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# Diagnosis and treatment of severe diaphragmatic hernia in a cat: A case study

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**Abstract.** Hernia refers to the condition where visceral organs protrude through weak points or fissures in the diaphragm into the thoracic cavity or other anatomical cavities. Diaphragmatic hernia in cats is a pathological state where one or more visceral organs from the abdominal cavity enter the thoracic cavity through a ruptured diaphragmatic opening. It is predominantly caused by accidental trauma to the diaphragm or congenital diaphragmatic developmental anomalies. Timely treatment of diaphragmatic hernia in cats is crucial to prevent respiratory distress and potential life-threatening consequences. This article presents a case study of a severely affected cat with diaphragmatic hernia, its diagnosis through clinical and laboratory examinations, successful surgical treatment, and postoperative care, providing valuable insights for the management of similar feline diaphragmatic hernia cases.

**Keywords:** Hernia, Diaphragmatic Hernia, Diagnosis, Treatment.

## 1. Introduction

Diaphragmatic hernia is a medical condition in which abdominal organs pass through weak points or fissures in the diaphragm into the thoracic cavity. This condition can be classified into congenital and acquired categories. Research indicates that in canine and feline cases, 76.8% of diaphragmatic hernias are traumatic in origin, 9.6% are congenital, and 13.8% have unknown causes. Congenital diaphragmatic hernia results from incomplete development of the diaphragm or prenatal diaphragmatic injury [1]. Acquired diaphragmatic hernias are often the result of traumatic incidents such as vehicular accidents, falls from heights, or other severe impacts. Cats have a higher prevalence of diaphragmatic hernia compared to dogs, and in some cases, it is incidentally discovered through X-ray examinations during investigations of other medical conditions.

Severe diaphragmatic hernias can lead to the displacement of a significant amount of abdominal intestines and organs into the thoracic cavity, causing compression of the lungs and heart. This results in respiratory distress, loss of appetite, and the necessity of surgical intervention for resolution. Without timely surgical treatment, there is a substantial risk of mortality [2].

Recently, the clinic admitted a case of a severely affected stray cat with a diaphragmatic hernia. Prompt surgical intervention was undertaken, and the cat made a remarkable recovery. This report outlines the diagnosis and treatment approach for this specific case.

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## 2. Case Presentation

### *2.1. Clinical Examination*

The patient, named Sisi, a 1-year-old female, unspayed domestic cat weighing 3.7 kg, was recently adopted from a local animal shelter. The owner noticed that Sisi appeared lethargic, urinated frequently, showed mild signs of reduced appetite, and did not exhibit diarrhea or vomiting. A physical examination was recommended.

Upon examination, Sisi's body temperature was 39.6°C, pulse rate was 180 beats/min, respiratory rate was 36 breaths/min, and she displayed mild dehydration (3%). Sisi's body condition score was 4 out of 9, indicating relative emaciation compared to cats of the same breed. She appeared mentally distressed and slightly agitated. During the inquiry, it was revealed that Sisi had been a free-roaming cat, frequently interacting with other cats. Over the past two weeks, she had experienced a decrease in appetite and had been consuming only cat treats. Palpation of the abdomen revealed a noticeable reduction in the number of intestinal loops compared to a healthy cat, and there were fecal balls in the rectum. Visual examination showed cyanotic mucous membranes, bluish-purple discoloration of the tongue, mild gingivitis, signs of respiratory distress, and abdominal breathing.

### *2.2. Laboratory Examination*

*2.2.1. Complete Blood Count.* The results of the complete blood count for Sisi are presented in Table 1. Based on these data, it can be deduced that the elevated white blood cell and lymphocyte counts indicate a bacterial infection. The decreased red cell distribution width (RDW) suggests iron-deficiency anemia. The elevated platelet count suggests a chronic infection. Increased red blood cell count and hemoglobin levels indicate dehydration due to reduced fluid intake, while other parameters fall within normal ranges.

**Table 1.** Results of Hematological Examination.

| Hematological Parameter and Unit | Results | Reference Range for Cats | Observations |
|---|---|---|---|
| White Blood Cells (WBC)×109/L | 21.01↑ | 5.5-19.5 | Elevated |
| Red Blood Cells (RBC)×109/L | 10.9↑ | 4.6.0-10.0 | Elevated |
| Hemoglobin (Hb) g/l | 160↑ | 93-153 | Elevated |
| Hematocrit (Hct) % | 29.2 | 28-49 | Normal |
| Mean Corpuscular Volume (MCV)/fL | 42.2 | 39-52 | Normal |
| Red Cell Distribution Width-SD (RDW-SD)SD/fL | 46↓ | 47-62.7 | Decreased |
| Red Cell Distribution Width-CV (RDW-CV) CV% | 16.3 | 14-18 | Normal |
| Platelet Count×109/L | 622↑ | 100-514 | Elevated |
| Mean Platelet Volume (MPV)/fL | 15.1↑ | 5.0-11.8 | Elevated |
| Platelet Distribution Width (PDW) % | 15.4 | 0.1-30 | Normal |
| Lymphocytes 109/L | 8.9↑ | 0.8-7 | Elevated |
| Monocytes 109/L | 0.5 | 0.1-1.9 | Normal |
| Granulocytes 109/L | 8.9 | 2.1-15 | Normal |

Note: ↑ denotes elevated values, and ↓ denotes decreased values.

*2.2.2. Blood Biochemical Analysis Results.* The blood biochemical analysis results for the affected cat are presented in Table 2. From the data in Table 2, it can be inferred that various parameters of the blood biochemistry in the affected cat, specifically total protein and alanine aminotransferase (ALT), were

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elevated. This elevation suggests liver damage in the cat, accompanied by symptoms of anemia. The increased blood glucose concentration may be indicative of general physical discomfort or a stress response. Urea nitrogen, which assesses nitrogen in urea, primarily examines the status of kidney function, and when considered alongside creatinine (CRE), holds significant implications for renal health [3]. All other biochemical markers within this panel remained within normal ranges.

**Table 2.** Results of Blood Biochemical Examination.

| Test Parameter | Test Results | Reference Range | Organ/System |
|---|---|---|---|
| Albumin (ALB) | 27.3g/L | 22-44 | Liver, Kidneys |
| Total Protein (TP) | 96.8g/L↑ | 57-89 | Systemic |
| Globulin (GLOB) | 29.5g/L | 23-52 | Liver |
| Albumin/Globulin Ratio (A/G) | 0.94 | | Liver |
| Total Bilirubin (TB) | 1.6umol/L | 0-15 | Liver |
| Gamma-Glutamyl Transferase (GGT) | 5U/L | 0-12 | Liver |
| Aspartate Aminotransferase (AST) | 21U/L | 0-448 | Liver |
| Alanine Aminotransferase (ALT) | 144U/L↑ | 5-130 | Liver |
| Alkaline Phosphatase (ALP) | 65U/L | 14-111 | Liver |
| Total Bile Acids (TBA) | 3.31umol/L | 0-9 | Liver, Pancreas |
| Amylase (AMY) | 674U/L | 500-1500 | Pancreas |
| Lipase (LPS) | 23U/L | 0-40 | Pancreas |
| Lactate Dehydrogenase (LDH) | 271U/L | 0-798 | Myocardium, Liver |
| Creatine Kinase (CK) | 104U/L | 0-559 | Myocardium |
| Creatinine (Crea) | 106umol/L | 80-180 | Kidneys |
| Uric Acid (UA) | 20.46umol/L | 0-60 | Kidneys |
| Blood Urea Nitrogen (BUN) | 4.18mmol/L↑ | 1.76-3.28 | Kidneys |
| Urea/Creatinine Ratio (U/C) | 19.3 | 17.5-21.9 | Kidneys |
| Glucose (GLU) | 168mmol/L↑ | 4.11-8.83 | Systemic |
| Total Cholesterol (TC) | 2.26mmol/L | 1.68-5.81 | Liver |
| Triglycerides (TG) | 0.20mmol/L | 0-1.13 | Liver |
| Total Carbon Dioxide (tCO2) | 17.1mmol/L | 13-25 | Kidneys |
| Calcium (Ca) | 1.22mmol/L | 1.98-2.83 | Kidneys |
| Inorganic Phosphorus (PHOS) | 1.04mmol/L | 1-2.42 | Kidneys |

*2.2.3. Results of Serum Amyloid A Examination in Cats.* The results of the serum amyloid A (SAA) examination in the affected cat are presented in Table 3. From the data in Table 3, it can be deduced that the affected cat has an ongoing inflammatory condition. This inference suggests the presence of bacterial infection and inflammation, leading to elevated levels of SAA in the body.

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**Table 3.** Feline Serum Amyloid A (fSAA) Levels.

| Serial Number | Abbreviation | Parameter | Result | Unit | Reference Range (For Reference Only) | Clinical Interpretation |
|---|---|---|---|---|---|---|
| 1 | fSAA | Feline Serum Amyloid A (fSAA) | 23.1↑ | mg/L | Cat: 0~8mg/L | <8 mg/L: Normal<br>8-40 mg/L: Elevated or Mild Inflammation<br>>40 mg/L: Severe Inflammation |

*2.2.4. Coagulation Assay Results.* The coagulation assay results for the affected cat are shown in Table 4. From the data in Table 4, it can be concluded that there were no abnormalities in coagulation function.

**Table 4.** Coagulation Test Results.

| Blood Parameter | Result | Cat Reference Range |
|---|---|---|
| Activated Partial Thromboplastin Time (APTT) | 17.6s | 16-24s |
| Prothrombin Time (PT) | 9.2s | 7-15s |

*2.2.5. Radiological Examination Results.* Through digital radiography (DR), it was discovered that the cat suffered from severe diaphragmatic hernia, with a significant portion of the abdominal intestines, liver, and stomach entering the thoracic cavity. The cardiac silhouette in the chest was no longer discernible.

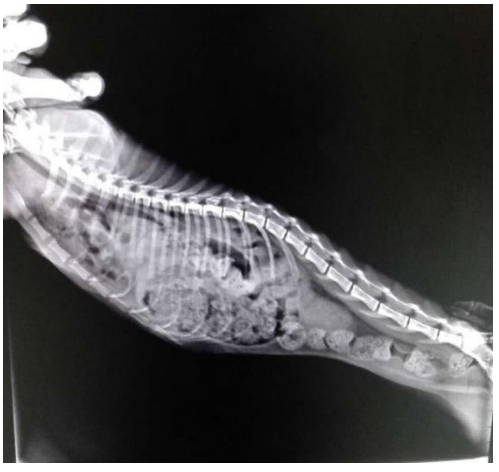

**Figure 1.** Left lateral position.

**Figure 2.** Positive position.

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### *2.3. Diagnosis*

Based on the clinical, laboratory, and radiological examinations described above, the diagnosis of diaphragmatic hernia in the affected cat was confirmed [4]. Considering the cat's age, mental state, and after consultation with the owner, the decision was made to proceed with surgical treatment.

## 3. Surgical Treatment

### *3.1. Anesthesia and Preoperative Preparation*

Before surgery, the cat was administered subcutaneous injection of hemostatic sensitin (0.8 ml) and intramuscular injection of tiletamine-zolazepam (0.4 ml). A venous access was established, and propofol was slowly infused intravenously at a rate of 5 mg/kg. After reaching intubation criteria, the cat was intubated rapidly, connected to a mechanical ventilator for anesthesia maintenance, placed in dorsal recumbency, and maintained at a table temperature of 28°C. Electrocardiogram monitoring, Doppler blood pressure measurement, and body temperature monitoring were initiated.

### *3.2. Surgical Procedure*

The abdomen and thorax were shaved and prepared for surgery. Sterile drapes were applied, and a midline abdominal incision was made just anterior to the umbilicus. The incision sequentially traversed the skin, subcutaneous tissue, muscles, and peritoneum, allowing access to the abdominal cavity. It was observed that a significant portion of the abdominal organs had entered the thoracic cavity, and the diaphragm and thoracic cavity were in direct communication. The remnants of the diaphragm muscle were not evident, preventing the complete reduction of the liver, stomach, and intestinal loops. The incision was enlarged to facilitate organ reduction. Subsequently, the sternum was cut along the midline, and careful exploration led to the identification of remnants of the diaphragm muscle. These remnants were secured with tissue forceps, and a fresh incision was made to accommodate the return of the abdominal organs. Non-absorbable sutures were used to close the diaphragm, employing interrupted sutures with at least a 0.5 cm margin from the closure edge to prevent tearing [5]. Steel wires were used to stabilize the divided sternum, and a three-way chest tube was placed. Routine closure of the chest and abdomen was performed. Air in the chest cavity was evacuated through the chest tube, restoring negative pressure in the thoracic cavity. Oxygen was administered rapidly to ensure proper lung inflation [6].

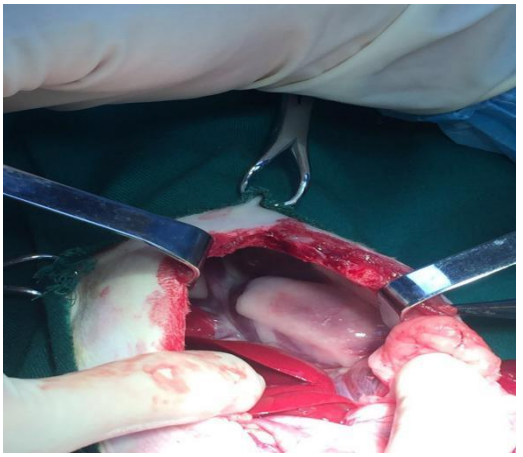

**Figure 3.** Direct thoracoabdominal connection.

## 4. Postoperative Care

Postoperatively, an Elizabethan collar was placed on the cat, and the wound was covered with sterile gauze and self-adhesive bandage, ensuring appropriate tension without excessive tightness. The cat was transferred to the Intensive Care Unit (ICU) and received routine anti-inflammatory and analgesic

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medications. Fluid therapy and nutritional support were provided, with fasting and restriction of water intake for the first 12 hours.

Ceftriaxone (Cephtriaxone) was administered continuously for one week, tiletamine-zolazepam for one week, hemostatic sensitin for three days, and furosemide for three days. Prescription canned food was administered daily. The wound was disinfected using chlorhexidine spray. Exudate and excess gas in the chest cavity were aspirated through the three-way chest tube. On the third day post-surgery, a follow-up DR examination was conducted, and on the fourth day post-surgery, there was no significant exudate in the chest cavity, and the chest tube was removed [7]. Suture removal was performed one week post-surgery, and the cat was discharged in good condition.

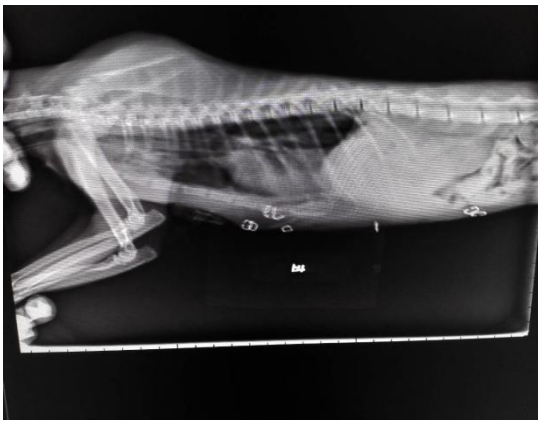

**Figure 4.** 3-day postoperative X-ray.

## 5. Conclusion and Discussion

Distinguishing between congenital and acquired diaphragmatic hernias in cats can be challenging, especially when the patient's medical history is unknown. Some mild hernias may not present obvious clinical symptoms, and it is advisable to obtain preoperative X-rays when performing abdominal surgeries in cats to rule out the possibility of diaphragmatic hernia. In this case, the hernial defect was exceptionally large, and there were no apparent remnants of the diaphragm muscle, with numerous abdominal organs entering the thoracic cavity. A simple midline abdominal incision would not provide adequate exposure for organ reduction and repositioning. Therefore, a combined approach involving a midline sternotomy and abdominal incision was employed to enhance surgical visualization. Postoperatively, providing analgesia for a week was deemed necessary due to sternal incision and potential discomfort [8].

Given the prolonged lung compression, atelectasis and subsequent pulmonary edema might occur after re-expansion. To prevent pulmonary edema, furosemide was administered for 2-3 days postoperatively, and the cat was placed in an oxygen chamber to facilitate recovery. Additionally, abrupt relief of lung compression may lead to reperfusion injury to the lung vasculature. Therefore, preoperative administration of non-steroidal anti-inflammatory drugs (NSAIDs) was considered [8].

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