

RESEARCH ARTICLE

Comparison of the Focused Assessment with Sonography for Trauma Protocol and Animal Trauma Triage Scoring System in Traumatized Dogs

Kurtulus PARLAK^{1,a (*)} Nuriza ZAMIRBEKOVA^{1,b} Elgin Orcum UZUNLU^{1,c}
Eyup Tolga AKYOL^{2,d} Nuri YAVRU^{1,e}

¹ Department of Surgery, Faculty of Veterinary Medicine, Selcuk University, TR-42130 Konya - TURKEY

² Department of Surgery, Faculty of Veterinary Medicine, Balikesir University, TR-10145 Balikesir - TURKEY

ORCID: ^a 0000-0002-8656-037X; ^b 0000-0003-4465-5511; ^c 0000-0001-5356-8968; ^d 0000-0002-9775-7557; ^e 0000-0001-9773-9327

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Abstract

FAST (focused assessment with sonography for trauma) is an ultrasound protocol developed to assess conditions such as pneumothorax, hemothorax, hemoabdomen, bladder rupture, and organ damage due to trauma. It is performed at the time of presentation of a trauma patient for rapid diagnosis. The aim of this study is to compare the results of FAST and ATT (Animal Trauma Triage) scoring system, which are among the first triage examinations, and to determine whether they support each other. Material of the study consisted of 50 dogs (different breed, sex and age) presented in years between 2019-2020 to Selcuk University, Faculty of Veterinary Medicine, Department of Surgery Clinics with trauma history within 24 h. FAST and ATT scoring system were performed for each dog. ATT score of 50 traumatized dogs was evaluated by dividing into 3 categories; ATT scores of 21 dogs were good (0-5), 19 dogs were moderate (6-11), and 10 dogs were poor (12-18). Thoracic and abdominal abnormal findings were detected by T-FAST in 12 dogs (24%) and by A-FAST in 10 dogs (20%). Spearman correlation analysis showed there was no significant association between ATT score and A-FAST ($r=0.04$, $P=0.75$), and ATT score and T-FAST ($r=0.140$, $P=0.33$) in traumatized dogs. In conclusion, FAST should be performed for urgent diagnosis of possible thoracic or abdominal pathological findings in traumatized dogs, regardless of ATT score.

Keywords: Dog, FAST, Focussed sonography, Trauma, ATT

Travmalı Köpeklerde Travma İçin Sonografi İle Odaklı Değerlendirme Protokolü ve Hayvan Travma Triyajı Skorumunun Karşılaştırılması

Öz

FAST (travma için odaklanılmış sonografi) travmaya bağlı pnömotoraks, hemotoraks, hemoabdomen, idrar kesesi rupturu, organ hasarı gibi durumların değerlendirilmesi için geliştirilmiş bir ultrasonografi protokolüdür. Hızlı teşhis için travma hastasının sunumu sırasında uygulanır. Çalışmada travmatize olmuş köpeklerde ilk triyaj muayenelerinden FAST ve ATT (Animal Trauma Triage) skorlama sistemi sonuçları karşılaştırılarak, bu önemli triyaj muayene yöntemlerinin birbirlerini destekleyip desteklemediklerinin belirlenmesi amaçlanmaktadır. Çalışma materyalini; 2019-2020 yılları arasında Selçuk Üniversitesi Veteriner Fakültesi Cerrahi Kliniği'ne travma şikayeti ile getirilmiş farklı ırk, cinsiyet ve yaşta 50 köpek oluşturdu. Travma sonrası üzerinden 24 saat geçmemiş köpekler çalışmaya dahil edildi. FAST ve ATT skorlama sistemi her bir hayvan için uygulandı. Travma geçiren 50 köpeğin ATT skorlaması 3 kategoriye ayrılarak değerlendirildi; 21 köpeğin ATT skoru iyi (0-5), 19 köpeğin ATT skoru orta (6-11) ve 10 köpeğin ATT skoru kötü (12-18) bulundu. 12 köpekte (%24) T-FAST muayenesinde toraks bölgesinde, 10 köpekte (%20) A-FAST muayenesinde abdominal bölgede anormal bulgular belirlendi. Spearman korelasyon analizi, travmalı köpeklerde ATT skoru ve A-FAST ($r=0.04$, $P=0.75$) ile ATT skoru ve T-FAST ($r=0.140$, $P=0.33$) arasında önemli bir ilişki olmadığını gösterdi. Sonuç olarak, travma geçiren köpeklerde ATT skoru ne olursa olsun, olası torasik veya abdominal patolojik durumların acil olarak saptanması için FAST uygulanması gerektiği sonucuna varıldı.

Anahtar sözcükler: FAST, Köpek, Odaklı sonografi, Travma, ATT

INTRODUCTION

Since the 1990s, focused assessment with sonography for trauma (FAST) has been the primary care, standard care and

screening technique in many algorithms for both blunt and penetrating trauma in humans^[1-4]. FAST aims to diagnose the lesions that require urgent intervention such as pneumothorax, hemothorax, hemoabdomen, bladder

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(*) Corresponding Author

Tel: +90 555 042 9183

E-mail: kparlak@selcuk.edu.tr (K. Parlak)



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rupture and organ damage due to trauma [2,5-9]. The advantage of FAST is a rapid diagnosis with minimal manipulation. Previous studies have shown clinical utility in diagnosing and managing intraabdominal and intrapleural injuries due to trauma in dogs and cats [2,5,6,10-14]. The increasing range of critical care qualifications available and expectations of patient owners have led to the use of FAST in animals as well as in humans [15]. In veterinary medicine, the term "T-FAST" is used for the thoracic region, and "A-FAST" for the abdominal region [16].

Animal trauma triage (ATT) score is used to measure illness severity that numerically classifies the degree of trauma in an attempt to quantify mortality risk probability in veterinary medicine [17]. ATT has been widely utilized in veterinary medicine, both clinically and in clinical research settings [18]. ATT score is based on a 0-3 scale (0 being slight or no injury, 3 indicating severe injury) with assessment of 6 independent components (perfusion, cardiac, respiratory, eye/muscle/skin, skeletal, and neurologic) that contribute equally to the overall predictive score [17].

In veterinary medicine, FAST and ATT scoring system are performed during the first triage at the time of presentation of a trauma patient and provide information about the prognosis [19,20]. The aim of this study is to compare the results of FAST and ATT scoring system, which are among the first triage examinations, and to determine whether they support each other.

MATERIAL AND METHODS

Ethical Statement

This study was approved by Selcuk University, Faculty of Veterinary Medicine, Laboratory Animal Production and Research Center Ethics Committee (SUVDAMEK) (2019/43). Patient owners of all cases signed an informed consent form.

Animals and Examinations

Material of the study consisted of 50 dogs (different breed, sex and age) presented in years between 2019-2020 to Selcuk University, Faculty of Veterinary Medicine, Department of Surgery Clinics with a trauma history within 24 h.

Initially, traumatized dogs were scored with ATT [21]. Appropriate stabilization was provided in order to ensure the care of the patient. Six independent components (perfusion, cardiac, respiratory, eye/muscle/skin, skeletal, and neurologic) were evaluated in ATT for each patient [17,21]. Scores between 0 and 3 are given for each category. According to the urgency of their clinical condition, following intravenous catheter insertion, one-fourth of the shock dose (20-30 mL/kg/h) intravenous (IV) fluid lactated Ringer's solution (over 15 min), methylprednisolone (4 mg/kg, IV) (Prednol-L®, Mustafa Nevzat, Turkey) administered

for the initial medical management and patient reassessed. O₂ therapy (5 L/min flow rate) was performed to patients via facemask and cefazolin (25 mg/kg, IV) (Ilespor®, Ibrahim Etem, Turkey) was administered as antibiotic therapy. Also, tightly fitting mask was switched out periodically to prevent rebreathing of carbon dioxide. Normalized patients were moved for radiographic examination. According to performed examinations; thoracocentesis, thoracostomy tube insertion or surgery was performed [22,23].

FAST (A-FAST, T-FAST) Procedure

During these therapies, sonographic examination (EDAN DUS 60/USA) was performed for A-FAST and T-FAST of the traumatized dog in lateral recumbency. Left or right lateral recumbency was determined depending on rib or vertebral fractures [5,24]. For A-FAST, the ultrasound probe was set to 5-7.5 megahertz (MHz) and the transducer depth to 5-10 cm depending on the size of the patient. For T-FAST, the probe was set to 7.5 MHz and the transducer depth to 4-6 cm [24]. In the sonographic examination, the imaging areas were opened by separating the hair only and using alcohol. However, the area was clipped in cases where the animal's coat was impairing the imaging.

A-FAST examination started from the diaphragmatico-hepatic (DH) site by placing the ultrasound probe on the subxiphoid area and possible evaluations were made. Following DH site, the splenorenal (SR) view was examined by placing the probe on the left side of the dog under the last rib, cysto-colic (CC) view was examined by placing the probe on the bladder and hepato-renal (HR) view was examined by placing the probe close to the umbilical region on the right side. In all these views, the probe was oriented in several directions at different angles until the target organs were identified. Right and left kidneys, spleen, intestine, bladder rupture and peritoneal free fluid (intra-abdominal hemorrhage) were evaluated and noted in the sonographic examination of these views.

In T-FAST examination, bilateral chest tube site (CTS) (both sides of the chest between 7-9th intercostal spaces), bilateral pericardial chest site (PCS) (bilaterally on the heart between 5-6th intercostal space) and DH site (from subxiphoid area) were examined. The probe was moved between every few centimeters on the intercostal spaces to increase the chance of detection of pericardial and pleural fluid. The short and long axes of the heart were visualized by directing the probe "towards the elbow" and "towards the spine". Pneumothorax, hemothorax, pulmonary contusion and hemopericardium were evaluated in T-FAST.

Radiographic Examination

Normalized dogs were moved to radiographic examination after the IV fluid and O₂ therapies. Examinations (Konica Minolta, Regius 110, JAPAN) were performed for abdomen and thorax in the latero-lateral, dorso-ventral and ventro-

dorsal positions according to the clinical conditions of the dog.

Statistical Analysis

Statistical analysis was performed using the statistical package (SPSS 25.0, IBM Corp. 2017). ATT scoring was divided into 3 categories (good 0-5, moderate 6-11, poor 12-18) in terms of prognosis. The Spearman correlation test was used for detection of correlation between A-FAST, T-FAST and ATT. Statistical significance was considered as $P < 0.05$.

RESULTS

In the study, 50 traumatized dogs of different breeds, ages (mean age 12 ± 1 months) and gender (29 males-21 females) were evaluated. All dogs had trauma due to a motor vehicle accident. A-FAST and T-FAST procedures were generally performed in 10-25 min. The fastest and easiest examination areas were the diaphragmatico-hepatic, cysto-colic and chest tube sites in the FAST procedures.

The sign of abdominal effusion was observed in 10 dogs by A-FAST of 50 traumatized dogs. In the remaining 40 dogs, the sign of effusion was not established. However,

because of reduced abdominal serous detail in radiographic examination, development of effusion was suspected in 15 dogs (Fig. 1, Fig. 2). Also, no rupture was detected, and normal anatomical structure of the bladder was seen in the A-FAST of 50 dogs.

According to the T-FAST examinations of 50 traumatized dogs; B-Line (interstitial-alveolar pulmonary pathology) was detected in 9 dogs. There was no glide sign (pneumothorax positive) in 2 dogs. The step sign (partial PTX, hemothorax, rib fractures, intercostal muscle tear, pulmonary contusions) was detected in 1 dog (Fig. 3). In the radiographic examination of the thorax; pneumothorax in 10 dogs, pleural effusion in 1 dog and pulmonary contusion (Fig. 4) in 7 dogs were diagnosed. In a patient with multiple pathological findings, the step sign was also detected by FAST examination (Table 1). The step sign, which is observed in pulmonary contusion, was confirmed by the observation of pathology in the lungs during necropsy (Fig. 5).

The ATT scores of the 50 traumatized dogs were divided into 3 categories and evaluated. Results of ATT scoring system for 21 dogs were good (0-5), 19 dogs were moderate (6-11) and 10 dogs were poor (12-18). A Spearman correlation analysis demonstrated that there was no significant

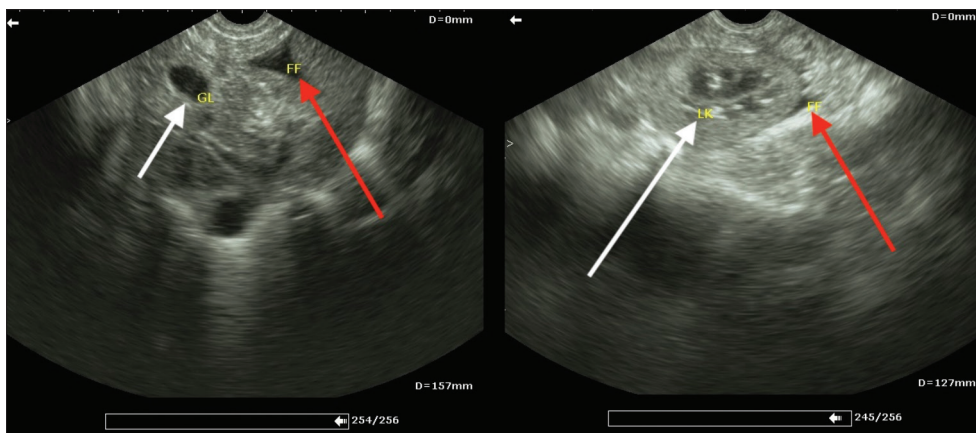


Fig 1. Abdominal effusion in A-FAST. Free fluid (red arrows) image above the gallbladder (white short arrow) and left kidney (white long arrow)

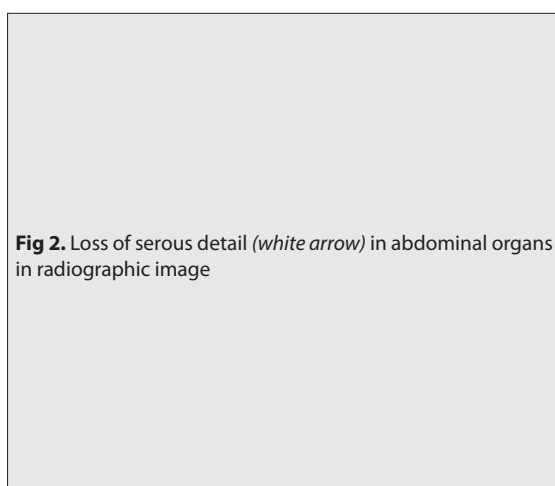
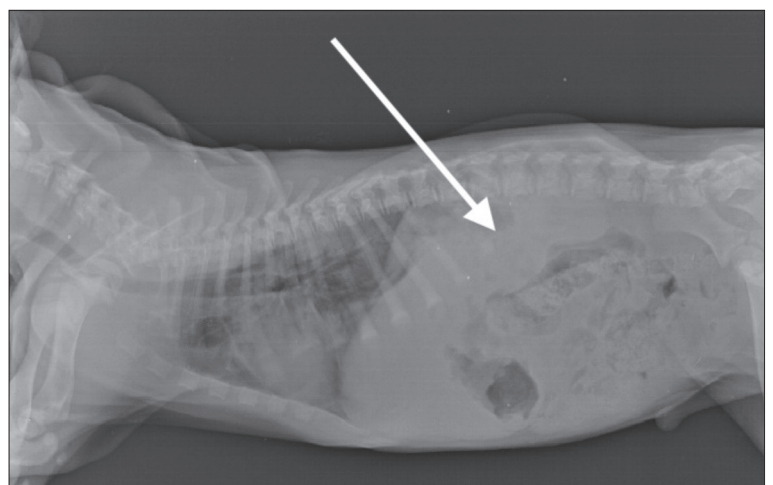


Fig 2. Loss of serous detail (white arrow) in abdominal organs in radiographic image



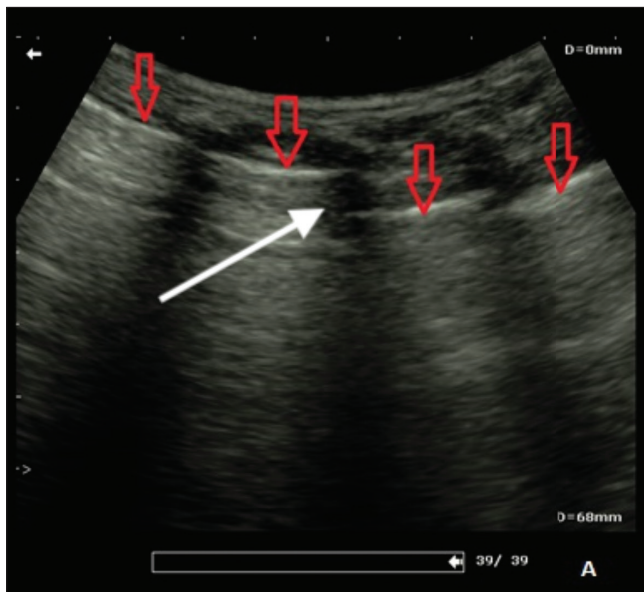


Fig 3. Step Sign (white arrow) in T-FAST (red arrows: pleural lines)

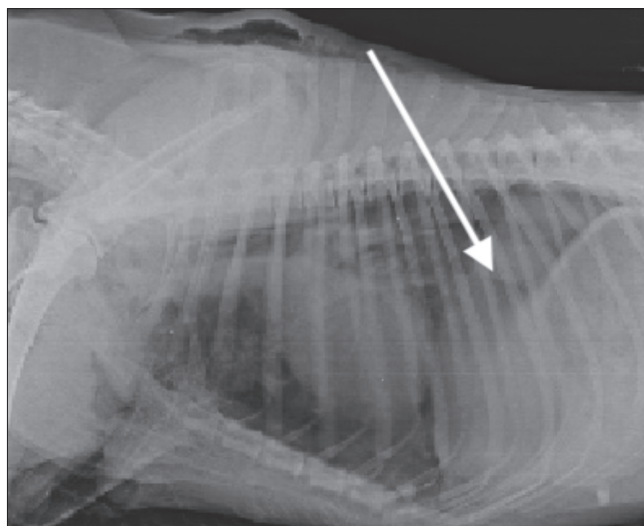


Fig 4. Radiographic view in case of pulmonary contusion (white arrow)

association between ATT score and A-FAST ($r=0.04$, $P=0.75$), and ATT score and T-FAST ($r=0.140$, $P=0.33$) in traumatized dogs.

DISCUSSION

In recent years, motor vehicle accidents cause high mortality rates for both people and animals due to excessive urbanization and advancing technology. Particularly dogs, that live on the street and can establish close relationships with people, are highly affected [18,25,26]. For this reason, traumatized animals with motor vehicle accident history in the emergency clinics are increasing day by day. Therefore, it is not surprising that all traumatized dogs, which were evaluated in our study, had a “motor vehicle accident” history. The fact that post-traumatic A-FAST and T-FAST procedures can be performed in 10-25 min indicates that the diagnosis of pathologies can be made rapidly in order to begin the correct treatment as soon as

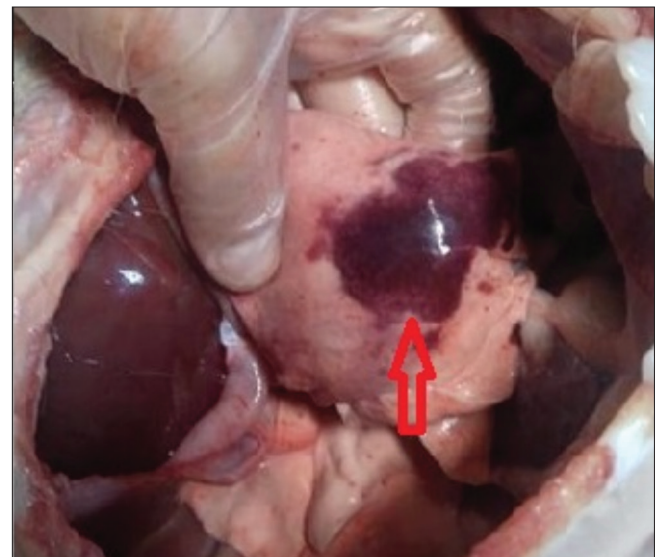


Fig 5. Pulmonary contusion (red arrow) during the necropsy

Table 1. Examination results by FAST, Radiography and ATT scores in 50 dogs following motor vehicle accident trauma

Procedures (n=50)	Results
A-FAST	Abdominal effusion (n=10, 20%)
Abdominal Radiography	Loss of serous detail (n=15, 30%)
T-FAST	Interstitial-alveolar pulmonary pathology (B-Line) (n=9, 18%) Pneumothorax (No glide sign) (n=2, 4%) Pulmonary contusion (step sign) (n=1, 2%)
Thorax Radiography	Pneumothorax (n=10, 20%) Pleural effusion (n=1, 2%) Pulmonary contusion (n=7, 14%)
ATT Score	Good (0-5) (n=21, 42%) Moderate (6-11) (n=19, 38%) Poor (12-18) (n=10, 20%)

A-FAST: Abdominal focused assessment with sonography for trauma; T-FAST: Thoracic focused assessment with sonography for trauma; ATT: Animal trauma triage

possible^[5,6,16,27]. In addition, unlike humans, dogs have a dense hair coat, which requires clipping for the FAST procedures. In the study, although the examination time of the FAST procedures took a long time at the beginning, with increasing experience, the procedure shortened. However, independent from experience, it has been observed that dogs with complex, long and dirty hair absolutely need shaving for proper FAST procedure.

Veterinary studies have also confirmed the applicability of the FAST procedure in the diagnosis of abdominal and pleural free fluid due to blunt trauma in dogs^[11]. In the evaluation of A-FAST of traumatized dogs, intra-abdominal damage, specifically hemoabdomen, was reported more frequently^[5,6]. In addition, the high sensitivity rate of T-FAST in traumatized dogs has shown that T-FAST can be used as the first screening method in blunt and penetrating traumas. It has been shown in previous studies to have a sensitivity of more than 75% in detecting pneumothorax in dogs after blunt trauma^[28,29]. However, it has been reported that this sensitivity rate may be higher when performed by a specialist physicians^[5]. The A-FAST examination requires more attention and experience in terms of fluid presence, according to our study. It is thought that determination of free fluid is more possible to interpretation since the presence of free fluid in thoracic radiographs conceals the apex of the heart due to gravity. In addition, radiography is one of the frequently used imaging methods in the diagnosis of pathologies that are common in dogs with trauma such as pneumothorax and pulmonary contusion.

The use of A-FAST has also been helpful in determining the integrity of the bladder. In FAST studies, it was stated that the probability of rupture is quite low when the bladder is viewed with a normal contour^[5,6]. In the subsequent radiographic examinations, the integrity of the bladder was confirmed, and this was supported by the literature data^[5,6].

Observation of a step sign referred to pleuropulmonary line continuity pathologies, such as intercostal tears, rib fractures, and subcostal hematoma^[16,28]. According to our study, allowed the confirmation of multiple pathologies, which were diagnosed with FAST procedures, by necropsy and showed that FAST procedures could be used significantly in complicated cases. In the FAST procedures, examination of the diaphragmatico-hepatic and chest tube sites was encountered as the most comfortable examination areas.

In the veterinary medicine, the "T" in "FAST" not only "Trauma", but also stands for "Triage" and "Tracking"^[16]. For this reason, it was investigated the ATT scoring system and FAST protocols, which are triage methods in veterinary emergency, whether superior to each other or whether complement each other. Many retrospective studies have been conducted on the ATT scoring system, and positive

prognostic data have been reported in the evaluation of dogs after trauma (survival rate, diagnosis and treatment protocols)^[17,21,25,30]. Ash et al.^[21] 599 dogs with complete data entries recruited into the Veterinary Committee on Trauma patient registry. Interventions: None. Measurements and Main Results: We compared the predictive power (area under receiver operating characteristic [AUROC]) reported that each 1-point increase in ATT score was associated with 2.07 increase in mortality rates. The observation of life-threatening multiple pathology findings in animals with high ATT scores in our study is consistent with the literature data. Rapid diagnosis and treatment of these pathologies can be achieved with FAST, and positive responses can even be obtained in animals with low probability of survival. However, in the ATT scoring system, only perfusion, respiratory and neurologic categories can show an equivalent performance. The findings obtained in our study are also similar to the literature, and it is recommended examining only the perfusion, respiratory and cardiac categories. Because the basic pathological signs (abdominal effusion, pleural effusion, pulmonary contusion, pneumothorax) determined in the FAST protocol are directly related to the respiratory, perfusion and cardiac systems.

Fast is thought to be a procedure that should be performed before radiography in determining rapid diagnosis and intervention methods (such as thoracocentesis, abdominocentesis) in dogs with trauma. It is important to gain experience by performing multiple abdominal and thoracic sonographies for successful FAST results. In addition, FAST does not prevent emergency interventions such as fluid-electrolyte therapy, administration of respiratory and circulatory analeptics to the traumatized dog during examination. This is especially important in emergency medicine for teamwork and rapid response.

As a result, in order for the FAST examination to be evaluated with ATT, it is thought that only respiratory, cardiac and perfusion categories should be considered and examined in the ATT scoring system for the traumatized dogs. Although FAST and ATT are considered as first triage examinations in emergency, FAST should be performed to determine the possible thoracic or abdominal pathological conditions, regardless of the ATT score.

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AUTHOR CONTRIBUTIONS

KP and NY, drafting and critically revising the study for important intellectual content. Final approval of the version to be published. NZ, EOU and ETA, make a significant contribution to the study concept or design; data collection, analysis or interpretation.

DECLARATION OF CONFLICT OF INTEREST

The authors declared that there is no conflict of interest.

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