

Traumatic Diaphragmatic Hernia in Cats: A Retrospective Study of 15 Cases (2016-2017)

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ABSTRACT

In this study, evaluation of clinical and operative results of cats with diaphragmatic hernia presented with respiratory failure was aimed. The cats were in different age, breed and sex. All of the cats were treated surgically with 73.3% survival rate. The highest incidence of herniation was in the liver and small intestine, but stomach and spleen also was encountered. All deaths occurred during surgery, the cases completed surgical procedure were healed. The cats which died had multiple organ herniation as well as laceration of the lungs and fluid accumulation in the thoracic cavity were noticed. It was seen that intensive care cabin applications and Ventolin - Pulmicort support through nebulizer provided marked contribution on survival rate.

Keywords: Cat, diaphragm, hernia, intensive care

Kedilerde Travmatik Diyafram Fıtık: 15 Olgu (2016-2017)

ÖZ

Bu çalışmada, kliniğimize solunum güçlüğü şikâyeti ile getirilen kedilerde karşılaşılan diyafram fıtıklarının klinik ve operatif sonuçlarının değerlendirilmesi amaçlanmıştır. Kediler farklı yaş, ırk ve cinsiyette idiler. Tüm kediler % 73.3 sağ kalım oranıyla cerrahi olarak tedavi edildi. En fazla fıtıklaşan organ karaciğer ve ince bağırsak olmakla birlikte mide ve dalakla da karşılaşıldı. Tüm ölümler operasyon sırasında meydana geldi, operasyonu tamamlanan olguların tamamı yaşadı. Ölen kedilerde çoklu organ fıtıklaşması yanı sıra gerek fıtıklaşan organ gerekse akciğerlerde laserasyon, göğüs boşluğunda sıvı toplanması dikkati çekti. Yoğun bakım kabin uygulamaları ve nebulizator aracılığı ile ventolin- pulmicort desteği sağ kalım üzerine olumlu katkı sağladığı görüldü.

Anahtar Kelimeler: Kedi, diyafram, fıtık, yoğun bakım

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INTRODUCTION

Diaphragm is a musculocutaneous structure that separates abdominal and thoracic cavity, supports ventilation, and plays a role in lymphatic fluid flow. Embryologically it develops from the septum transversum in the ventral side, two pleuroperitoneal leaves and the mesentery of the small intestines in the dorsal side (Orton 2017, Randall 2018). Diaphragmatic hernia is a defect or hole in the diaphragmatic muscle which allows the one or more organs located in the abdominal cavity to move into the thoracic cavity. It may be occurred congenital or acquired and, is encountered in cats and dogs as a common problem (Fossum 2002, Gibson et al. 2005). Congenital diaphragmatic hernia is caused from the failure of the development of transversal septum. Since clinical findings are not very clear, the herniation usually determined incidentally after thorax radiography. Acquired hernias generally occur after the blunt traumas (traffic accidents, fall from high places etc.). Traumatic diaphragm hernias in cats and dogs are more common than congenital hernias and treated with surgically (Fossum 2002, Schmiedt et al. 2003, Minihan et al. 2004, Randall 2018). Initial approach to the patient with respiratory distress and, management of pre/post-operative period including oxygen therapy, fluid therapy, control of body temperature, using of the inhaler therapeutics have great role on prognosis (Mazzaferro et al. 2013, Nelson 2015). In this study, to share preoperative medical management, surgical treatment and results of the diaphragmatic hernia cats represented our clinic was aimed.

MATERIAL and METHOD

The study was conducted on 15 cats of different ages, breed and sexes. Place of hernia, herniated organs, complications and survival rates of cats were recorded to the trauma form. All cats were brought to our clinic with respiratory complaints. Clinical, radiological, hematological and biochemical analyzes were performed on all animals. Ventro-dorsal and latero-lateral, radiological position (Figure 1) (positive contrast celiography in 1 case, Iohexol Omnipaqua, Amersham, USA) was taken and it has been interpreted. Diaphragmatic hernia was diagnosed by clinical and radiographic findings (Figure 1A-B).

Preoperatively, the patients were to the intensive care cabin and oxygen support was provided for 24 hours. Serum and antibiotic (cefazolin sodium of 20 mg / kg, Iespor®, IE Ulagay, Istanbul) were administered intravenously for prophylaxis. Induction of the general anesthesia induction was performed with intravenous propofol of 4 mg / kg (Diprivan®, Astra Zeneca). Then, anesthesia was maintained with 1-3% MAC isoflurane (Isoflurane, Adeka, Samsun) by intubation with 3-3.5 cuffed endotracheal tubes. The

patients were placed in a dorsal recumbency on the operating table tilted 40 degrees in caudal direction. During the operation, Ringer's lactate solution of 10 ml/kg/ h (500 ml, Polypharma) was administered intravenously. Operation area was prepared aseptically and covered sterile drapes. The diaphragm was approached by ventral median line laparotomy extending from the xiphoid cartilage to the umbilicus (Figure 2). The organs displaced to the thoracic cavity (Figure 3) were re-poisoned to the abdomen. Diaphragmatic defect (Figure 4A) was repaired with simple continuous or interrupted suture techniques with non-absorbable material (Figure 4B)(Prolene, Ethicon, Johnson & Johnson, Brussels, Belgium, USP 2/0-3/0). The negative pressure of the thoracic cavity was created before the last stitches. Abdominal cavity was lavaged with saline (Isotonic Sodium Chloride, 500 ml, Koçak Farma), the operation area was closed routinely. Polypropylene mesh (Polypropylene mesh)(Prolene®, Ethicon) implantation was needed in only one case to close of the abdominal cavity. No chest tube was placed in any of the patients. All cases were observed in the intensive care unit for 3 days. Meanwhile, oxygen support is provided and methylprednisolone of 1 mg/kg (Prednol®, Mustafa Nevzat, Turkey) were administered intramuscularly. Also salbutamol sulfate (Ventolin Nebules® 2.5mg/ml, GlaxoSmithKline) – budesonide (Pulmicort® Nebulizer sus. 0.5mg/ml Astra Zeneca) was given with mask via nebulizer twice a day (Figure 6). Additionally, cefazolin sodium administration continued for postoperative one week.

RESULTS

The cats were between 5 months and 15 years old, 2 male and 13 female, mean 2-5.5 kg body weight (Table 1). Etiologies of the diaphragmatic hernias were motor vehicle accidents in 5 cases, falling from high places in 4 cases and unknown traumas (as a result of run away from home) in 6 cases. Clinical presentation durations of the cases were between 1 to 5 days after trauma Tachypnea (15 cases), dyspnea and orthopnea (5 cases), inappetence (5 cases), open mouth respiration (3 cases), abdominal respiration (3 cases) exercise intolerance (2 cases) and vomiting (1 case) were determined in clinical and physical examination. Direct radiographies provided sufficient information in 14 cases, but positive contrast celiography was performed in one cases. Radiographic examination revealed that loss of diaphragmatic shadow and heart silhouette and displaced abdominal organs in the thorax. Celiography revealed that the contrast medium was distributed in thorax. The results of hematological and biochemical analysis were within normal limits. The diaphragmatic defects were on dorsal region in one case, ventral region in other cases (right in 6 cases, central in 4 cases, left in 3 case, right and left in 1 case). The herniated organs were single organ in 5

cases (2 small intestines, 3 liver), multiple organs in 10 cases (spleen, liver, stomach and intestine in 3 cases; small intestine and liver in 4 cases; stomach, spleen and small intestine in 2 cases; spleen and small intestine in 1 case). Four patients were died during

the operation. The cases died had marked laceration of the lungs and large amount fluid accumulation into the thoracic cavity.

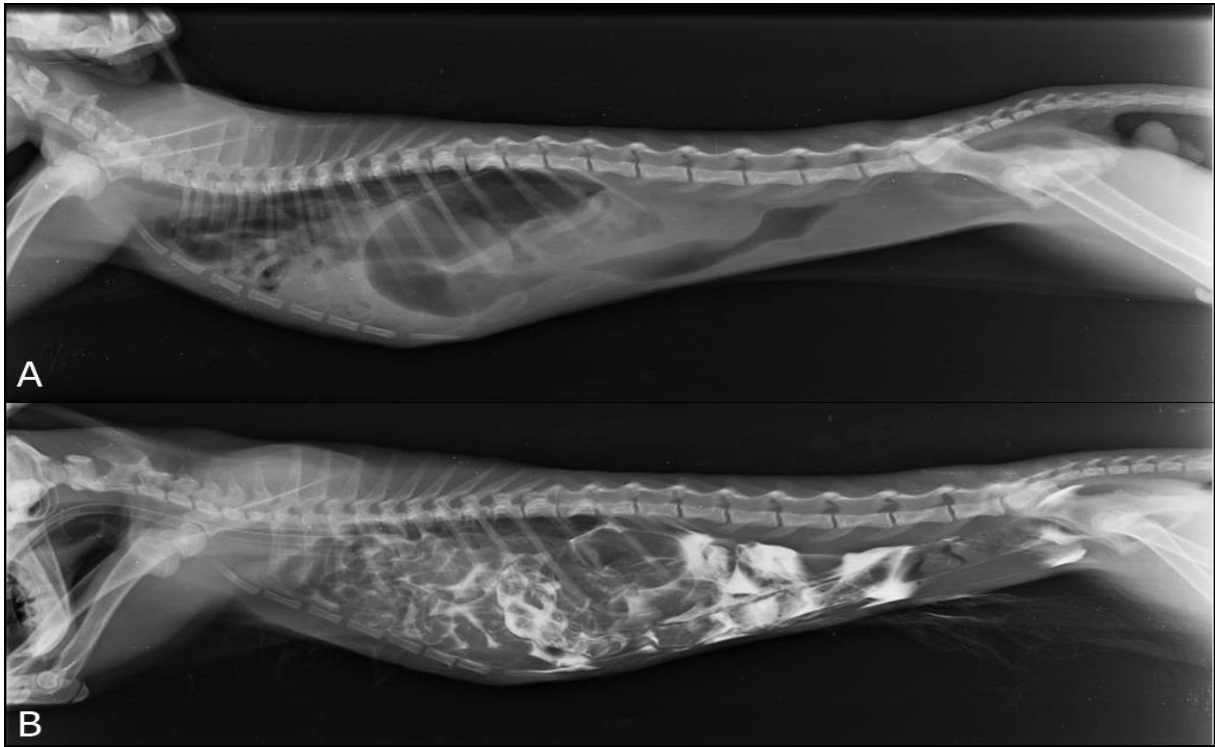


Figure 1. Direct radiography (A) and peritoneography (B).



Figure 2. Limitation of the operation side with surgical drapes.

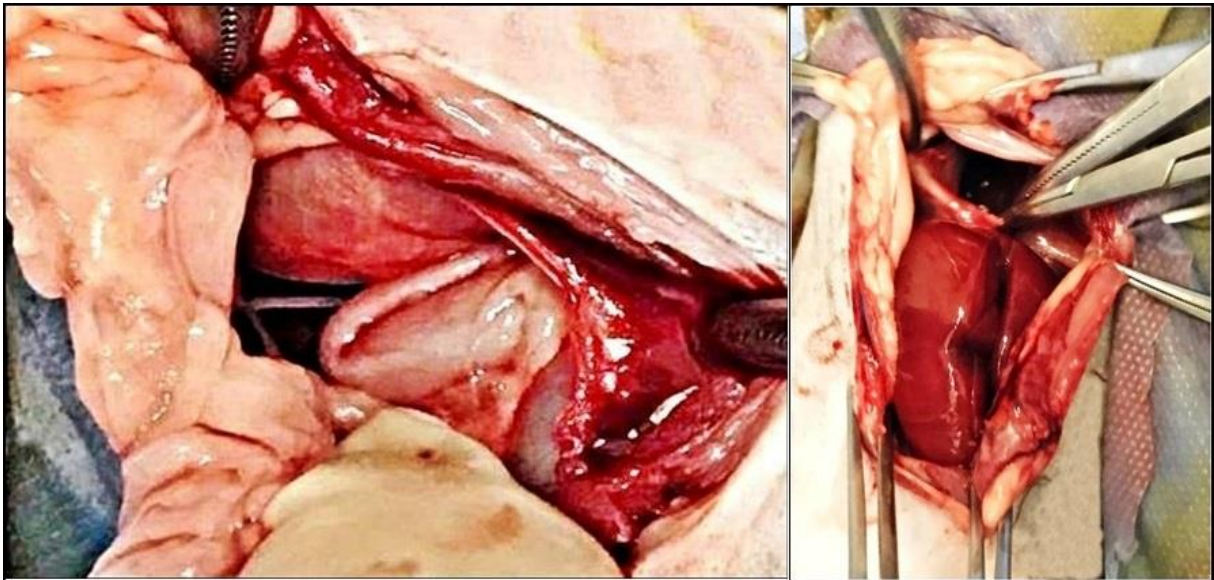


Figure 3. Intestine in thoraks.

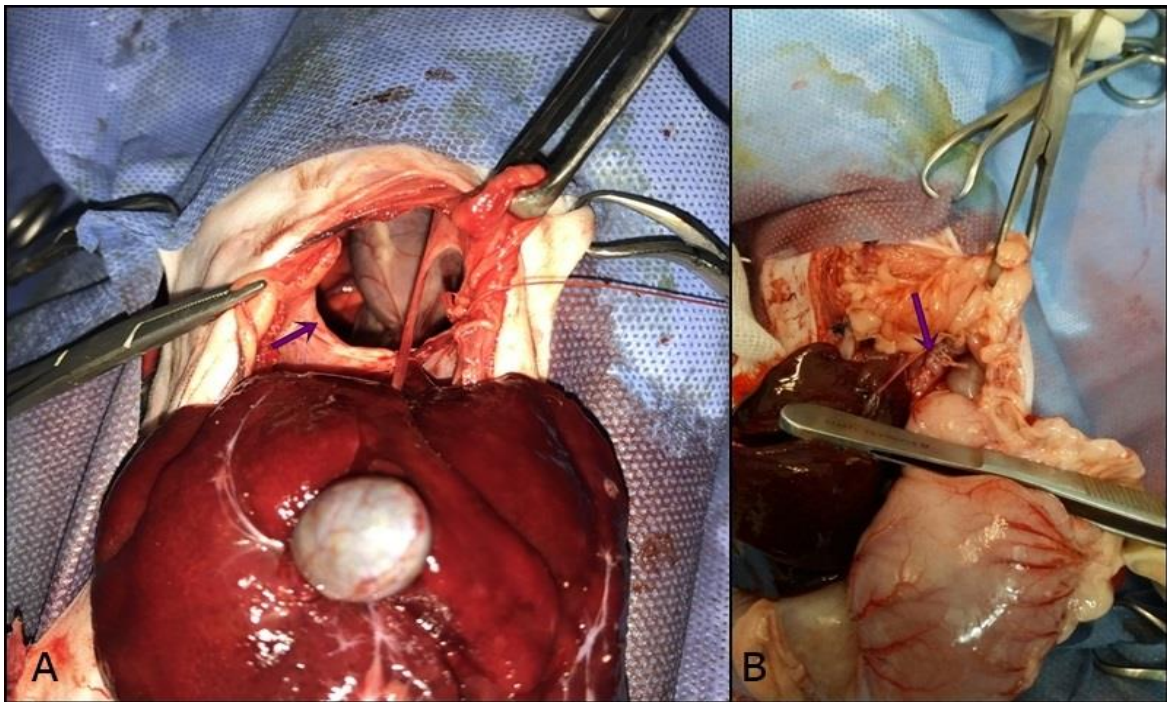


Figure 4: Diaphragmatic herni (A). Repair of the diaphragmatic hernia (B).



Figure 5: Polypropylene mesh.



Figure 6: Postoperative nebulisation.

Table 1. Cats information

	Age	Sex	Location of Hernia	Hernia organs	Cause
1	8 months old	Male	Dorsal-Central	Spleen, Small intestines	
2	12 years old	Female	Ventral -Left	Liver	
3	2 years old	Female	Ventral-Right	Small intestines	
4*	3 months old	Female	Ventral-Central	Spleen, Liver, Stomach, Small intestines	
5*	2 years old	Female	Ventral -Left	Spleen, Liver, Stomach, Small intestines	
6	5 months old	Female	Ventral- Right	Liver, Small intestines	
7*	1 years old	Female	Ventral-Central	Liver, Small intestines	
8	8 months old	Female	Ventral-Central	Liver, Small intestines	Trauma
9	7 months old	Female	Ventral-Right	Liver	
10	5 months old	Female	Ventral-Right	Small intestines	
11	1 years old	Female	Ventral-Right	Spleen, Liver, Stomach, Small intestines	
12	1 years old	Female	Ventral-Right-Left	Spleen, Stomach, Small intestines	
13	4 months old	Female	Ventral- Left	Spleen, Liver, Stomach, Small intestines	
14	15 years old	Female	Ventral- Right	Liver	
15*	4 months old	Male	Ventral- Central	Liver, Small intestines	

* Four patients were died during the operation

DISCUSSION

Diaphragmatic hernia is a defect or hole in the diaphragmatic muscle which allows the one or more organs located in the abdominal cavity to move into the thoracic cavity. It has very high incidence in cats after trauma. Survival rate after surgery of diaphragmatic hernia is reported as 54-90% (Schmiedt et al. 2003, Minimal et al. 2004, Gibson et al. 2005, Besalti et al. 2011, Legallet et al. 2017). Following the procedure which used in this study 73.3% survival rate was accomplished.

Many studies (Minimal et al. 2004, Hyun 2004, Besalti et al. 2011) have stated that diaphragmatic hernia cases occur more in male cats than females. However, 13 of the cats with diaphragmatic hernia were female and only 2 cases were male in our study.

Clinical manifestations of diaphragmatic herniation in animals include respiratory problems, increased respiratory rate, collapse, regurgitation, vomiting and muffled heart sounds. These findings may not be

found in chronic cases (Fossum 2002, Schmiedt et al. 2003, Minimal et al. 2004, Gibson et al. 2005, Ozer et al. 2007, Besalti et al. 2011). Radiological findings include loss of the diaphragmatic shadow and heart silhouette, pleural effusion, gas findings of the gastrointestinal organs and shadow of the other abdominal organs in the thoracic cavity. Some patients may have no radiographic findings (Voges et al. 1997, Hyun 2004). Such cases can be diagnosed by contrast radiography of the gastrointestinal tract, peritoneography, thorax or abdominal ultrasonography and computed tomography (Gibson et al. 2005, Kibar et al. 2006). Transition of radiographic contrast agents injected into the peritoneal cavity to the thoracic cavity is evaluated by performing peritoneography (Sullivan and Lee 1989, Kibar et al. 2006, Tillson 2014). In this study, all cases were presented with complain of respiratory problems. Clinical and radiological examinations revealed diaphragmatic hernia. Except one case which diagnosed by celiography, because direct radiography and clinical examination findings were sufficient for

diagnosis in all cases, to perform other examination methods such as peritoneography, ultrasonography and computed tomography was not needed.

No specific laboratory findings are usually found in hernia cases. Some studies state that the cases with hernias of the liver may have high levels of aminotransferase and serum alkaline phosphatase (Fossum 2007, Ozer et al. 2007). In our study no abnormal laboratory finding were determined in any case, even in the cats with liver herniation.

The diaphragmatic rupture should be closed with a simple surgical suture. For this purpose, the absorbable or non-absorbable suture material should be used, and the needle tip has to be round. Autogenous and synthetic grafts may be needed in some cases where the defect cannot be repaired completely. By providing inspiration, the lungs are brought in fully expanded form to provide negative pressure in the thoracic cavity before final suture (Fossum 2002). In our study, non-absorbable suture material was used to repair the defect. Negative pressure before last suture was provided. No grafting material was needed to close the diaphragmatic defects. Only in one case, a synthetic mesh was used for the closure of the abdomen, because of enlargement of herniated organs.

Depending on the size and location of the diaphragmatic defects and the mobility of the abdominal organs, the herniated organ varies, but usually is liver. In addition, the small intestine, stomach, spleen, omentum, pancreas, colon, uterus can also herniate. According to some authors, the diaphragmatic rupture is mostly seen on the right side, and the liver, the small intestine, the pancreas is usually herniated from this defect. The stomach, spleen and small intestines is largely herniated from the left side defects (Schmiedt et al. 2003, Hyun 2004, Gibson et al. 2005, Baines 2016). In our study, the diaphragmatic defects were on dorsal region in one case, ventral region in other cases. The ventral defects were localized on right side in 6 cases, central in 4 cases, left side in 3 case, right and left in 1 case. Among the herniated organs, the most common was liver and small intestine, but stomach and spleen were also encountered.

Surgery of the diaphragmatic hernia has a greater anesthesia risk than other abdominal operations. Dorsal recumbency on the operation table causes increased pressure in the lungs and displacement of the heart resulting exacerbated cardiovascular and respiratory disorders. Longer operation and longer anesthesia duration and higher soft tissue damage and need of oxygenation rises mortality rate in cats and dogs (Legallet et al. 2017). In addition, localization of hernia, amount of herniated organs, elapsed time after trauma to the operation also affect perioperative

mortality (Besalti et al. 2011, Legallet et al. 2017). Therefore, the time between anesthesia induction and herniorrhaphy should be as short as possible and oxygenation should be provided before and after anesthesia (Besalti et al. 2011, Yool 2014). In our study anesthesia duration before the surgical intervention was kept as short as possible. Oxygen support was supported before and after the operation and the cats.

Oxygen therapy is a well-known indispensable procedure for respiratory distress patient. But also to keep the animal calm and prevent getting stress has high important choosing the way of providing oxygen (Sharp et al. 2013). Therefore, the most recommended method is the oxygen cage (Mazzaferro et al. 2013, Mackay 2001). All cats included our study got oxygen support by using intensive care cabin a day before and 3 days after surgery. Also usage of the intensive care cabin provided keeping animal warm and preventing hypothermia.

The fluid therapy is another important step to improve tissue perfusion and oxygen delivery associated with bradycardia, hypotension and hypovolemia in the cats with diaphragmatic hernia (Nelson 2015). During the operation, Ringer's lactate solution of 10 ml/kg/h was administered intravenously to the all cats.

Aerosol therapy is known a functional method of drug delivery to direct therapy at the site of the problem (Miller et al. 2003). Aerosol agents include physiologic saline, some antibiotics, glucocorticoids and bronchodilators (Kirschvink et al. 2006). Usage of the aerosol glucocorticoids limits systemic complications and provides immediate relief of bronchoconstriction. Prednisone or prednisolone treatment in the cats works well as an anti-inflammatory agent but concurrent use of oral bronchodilators generally is usually recommended for bronchoconstriction (Rozanski et al. 2007). In our study ventolin and pulmicort were administered twice a day with mask by aid of nebulizer concurrently systemic methylprednisolone therapy. Thus, all cats who survived surgery (73.3%) lived no complication and healed completely in a short time.

As a result, it was concluded that the management procedures include fluid therapy, oxygen and, ventolin and pulmicort therapy concurrent with systemic methylprednisolone, and doing all of these in intensive care cabin to keep the animal away from stress contributes the survival rates of the cats.

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