Use of peritoneography (positive contrast che-
liography) and ultrasonography in the diagnosis
of diaphragmatic hernia: review of 35 cats

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SUMMARY
This study was aimed at the evaluation and practical use of findings
obtained from direct radiography, peritoneography (positive contrast che-
liography) and ultrasonography in cats referred to clinic upon suspicion of
hernia diaphragmatica.

The study material comprised of 35 cats of different breeds, age, and sex
(19 females, 16 males) with suspected diaphragmatic hernia between the
years 2002 and 2004. The period between the occurrence of the traumatic
incident and the admission of the animal to the clinic ranged between 1 and
15 days in 30 (86%) cats. The remaining 5 (14%) cats were referred to our
clinic within 1-3 months following the trauma. Ultrasonographic examina-
tion revealed the protrusion of abdominal organs into the thoracic cavity in
33 (94%) cases among 35 cats suspected to have diaphragmatic hernia. The
contrast material injected into the peritoneal cavity was determined to pass
into the thorax in 33 (94%) cases. The contrast material was not able to pass
to the thoracic cavity in 2 (6%) cases due to the presence of adhesions.

In conclusion, in cats referred to clinic upon suspicion of hernia dia-
phragmatica, the joint evaluation of peritoneographic and ultrasonographic
findings was considered to yield more accurate results.

Keywords: Peritoneography - hernia diaphragmatica - cat.

RéSUMé
L'utilisation de la péritonéographie et de l'échographie dans le diagnos-
tique de la hernie diaphragmatique: examen de 35 chats. Par M. KIBAR,
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Le but de cette étude est d'évaluer l'intérêt pratique de la radiographie,
de la péritonéographie et de l'échographie chez des chats présentés à la cli-
nique et suspects de hernie diaphragmatique.

La population étudiée consiste en 35 chats de races, d'âge, et de sexe diffé-
rents (19 femelles, 16 mâles) suspects de hernie diaphragmatique, entre
les années 2002 et 2004. La période séparant le traumatisme et l'admission
de l'animal à la clinique varie de 1 à 15 jours chez 30 chats (86%). Les 5
chats restants (14%) ont été présentés à notre clinique dans les 1 à 3 mois
suivant le trauma. L'échographie a indiqué le passage des organes abdomi-
naux dans la cavité thoracique dans 33 cas (94%) parmi 35 chats suspects
de hernie diaphragmatique. Le matériel de contraste injecté dans la cavité
péritonéale est passé dans le thorax dans 33 cas (94%). Le matériel de
contraste n'a pas pu pénétrer dans la cavité thoracique dans 2 cas (6%) en
raison de la présence d'adhérences.

En conclusion, chez les chats présentés à la clinique et soupçonnés de
hernie diaphragmatique, c’est l’association de la péritonéographie et de
l’échographie qui a permis d’obtenir les résultats les plus précis.

Mots-clés: Péritonéographie - hernie diaphragmatique - chat.

Introduction
Protrusion of one or more of the abdominal organs into the
thoracic cavity through an abnormal opening in the dia-
aphragm is described as a diaphragmatic hernia. In such
cases, the abdominal organs enter either the pleural or the
pericardial sacs [1, 5, 6, 14, 29, 31]. Generally being a sequel to trauma, diaphragmatic hernia
seldom arises from congenital defects and is common in the
cat and dog. Traumatic cases generally occur due to vehicu-
lar accidents, high falls or blunt trauma [2, 5, 7, 20]. The sud-
den increase in abdominal pressure at impact is dissipated
cranially, resulting in disruption of the diaphragm [5, 7, 25,
30]. Clinical findings may be observed either immediately
after the traumatic incident or during the forthcoming days,
months or years [5, 14, 22, 30]. Clinical symptoms displayed
by animals with diaphragmatic hernia include acute dyspnea,
collaps, regurgitation and vomiting. Herniation of abdominal
organs into the thoracic cavity and any subsequent pleural
fluid accumulation from hemorrhage or organ entrapment
may result in the inability to inflate some or all of the lung
lobes [5, 14, 21, 22, 29, 30]. Furthermore, abdominal organs
cannot be felt on abdominal palpation [9, 14, 23]. Presence
of severe haemorrhage, myocardial contusion, gastric tym-
pamy or intestinal invagination indicates increase in the seve-
rity of clinical symptoms and potential threat to life [5, 9, 14,
31]. Mortality rates for cats with hernia diaphragmatica are
20.0 and 18.8% for acute and chronic hernias [14, 18, 26,
30].

Diaphragmatic hernia can be diagnosed by means of radio-
ultrasonography and surgery [3, 8, 11, 12, 16, 17, 23, 24]. Direct radiographic examination constitutes the primary
diagnostic method for diagnosis of diaphragmatic hernia.
Positive contrast gastrography or peritoneography can be
consulted so as to assist diagnosis in cases in which direct
radiography proves to be inadequate [4, 5, 10, 15, 16, 19, 22,
26]. Significant information related to diaphragmatic hernia
is known to be collected by means of noncardiac thoracic
ultrasonography [2, 8, 12-14, 23, 27-29]. This study was aimed at the evaluation and practical use of
findings obtained from direct radiography, peritoneography
and ultrasonography in cats referred to clinic upon suspicion

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of hernia diaphragmatica. The accuracy of ultrasonographic and peritoneographic examination in the diagnosis of animals with diaphragmatic hernia and the comparative advantages of the aforementioned diagnostic methods were also studied.

Materials and Methods

The study material comprised of 35 cats referred to the Surgery Clinic of Ankara University Faculty of Veterinary Medicine upon suspicion of diaphragmatic hernia between the years 2002 and 2004. The mean age was 5.5±4.5 years (range, 9 months to 12 years). 19 (54%) of the cats female, and 16 (46%) were male. The mean weight of all cats with diaphragmatic hernia was 4.5 kg±1.4 (range, 3 to 6.8 kg). The study population consisted of 20 European Shorthair, 7 mixed breed, 3 Turkish Van, 2 Persian, 2 Turkish Angora, and 1 Siamese.

Anamnesis provided by the owners of the animals revealed a history of traffic accidents and high falls in 30 cases, whereas the cause of hernia was unknown in 5 cases.

Prior to ultrasonographic examination, hair coat was clipped from the related part of the body and ultrasonographic gel was applied. A 7 MHz sector transducer was utilised during ultrasonographic examination (ESAOTE AU5, ESAOTE BIOMEDICA; Via Siffredi 58; 16 153 Genova, Italy). Ultrasonographic examination was performed so that animals without dyspnea were laid down on their right side whereas animals displaying signs of dyspnea were maintained in dorsal position. The transhepatic window was used for the initial ultrasonographic scan. For this purpose, the probe was placed in a position caudal to the xiphoid process and directed to the cranial aspect of the liver. Following this examination, the possible presence of abdominal organs in the thorax was bilaterally examined through the 5th-13th intercostal spaces, whereas the presence of abdominal organs could be revealed. The presence of air bubbles in the injector was indicative of the needle being located in the peritoneal cavity. The rear part of the animals was slightly elevated so as to ease the flow of the contrast material into the thoracic cavity. Radiographs in right and left latero-lateral and ventro-dorsal positions were taken immediately after injection and manipulation. Dorso-ventral radiographs were also obtained in some cases upon requirement.

Results

According to information obtained from the owners of the animals, the period between the occurrence of the traumatic incident and the admission of the animal to the clinic ranged between 1 and 15 days in 30 (86%) cats. The remaining 5 (14%) cats were referred to our clinic within 1-3 months following the trauma. The mean heart rate at presentation was 172±30 beats per minute (bpm; 118 to 234 bpm); the mean respiratory rate 38±12 breaths per minute (breaths pm; range, 25 to 58 breaths pm); and the mean temperature was 37.4°C±2.50 (range, 35.4 to 39.8°C).

Ultrasonographic examination revealed the protrusion of abdominal organs into the thoracic cavity in 33 (94%) cases among 35 cats suspected to have diaphragmatic hernia. The liver was determined to protrude into the thoracic cavity in 20 (57%) cases according to ultrasonographical examination (figure 1). Asymetrical or irregular cranial hepatic border was observed in 17 (49%) of 20 cases (figure 2). The diaphragmatic border was observed to be normal in 3 (9%) cases due to the adhesion between the liver and lungs. The small intestine was determined to have protruded into the thoracic cavity in 2 (6%) cases. Furthermore, among cases in which the liver had protruded into the thoracic cavity, the liver was determined to be related to the lateral part of the heart in 3 (9%) cases. The heart was observed to have an abnormal position in 2 (6%) of these cases. The liver was located caudal to the heart in 17 (49%) cases. The stomach and intestines were determined accurately by means of ultrasonographic examination. The stomach had protruded into the thoracic cavity in 4 (11%) cases and was easily diagnosed. The small intestine had protruded into the thorax in 5 (24%) cases (figure 3). Despite the rupture of the diaphragm no ultrasonographic finding was obtained in 2 (6%) cases. Pleural effusion was detected in 7 (20%) of 35 cases. This finding was particularly observed in cases characterised with the protrusion of both the stomach and the small intestine into the thoracic cavity as well as the single case in which an adhesion between the liver and lungs was present.

Direct radiography and peritoneography revealed the loss of the diaphragmatic border in 34 (97%) cases (figure 4). The contrast material injected into the peritoneal cavity was determined to pass into the thorax in 33 (94%) cases (figure 5). The contrast material was not able to pass into the thoracic cavity in 2 (6%) cases due to the presence of adhesions. However, upon administration of contrast material by oral route, the stomach and small intestine were each determined to protrude into the thoracic cavity in one case. The loss of the hepatic border, considered to be another significant finding, was observed in 30 (86%) cases. The protrusion of the intestines into the thorax and the covering of the exterior of the intestines with contrast material was determined in 18 (51%) cases. The stomach was detected to be located in the thorax in 4 (11%) cases. Complications such as hypersensitivity or peritonitis arising from administration of contrast material were not encountered in this study.
Internal organs that protrude into the thoracic cavity in animals with diaphragmatic hernia can be determined by means of ultrasonographic examination [8, 12, 14, 17, 18, 22, 27, 28]. Amongst the 35 cases included in this study, the protrusion of abdominal organs into the thoracic cavity was determined in 33 cases. The same finding was also obtained upon peritoneography. In this regard, the two diagnostic methods appear to have no superiority against each other. However, as reported by researchers, in case of the presence of adhesions, the contrast material is not able to pass into the thoracic cavity. The passage of contrast material into the thoracic cavity was not been able to be observed in 2 cases in this study due to adhesions. Significant medical information was obtained in these cases by means of ultrasonographic examination.

Researchers have also reported herniation of the liver to be easily diagnosed by means of ultrasonographic examination.
However it is also highlighted that such cases should be evaluated with care so as to prevent misdiagnosis, for as much as the liver tissue and consolidated lung tissue display similar appearance with uniform echotexture and echogenic wall upon ultrasonography. The underlying reason of this similarity in appearance arises from the walls of the portal vein pertaining to the liver and the lobar bronchioles filled with fluid pertaining to the consolidated lung tissue [8, 12, 17, 23, 27, 28]. Amongst the cats included in this study, the liver was determined to protrude into the thoracic cavity in 20 cases. The abovementioned difficulty in diagnosis previously reported by researchers was encountered in 4 of the 20 cases in which herniation of the liver was present. Differential diagnosis was performed by means of the branching of luminal structures pertaining to intathoracic liver and consolidated lung tissue. Furthermore, the bronchi were observed to stem close to hilum pulmonis and the basis of the heart. The structures that were similar to veins in appearance, however filled with air, were easily differentiated by means of the lack of blood flow upon doppler examination.

In certain cases in which the abdominal organs protrude into the thoracic cavity, adhesions have been reported to be observed either between internal organs or internal organs and the diaphragm [1, 3, 5, 14, 18, 27, 28, 31]. Amongst 20 cases in which herniation of the liver was present, adhesion between the liver and the lungs was observed in 3 cases. Furthermore, liver and lung tissue were not able to be differentiated during ultrasonography in these cases.

Researchers have reported the intrathoracic positioning of either only one or more than one of the abdominal organs in different cases [5, 22, 26, 27, 28]. The small intestine was determined to have protruded into the thoracic cavity in association with the liver in 2 of the cases included in this study. Excluding these two cases, the protrusion of two or more of the abdominal organs into the thoracic cavity was not observed in any of the animals included in this study.

In some cases, the protrusion of the abdominal organs into the pericardial sac upon the rupture of the pericardium and subsequent abnormal positioning of the heart have been reported to develop by researchers [2, 13, 19, 21, 24, 25, 29, 30]. The liver was in contact with the right lateral surface of the heart in 3 cases in which the liver had protruded into the thoracic cavity whereas amongst these cases, the heart was determined to have displaced in 2 cases. The liver was suspected to be located in the pericardial sac in one of these cases. However the liver was observed not to be in the pericardial sac at surgery.

The intra thoracic location of the abdominal organs, either the stomach or intestines, is reported to be easily determined by means of ultrasonographic examination but caution in diagnosis is highlighted [23, 27, 28, 31]. The protrusion of the stomach in 4 cases and the small intestine in 5 cases into the thoracic cavity was easily and explicitly determined in this study, based on the specific ultrasonographic appearances of these structures.

Information related to the normal anatomical and pathological conditions of the abdominal organs can be obtained by means of positive contrast peritoneography [1, 5, 6, 7, 9, 11, 20, 22, 31]. Excluding the 2 cases characterised with adhesions, diaphragmatic hernia was accurately diagnosed in all of the cases included in this study and findings were confirmed with ultrasonographic examination.

Researchers have reported certain criteria that bear significance with regard to the diagnosis of hernia diaphragmatica by means of peritoneography. Loss of the diaphragmatic border, presence of contrast material in the pleural cavity, loss of the normal hepatic border and displacement and protrusion of the abdominal organs into the thoracic cavity are listed as significant findings [5, 10, 11, 15, 20, 22, 26, 31]. The loss of the diaphragmatic border was observed in 34 cases included in this study. The diaphragmatic border was determined to be normal in one of the 2 cases with adhesions. Upon the perfomance of ultrasonographic examination and the administration of contrast material by oral route, the protrusion of the stomach in one and the protrusion of the intestines in the other case into the thoracic cavity was determined and hernia diaphragmatica was diagnosed accurately. The loss of the hepatic border which is another significant finding was observed in 30 of the 35 cases. The loss of the hepatic border was attributed to the the rupture of the diaphragm and the displacement of the abdominal organs through this rupture in these cases. Amongst these cases, the protrusion of the intestines and the stomach into the thoracic cavity was observed in 18 and 4 animals, respectively.

Contrast material administered by intraperitoneal route is rapidly absorbed from the peritoneal cavity and excreted via the kidneys. Furthermore, hypovolemia, hypersensitivity and peritonitis may develop due to the administration of contrast material [1, 4, 5, 26]. However no complication occurred following the administration of contrast material in this study. The contrast material was excreted from the body in a short time via the kidneys.

In conclusion, in cats referred to clinic upon suspicion of hernia diaphragmatica, the joint evaluation of peritoneographic and ultrasonographic findings was considered to yield more accurate results. The findings of peritoneography and ultrasonography were concluded to be complementary. Therefore we consider the consultation of both diagnostic methods in practice and the complementary use of findings for diagnosis in cats referred to clinic upon suspicion of diaphragmatic hernia to be more appropriate.

References

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