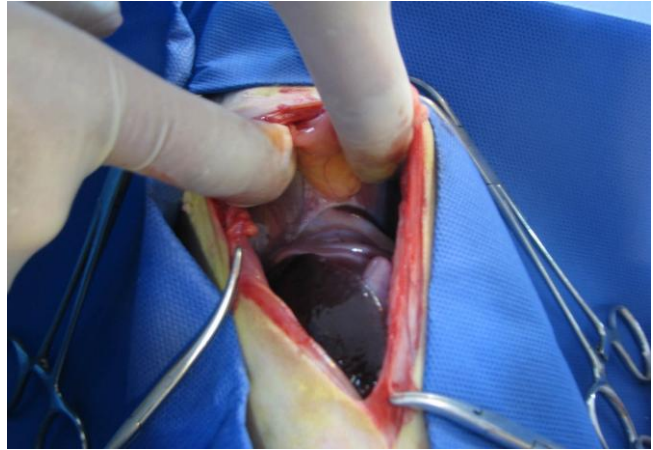


Fig. 2. Intraoperative view of a traumatic diaphragmatic rupture in a 12-month old male DSH cat with herniation of liver and small intestines.

Results

Fourteen cats (six out of eight male were castrated and three out of six female were spayed) were included in this study. The age of the patients was variable from 3 to 30 months (mean = 12 months). Eleven patients were domestic shorthair (DSH) cats and three were Persian cats. The acute diaphragmatic hernia was observed in 11 cats, and two cases were chronically involved.

Trauma (motor vehicle) was the most common cause of this hernia and one 3-month old Persian cat had PPDH. Clinical symptoms such as dyspnea, anorexia and open mouth were significant.

Concurrent disorders included luxation of both sacroiliac joints (one case), fracture of right pubis bone with a separation of ischium tuberosity (one case), fracture of 9th and 10th ribs and a Salter-Harris fracture (type II) of right femoral bone (one case), transverse fracture of distal aspect of humerus bone of right forelimb with an incomplete fracture of right tibia bone (one case) and mild pneumothorax (one case) were noted. A patient with concurrent disorders (20.00%) were discharged alive from the hospital.

The herniorrhaphy was performed by median celiotomy with sternotomy in three patients. The hernia repairing in a pregnant queen was performed after parturition. The frequency of rupture sites (consists of both tendinous center and peripheral muscles) was as follows: the right-side (11 cats), left-side (two cats), and dorsal side of diaphragm in one case

The most frequently inserted organ into the chest was liver (92.80%). Other herniation organs in order of frequency were: intestines (50.00%), stomach (41.66%), omentum (33.30%) and uterus (8.00%).

In our study, the survival rate after surgical treatment was 71.00%. Table 1 illustrates the measured parameters in detail for each cat.

Table1. The measured parameters in detail for each cat.

No.	Breed	Age (m)	Sex	Castrated/ spayed	Chronic/ Acute	Etiology	Concurrent disorders	Location of rupture	Herniated organs	Fate
1	DSH	24	M	Yes	Acute	MVT	-	Right-side	Liver, Small intestines	Alive
2	DSH	12	M	Yes	Acute	MVT	Transvers fracture of distal aspect of right humerus; Incomplete fracture of right tibia bone	Right-side	Small intestines, Stomach, Omentum	Death
3	DSH	11	M	Yes	Acute	MVT	-	Right-side	Liver, Omentum (maybe)	Alive
4	DSH	8	M	Yes	Acute	MVT	Fractures of 9 th and 10 th ribs A Salter-Harris fracture (type II) of right femoral bone	Right-side	Liver, Small intestines, Stomach, Omentum	Death
5	DSH	9	M	Yes	Acute	MVT	-	Right-side	Liver, Small intestines	Alive
6	DSH	12	M	Yes	Acute	HRS	Luxation of both sacroiliac joints	Left-side	Liver, Small intestines	Alive
7	DSH	6	M	No	Acute	MVT	Mild pneumothorax	Right-side	Liver, Stomach	Death
8	DSH	10	F	Yes	Acute	HRS	-	Dorsal	Liver, Small intestines	Alive
9	DSH	30	F	Yes	Acute	MVT	-	Right-side	Liver, Stomach	Alive
10	DSH	10	F	Yes	Acute	HRS	Fracture of right pubis bone Separation of ischium tuberosity	Right-side	Liver, Stomach	Death
11	DSH	8	F	No	Acute	MVT	-	Right-side	Liver, Stomach	Alive
12	Persian	3	F	No	Chronic	Congenital	-	Left-side	Liver, Omentum	Alive
13	Persian	7	M	No	Acute	MVT	-	Right-side	Liver, Small intestines	Alive
14	Persian	18	F	Pregnant	Chronic	HRS	-	Right-side	Liver, Omentum, Uterus	Alive

DSH: domestic shorthair; M: male; F: female; m: month; MVT: motor vehicle trauma; and HRS: high rise syndrome.

Discussion

As in several previous articles, the most commonly studied sex was male in this retrospective report,^{5,12-14} though Gibson *et al.* showed that the sex had no effect on the occurrence of a diaphragmatic hernia in cat.⁶ More recent studies have not reported sex, age or breed predilection, but in our study most of the cases were young.³ The PPDH is introduced as a common congenital disorders in cats with 2 years old and older due to intermittent and different symptoms.³ Banz and Gottfried showed that median age of the cats at the time of presentation was 48 months.¹⁵ There is no sex predisposition but Domestic Long Hair and Himalayan cats may be at increased risk.³ It was shown that motor vehicle trauma was the most common etiology of diaphragmatic rupture in small animals.³ In agreement with previous studies, we reported that motor vehicle accident was the most common etiology followed by high rise syndrome. Dyspnea was the most frequently observed clinical syndrome in our study. It was similar to other studies.^{2,5,6}

The contents of hernia depended on the anatomical position of the structures and the location of the rupture.^{11,13} In accordance with the previous findings, we reported that liver was the most frequently found within the thoracic cavity and other herniation organs included the following: small intestines, stomach, omentum and uterus (a pregnant queen).^{5,6,11,13}

The location of diaphragmatic hernia was associated with the position of the animal at the time of trauma and the site of viscera.³ Similar to several previous studies, the majority of cases had right sided hernia in this report.^{5,12,13,16}

Liver was introduced as a protective barrier on the right side of the diaphragm and could prevent hernia,¹⁷ but Besalti *et al.* reported that that the liver does not have a protective effect in prevention of hernia and it may make potential the effect of trauma due to the higher percentage of liver herniation. Intestines and stomach can play as a protective role because of tubular structures like and absorb the shock during trauma.⁵ Removal of the herniated abdominal organs seldom caused difficulty,⁵ but combination median sternotomy with celiotomy was useful for better visualization and more accurate dissection.^{2,14} We did combination median celiotomy with sternotomy in three cats. It has been reported that mortality rate was not different from the cats with or without concurrent injuries,^{5,18} but Schmiedt *et al.* showed that mortality rate was higher in patients with concurrent injuries than those without them.^{4,11} In our study, four of the five diaphragmatic hernia cases with concurrent injuries died. Previous studies showed that abnormalities often occurred concomitantly with PPDH as follows: cardiac abnormalities and sternal deformities, cranial abdominal wall, caudal sternal, diaphragmatic, and pericardial defects in dogs, and polycystic kidneys in cats.³ In this work, there was not any concurrent abnormality in patient with PPDH. The survival rate after surgical treatment was reported 54.00 - 90.00%. It was 71.00% in our study. Prolongation of surgical intervention for a minimum of one day to let stabilization of the patient was useful.^{4,10} However, a recent study reported that early surgery was not associated with high mortality rate.⁴ The mortality rate increased in older cats or those with severe respiratory disorders and concurrent injuries after hernia repair.¹¹

In conclusion, we suggested that stabilization of the patient was important before herniorrhaphy. Based on previous studies and this report, the hernia site, amount of inserted organs into thorax, concurrent disorders, and perioperative care dependence were associated with the survival rate.

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Conflict of interest

The authors declare that they have no conflict of interest.

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