



# Determination of the Diagnostic Role of Ultrasonography in Abdominal Injuries Caused by Mechanical Damage in Cats

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## Abstract

**Background and aim:** The aim of this study was to use ultrasonography to determine possible injuries in the abdominal cavity following mechanical trauma in order to identify cats with severe abdominal injuries that require urgent surgery.

**Materials and Methods:** This retrospective cross-sectional study was carried out on 22 affected cats with abdominal injuries caused by mechanical trauma. The results of clinical examinations, ultrasound and laparotomy (if performed) and the final diagnosis of the patient were recorded and the positive and negative results of ultrasound were matched with the results of laparotomy and the clinical course of the patient.

**Results:** In this study, the result of ultrasound in 14 cats (63.6%) was reported negative and without lesions and in 8 cats (36.4%) was positive. Among the mentioned cases, 6 cases (75%) had free-fluid abdominal lesion, 2 cases (25%) had pancreatic lesion, 1 case (12.5%) had kidney lesions, 1 case (12.5%) had intestinal lesions, and 2 cats (25%) had liver lesions. Therefore, the most common ultrasound report was free fluid accumulation in the abdomen. Of the 22 cases studied, 6 cases (27.3%) underwent laparotomy, and the result of laparotomy was positive in 5 cases (83.3%) and negative in 1 case (16.7%). In 2 cats (9.1%) the result of ultrasound was false negative and in one cat (4.54%) it was false positive. In this study, the sensitivity of ultrasound was 86.67% and its specificity was 85.71%.

**Conclusion:** In general, the results of this study show the important and valuable role of ultrasound as a primary diagnostic method to determine and diagnose free intra-abdominal fluid and intestinal and visceral injuries in ventricular trauma.

**Keywords:** *Cat, Sensitivity, Specificity, Trauma, Ultrasonography*

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## Introduction

Abdominal injuries refer to any type of injury and damage to the abdominal region. Such injuries in cats can be penetrating or non-penetrating, and in both types, they can damage the internal organs of the abdominal cavity in cats. The symptoms include abdominal stiffness, tenderness, abdominal pain, and abdominal bruising (Decampos Fonseca *et al.*, 2017). The abdominal cavity trauma can lead to the risk of loss of blood and internal infection (Lynch, 2017). To ensure diagnosis, ultrasonography, computed tomography (CT scan) and surgical and peritoneal washing should be performed. Recognizing and treating potential abdominal injuries in cats suffering from mechanical abdominal injury is critical. The occurrence of pain in the abdominal area prompts a physical examination of the abdomen (Gower *et al.*, 2009). There may be no proper clinical judgment about intra-abdominal lesions in some patients with a decreased consciousness or lack of animal collaboration, especially in patients with head injuries, pregnancy and puppies, and poisoned patients (Gottlieb *et al.*, 2017). It should be noted that in some studies, ultrasonography was performed alone and in some cases with CT scan and in others, ultrasonography was compared with CT scan and diagnostic peritoneal lavage (Liapi-Adamidou *et al.*, 2000). Boysen *et al.*, discovered that the most important features of ultrasound abdominal injuries in dogs and cats were liquid accumulation in the abdomen, peritoneal effusion, decreased gastrointestinal movements, and damage to tissues such as the liver and pancreas (Boysen *et al.*, 2016). Another study by Pastore *et al.*, emphasized the role of ultrasonography in the diagnosis of abdominal lesions as a primary diagnostic method because it is quick, fairly accurate and cost-effective (Pastore *et al.*, (2007). Currently, surgeons are taught to use ultrasonography on patients with abdominal injuries in the clinic, with the primary goal of determining the presence or absence of fluid in the abdominal cavity (internal bleeding) (Ettinger *et al.*, 2017).

While diagnostic peritoneal lavage and CT scan are the standard diagnostic methods for abdominal trauma, ultrasonography is also considered an early diagnostic tool for this type of patients. The dynamic diagnostic process, non-invasive nature, and simple, fast, and cost-effective access are just a few of the advantages of ultrasonography in abdominal trauma

(Moore *et al.*, 2002). The attempt to rapidly and reliably diagnose the two groups of patients is one of the key objectives in diagnosing the complications of abdominal trauma. The first are patients that have abdominal injuries that require immediate surgery, and the second are patients that have sustained minor injuries and do not need surgery. This study was an attempt to identify potential abdominal trauma injuries by means of ultrasound to differentiate between the above two groups and to determine the cats requiring urgent surgery.

## Materials and Methods

This retrospective cross-sectional study was conducted on 22 affected cats (8 male and 14 female) with abdominal injuries due to trauma in the small animal clinic of the Faculty of Veterinary Medicine, from January 2018 to September 2021. During daily visits, all cats with abdominal trauma that did not require an urgent laparotomy and were being treated conservatively in the emergency department were examined, and the required information included breeds, age, sex, cause of trauma, status at the time of admission to the clinic, stability or unit ability, clinical examination, ultrasonography and laparotomy result (if done), and the patient's final diagnosis. The positive and negative ultrasonography results were then compared to the laparotomy results and clinical course of the affected cats. Cats with stable vital signs and no hemodynamic problems were selected for this study, while patients with unstable vital signs and severe hemodynamic disorders were excluded due to an urgent need for surgery. Under the supervision of a radiologist, the examination was carried out using an ultrasound machine model (EUB-8500 XP (Hitachi Medical Corporation, Tokyo, Japan) with an 8-12 MHz probe. Each patient took about fifteen minutes on average. Patients were ultrasounded in their resting positions to the right and left, as well as in their dorsal position. Descriptive statistics were calculated with SPSS version 22 software, and the sensitivity and specificity of the ultrasonic method were calculated with MedCalc version 18.11.03 software below the rock curve level. P value of less than 0.05 was deemed significant ( $P \leq 0.05$ ).

## Results

A total of 22 affected cat [8 male (36.4%) and 14 female 63.6%] were evaluated. All of the patients

were stable in terms of vital signs and hemodynamic status. The cats had an average age of 4.6 years. In terms of prevalence, the cause of the trauma was an accident with a vehicle in 18 cases (81.8%), a fall from a height in 2 cases (9.1%), and other causes in 2 cases (9.1%) (Table 1). In terms of the type of trauma, non-penetrating trauma was more common in this study [21 cats (95.5%)]. Abdominal tenderness, mildly reduced blood pressure, tachycardia, and early clinical symptoms suspected of shock were among the clinical symptoms for which an ultrasound was requested (which responded to fluid therapy and remained vital signs). Affected cats with stable hemodynamic impairment that did not respond to standard treatment, such as fluid therapy, were excluded from the study. They underwent emergency laparotomy surgery without abdominal ultrasonography. Out of 22 cats, 14 (63.6%) were suspected of having abdominal tenderness, 5 (22.7%) of having a decrease in blood pressure without a specific cause, 2 (9.1%) of having decreased consciousness and physical examination uncertainty, 6 (27.3%) of having tachycardia with an unspecified cause, and 1 (4.5%) of having shock, implying that abdominal tenderness is one of the most common signs in Abdominal trauma. Abdominal ultrasonography results in these patients were reported as the presence or absence of a lesion in the liver, spleen, kidneys, and intestines, as well as the presence or absence of abdominal free fluid. The evaluation of these tissues in ultrasound examinations was based on the organ's heterogeneity, the presence

of hematoma in the tissue, the presence of free fluid around the organ, and the rupture of the organ.

In this study, the result of ultrasound was reported in 14 cats (63.6%) was reported negative and without lesions and in 8 cats (36.4%) positive. Among these said cases, 6 cases (75%) had free-fluid abdominal lesion, 2 cases (25%) had pancreatic lesion, 1 case (12.5%) had kidney lesions, 1 case (12.5%) had intestinal lesions, and 2 cats (25%) had liver lesions. Therefore, the most common ultrasound report was the accumulation of free fluid in the abdomen. Out of the 22 patients, 6 (27.3%) underwent laparotomy, with the outcome being positive in 5 (83.3%) and negative in 1 case (16.7%). The results of the pre-operative ultrasonography were negative in two cases (33.3%), but due to the exacerbation of the clinical symptoms and the surgeon's clinical suspicion, laparotomy was performed and its result was positive, so the result of ultrasonography was false negative in two cases (9.1%). One cat (4.54%) underwent surgery out of the four cases (66.6%) with positive ultrasound results; thus, the ultrasound result in one cat was false positive. Indeed, it must be pointed out that in this study, false positive cases could not be easily determined, because in some cases, there may have been abdominal lesions, but not to the extent that they require laparotomy surgery; in these cases, accurate diagnostic procedures such as CT scan can be helpful. In this study, ultrasonography had a sensitivity of 86.67% and a specificity of 85.71% (AUC = 0.862, P = 0.001).

The cause of trauma	Male	Frequency (%)	Female	Frequency (%)	Total patients	Total percentage
Accident	7	31.8	11	50	18	81.8
Fall from height	1	4.5	1	4.5	2	9.1
Miscellaneous causes	0	0	2	9.1	2	9.1
Total	8	36.4	14	36.4	22	100

**Table 1.** The frequency distribution of trauma causes in patients based on sex

## Discussion

There is currently a strong trend toward using ultrasonography to detect abdominal complications caused by mechanical damage, which is 96.6% and 94%, respectively, in a study by Felumlee *et al.*, (Felumlee *et al.* 2015), and these values were

recommended in some clinics as an early diagnostic and first-line treatment option for abdominal trauma (Moore *et al.*, 2002). The sensitivity and specificity of ultrasonography in abdominal trauma were reported as 81% and 99%, respectively, in a study by Boysen and Lisciandro (Boysen & Lisciandro, 2013).

A review of several studies found that the sensitivity of ultrasonography in abdominal trauma was approximately 63 %-99% and the specificity was approximately 95%-100% (Menzilcioglu *et al.*, 2014; Williams *et al.*, 2013). It should be noted that in some studies, ultrasonography was performed alone, while in others, it was combined with a CT scan, and in some others, it was compared with a CT scan and diagnostic peritoneal lavage. The majority of studies emphasized the role of ultrasonography as a primary diagnostic method in the diagnosis of abdominal lesions because it is quick, fairly accurate, and cost-effective. Currently, surgeons are taught to use ultrasonography on patients with abdominal injuries in the clinic, with the primary goal of determining the presence or absence of fluid in the abdominal cavity (internal bleeding). The sensitivity and specificity of ultrasonography with the results of laparotomy or the clinical course of the patient were investigated in the current study, and the results were consistent with those of Pastore *et al.*, (Pastore *et al.*, 2007). Because of its high sensitivity and specificity, ultrasonography may be useful in cases of abdominal trauma, according to the findings of this study. However, when the ultrasonography method is compared to the surgical operation and clinical course of the patient, as well as the sensitivity and specificity values of this method, clinical judgment and repeated physical examinations of the patient were important in the diagnosis of injuries and abdominal traumatic injury.

According to the findings of this study, indicated that the presence of free fluid in the abdomen in ultrasonography strongly suggests intra-abdominal injuries and internal bleeding. As a result, the presence of free fluid inside the abdomen was the most common ultrasonographic report after trauma in this study. Based on the findings of this study, it is believed that patients suffering from abdominal trauma that are hemodynamically stable and have an ultrasonography that shows the presence of free fluid in the abdomen or visceral trauma should undergo surgery unless the clinical course and physical examination indicate the need for supportive and conservative treatment. It is recommended to provide supportive and conservative treatment to patients whose ultrasound results are reported negative and those that have a stable hemodynamic status, unless the hemodynamic status becomes unstable, in which case more accurate diagnostic tests such as a CT scan

or laparotomy surgery can be helpful. In this study, out of the 27 patients undergoing surgery, ultrasonography was negative prior to surgery in 12 cats, but surgery was performed due to the patient's clinical condition, and the result was negative in 4 cases of patients that had laparotomy. Although the initial negative result in these patients may have been due to a low amount of free fluid in the abdomen when they were admitted at the clinic (which was not visible on ultrasonography), this amount increased during admission and patient care, leading to laparotomy at a later stage.

### Conclusion

In general, the findings of this study showed that ultrasonography plays an important role in abdominal trauma as one of the primary diagnostic methods for detecting and determining intra-abdominal free-fluid or visceral injuries. However, as previously stated, each patient must be treated individually, and performing ultrasonography in conjunction with physical and clinical examinations, as well as the surgeon's judgment on the diagnosis of intra-abdominal injuries and the necessity or otherwise of performing laparotomy surgery, would be valuable. It is obvious that the ultrasound method alone cannot be used to make definitive treatment decisions.

### Conflict of Interest

The authors declared no conflict of interest.

### Ethical Statement

This study does not present any ethical concerns.

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## تعیین نقش تشخیصی اولتراسونوگرافی در آسیب‌های محوطه بطنی ناشی از صدمات مکانیکی در گربه‌ها

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### چکیده

**زمینه و هدف:** تروما می‌تواند نافذ و یا غیر نافذ باشد و در هر دو نوع ممکن است باعث آسیب اندام‌های درونی حفره شکمی شود. هدف از این مطالعه تعیین صدمات احتمالی امعاء و احشای شکم به دنبال ترومای مکانیکی با استفاده از اولتراسونوگرافی می‌باشد تا بتوان گربه‌هایی که دچار صدمات شکمی شدید شده‌اند و نیاز به به عمل جراحی فوری دارند را مشخص کرد.

**مواد و روش‌ها:** این مطالعه مقطعی گذشته نگر بر روی ۲۲ گربه‌ی مبتلا به آسیب‌های شکمی ناشی از ترومای مکانیکی انجام شد. نتایج معاینات بالینی، اولتراسونوگرافی و لاپاراتومی (در صورت انجام) و تشخیص نهایی بیمار ثبت گردیده و بدین ترتیب در ادامه نتایج مثبت و منفی اولتراسونوگرافی با نتایج لاپاراتومی و سیر بالینی بیمار مطابقت داده شد.

**یافته‌ها:** در این مطالعه نتیجه اولتراسونوگرافی در ۱۴ گربه (۶۳٪) منفی و بدون ضایعه گزارش شد و در ۸ گربه (۴۳٪) مثبت گزارش شد که از این تعداد اخیر در ۶ مورد (۷۵٪) مایع آزاد شکم، در ۲ مورد (۲۵٪) ضایعه طحالی، در ۱ مورد (۱۲٪) ضایعه کلیوی، در ۱ مورد (۱۲٪) ضایعه روده‌ای و در ۲ مورد (۲۵٪) ضایعه کبدی گزارش گردید. بنابراین شایع‌ترین گزارش اولتراسونوگرافی، تجمع مایع آزاد در شکم بود. از ۲۲ بیمار مورد مطالعه، ۶ مورد (۲۷٪) لاپاراتومی شدند که نتیجه لاپاراتومی در ۵ مورد (۸۳٪) مثبت و در ۱ مورد (۱۶٪) منفی بود. در ۲ گربه (۹٪) نتیجه اولتراسونوگرافی منفی کاذب بوده و در یک گربه (۴٪) مثبت کاذب بود. در این بررسی میزان حساسیت اولتراسونوگرافی ۶۷/۸۶ درصد و ویژگی آن ۷۱/۸۵ درصد بود.

**نتیجه‌گیری:** به طور کلی نتایج این مطالعه نشان دهنده نقش مهم و با ارزش اولتراسونوگرافی به عنوان یک روش تشخیصی اولیه به منظور تعیین و تشخیص مایع آزاد داخل شکمی و صدمات امعاء و احشاء در تروماهای محوطه بطنی می‌باشد.

**واژه‌های کلیدی:** گربه، حساسیت، ویژگی، تروما، اولتراسونوگرافی

امیر صمدی، سیامک علیزاده. تعیین نقش تشخیصی اولتراسونوگرافی در آسیب‌های محوطه بطنی ناشی از صدمات مکانیکی در گربه‌ها. مجله طب دامپزشکی جایگزین. ۱۴۰۱، ۵ (۱۲): ۶۸۱-۶۸۶.

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