White Paper

Protocols for **Emergency ultrasound examinations in dog**

esaote

A practical guide to the FAST protocol, the gold standard in veterinary emergency rooms, with a particular focus on abdominal and thoracic examinations.

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Introduction

Ultrasonography has become an increasingly indispensable diagnostic tool, also in emergency/urgency situations, which is why the demand for it is increasingly widespread. Since it is a non-invasive, easy-to-apply, and inexpensive procedure, it is undoubtedly one of the first instrumental investigations that people often choose to carry out.

It is a well known fact, however, that the method is highly dependent on the operator who performs it and on his/her technical ability, experience, and knowledge of the instrument used.

To enable non-specialist operators to use ultrasonography in emergency situations, the FAST protocols were devised (which must not be equated with the literal meaning of the term). FAST is in fact an acronym (Focused Assessment with Sonography for Trauma, Tracking, and Triage) rather than a synonym for "QUICK." It is indicated solely to identify the presence or absence of an effusion, but not for a rapid evaluation of the various organs, which would require highly trained and experienced specialists.

History

FAST ultrasonography in human medicine was introduced in the 1990s as part of the evaluation protocols for trauma patients, based on the concept that in such patients, the presence of fluid build-up in the pleural, abdominal, and pericardial cavities is associated with organ injury, whereas in non-trauma patients it is related to other pathologies. In the early 2000s, the protocol was extended to include the recognition of pneumothorax and possible pulmonary disease and the assessment of the extent of abdominal effusion was made more precise by introducing a scoring system.[1]

Again in the early 2000s, the same diagnostic scheme was also applied in veterinary medicine and was further characterized by the definition of specific protocols for the abdomen (A-FAST) and the thorax (T-FAST).[2,3,4]

A-FAST

Abdominal FAST ultrasonography in trauma patients, especially in hemodynamically unstable patients, is indicated to search for signs associated primarily with hemoperitoneum and uroperitoneum, which can be identified as layers of peritoneal effusion.[1] Free fluid tends to collect in the declivous portions and is identified sonographically as triangular-shaped, anechogenic, more or less corpusculated areas surrounded by the abdominal organs.

It is performed with the patient in the lateral decubitus position. Both decubitus positions are validated, with clinical evaluation of the positioning best tolerated by the animal. This is based on the use of four acoustic windows: diaphragmatico-hepatic (DH), spleno-renal (SR), cysto-colic (CC), and hepato-renal (HR) (Fig. 1). Estimated execution time ranges from 3 to 6 minutes.[4]

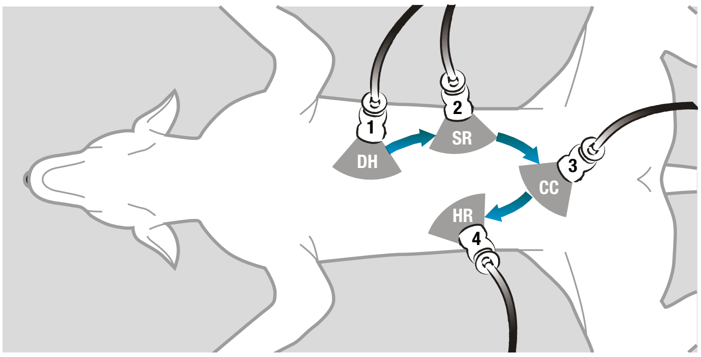


Fig. 1 Description of the A-FAST protocol at four points: diaphragmatico-hepatic (DH), spleno-renal (SR), cysto-colic (CC), and hepato-renal (HR). By performing them clockwise, the last acoustic window approached is most likely to be positive, since it has been in the declivous position for a longer time.[3]

Positioning the probe longitudinally over the retroxiphoid region will display the diaphragmatico-hepatic (DH) window. This type of scan can also provide an initial visualization of a possible pleural effusion. In fact, the DH projection is included in both the A-FAST and T-FAST protocols.[4] (Fig. 2)

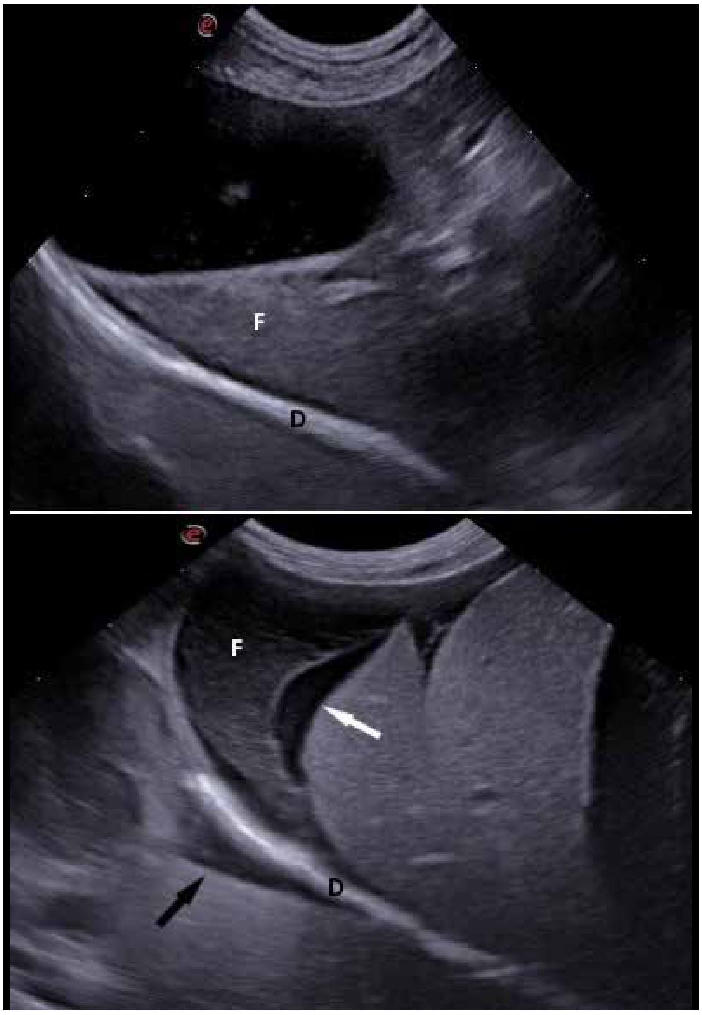


Fig. 2 DH window: above normal, below positive for peritoneal effusion (white arrow) and pleural effusion (black arrow), "F" liver and "D" diaphragm

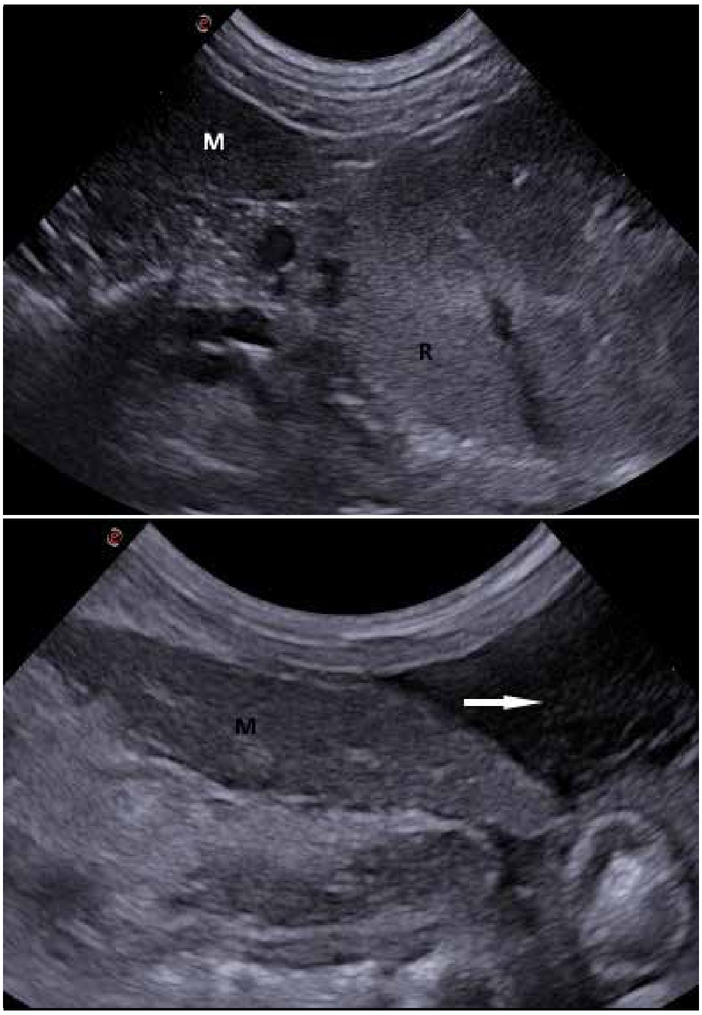


Fig. 3 SR window: above normal, below positive for peritoneal effusion (white arrow), "R" kidney and "M" spleen

Positioning the probe against the left flank, again with a longitudinal orientation, will display the spleno-renal (SR) window (Fig. 3).

With a longitudinal approach along the linea alba, cranially to the pubic margin, the cysto-colic (CC) window is visualized (Fig. 4),

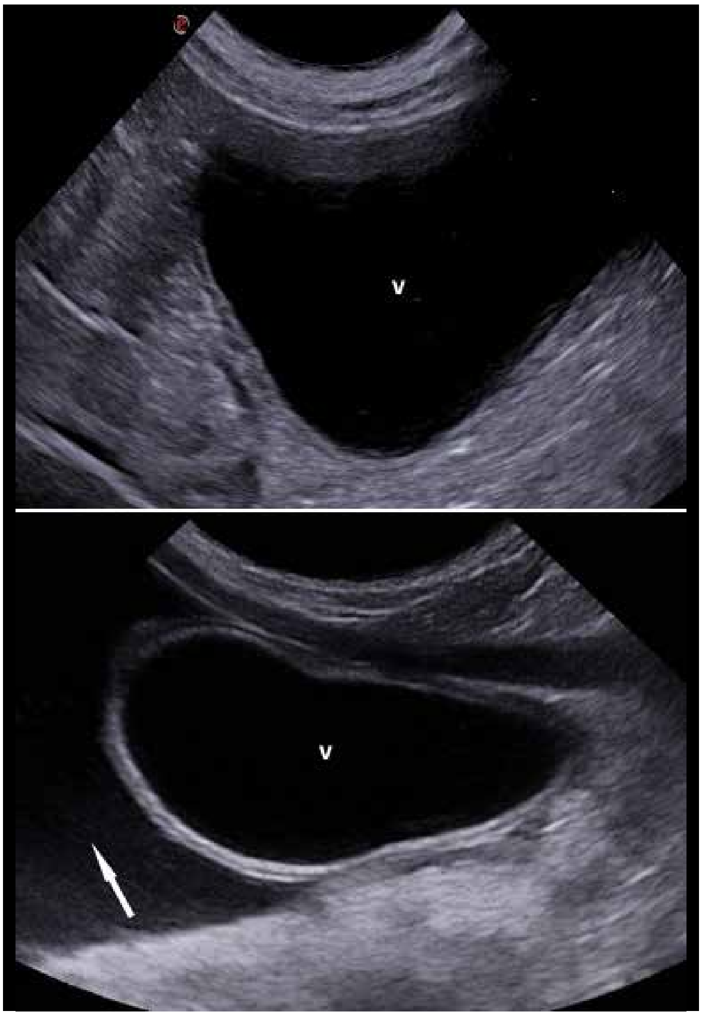


Fig. 4 CC window: above normal, below positive for peritoneal effusion (white arrow), "V" bladder

Fig. 5 HR window: above normal, below positive for peritoneal effusion (white arrows), "F" liver and "R" kidney

Finally, with an approach from the right flank, along the longitudinal axis, caudal to the last rib, we will obtain an image of the hepato-renal (HR) window. (Fig. 5)

The scoring system, known as the Abdominal Fluid Score (AFS) assigns one point for each site where effusion is found, and therefore ranges from 1 to 4. It is used to obtain a semi-quantitative assessment of the extent of peritoneal effusion and to monitor its progress in canine patients. However, it has not been found to be reliable in cats.[5] A-FAST every 4 h is indicated in trauma patients and even more frequently in cases where clinical and hemodynamic instability is detected.[4]

It is impossible to identify the type of fluid by ultrasound alone. Therefore, it is generally recommended to perform fine-needle aspiration to determine the type of fluid so that the clinical case can be managed correctly afterwards, as indicated by the diagram in Figure 6.[4] However, it seems logical that in patients with AFS 1-2, the location of the effusion may give an indication of its potential origin, especially when associated with an assessment of the presence and integrity of certain organs such as the bladder and gallbladder.[3]

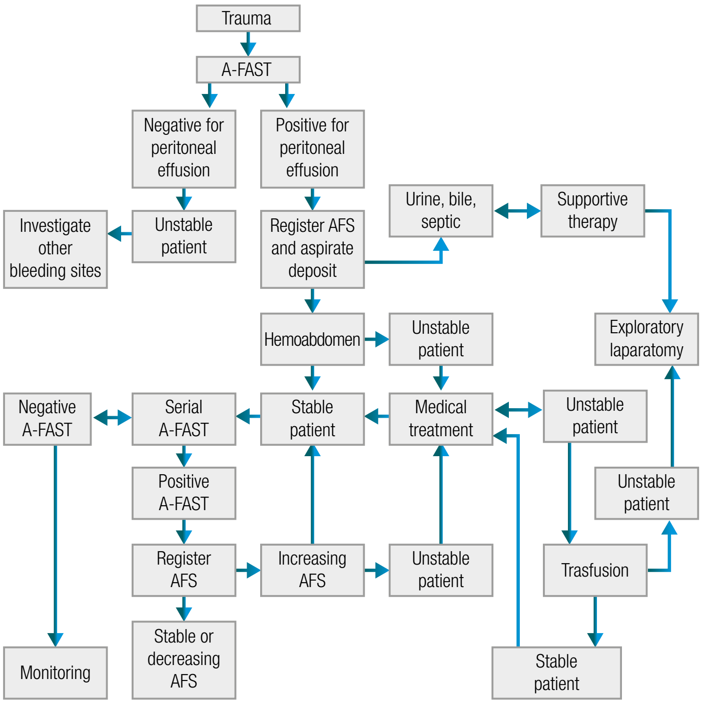


Fig. 6 Algorithm applicable to cases of dogs with blunt trauma[4]

T-FAST

The FAST protocol for thoracic examinations is indicated for the detection of pleural effusion, pericardial effusion, and pneumothorax, for which it has a specificity comparable to CT and even higher sensitivity[6]. Performing it entails positioning the patient in lateral decubitus and bilateral scanning of the thorax, with the probe positioned along the longitudinal axis, using 5 acoustic windows: through the seventh and ninth intercostal space (CTS) for an examination of the pulmonary fields, through the fifth and sixth intercostal space for an examination of the pericardium (PCS), transdiaphragmatic in retroxiphoid position using the DH projection of the A-FAST examination (Fig. 7).[1]

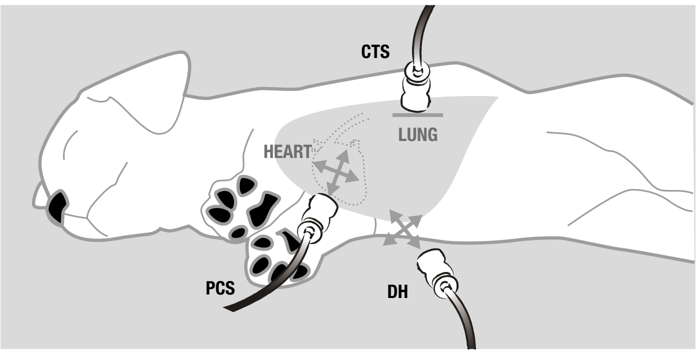


Fig. 7 Schematic diagram of probe positioning for performing the five-point TFAST protocol[4]

The normal appearance of the pulmonary fields in the ultrasound is caused by reverberation artifacts of the pleuro-pulmonary interface (A-lines) and the acoustic shadows of the ribs (gator or bat sign). (Fig. 8)

In the dynamic image, the "glide sign" i.e. the sliding movement of the visceral pleura over the parietal in the case of a normally ventilated lung with a regular surface, is of fundamental importance.[7]

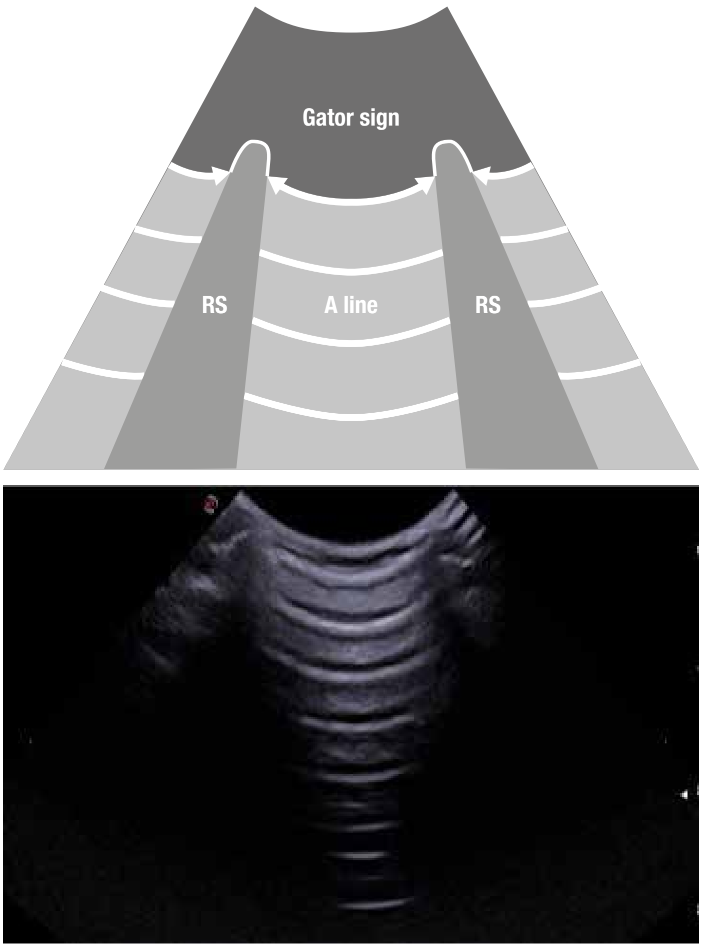
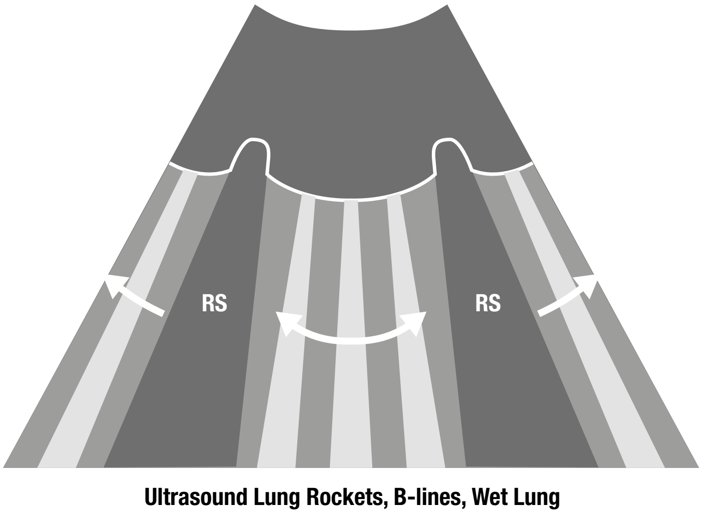
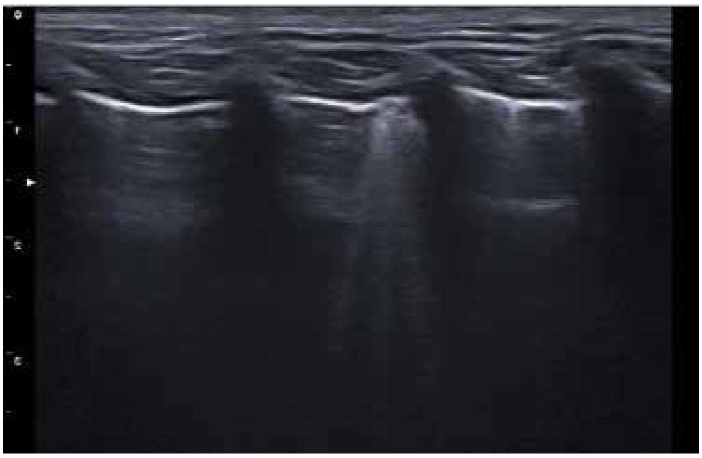


Fig. 8 Ultrasound appearance of normal pulmonary fields (drawing from[1])

B-lines are a type of reverberation artifact. If sporadic, they are considered normal, but if present in greater numbers they are indicative of interstitial-alveolar pathology. These are hyperechogenic lines originating in the visceral pleura and extending to the deep field, moving synchronously with the glide sign. Their appearance in traumatized subjects is indicative of pulmonary contusion[7] and is known colloquially as "wet lung." (Fig. 9)





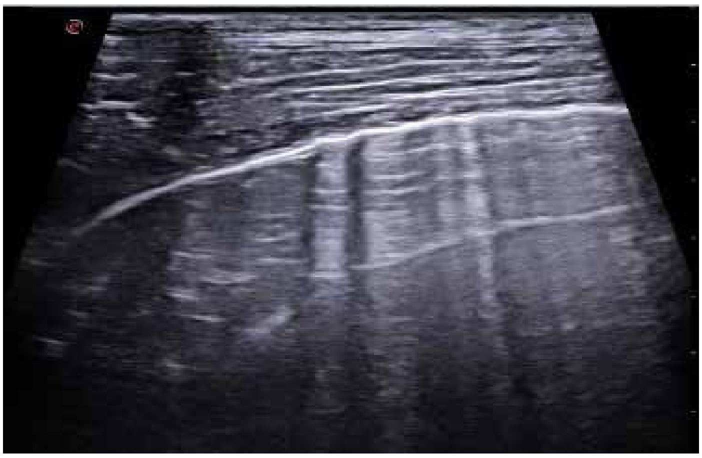


Fig. 9 Sporadic and diffuse B-lines (drawing from[1])

Pneumothorax is diagnosed if there is no evidence of the "glide sign" and no B-lines originating in the visceral pleura, which are prevented from forming.[4,6,7] The severity of the pneumothorax is assessed by moving the probe along the intercostal space from ventral to dorsal until the "glide sign" is recognized at the point where contact is restored with the visceral pleura, known as the "lung point"[6] (Fig. 10).

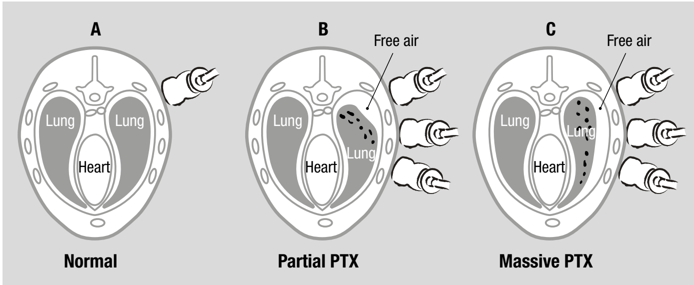


Fig. 10 Thoracic scan with "lung point" detection in order to quantify the extent of pneumothorax[6]

Absence of the "glide sign" and A-lines in favor of the presence of more or less echogenic fluid which, if abundant, allows the intrathoracic structures to be visualized, allows a diagnosis of pleural effusion to be made. (Fig. 11)

Fig. 11 An intercostal approach below the thoracic wall (P) shows the presence of a moderate amount of anechogenic pleural effusion (arrow), which makes the heart clearly visible (C).

Using both intercostal and transdiaphragmatic approaches increases sensitivity in detecting pleural and especially pericardial effusions. This is also because, through the DH window, the liver and gallbladder act as an acoustic window for the heart, avoiding artifacts due to intrapulmonary air. It also increases sensitivity in distinguishing pericardial effusions from pleural effusions and dilated cardiac chambers, reducing the likelihood of errors if a pericardiocentesis is required.[4,10] (Fig. 12)

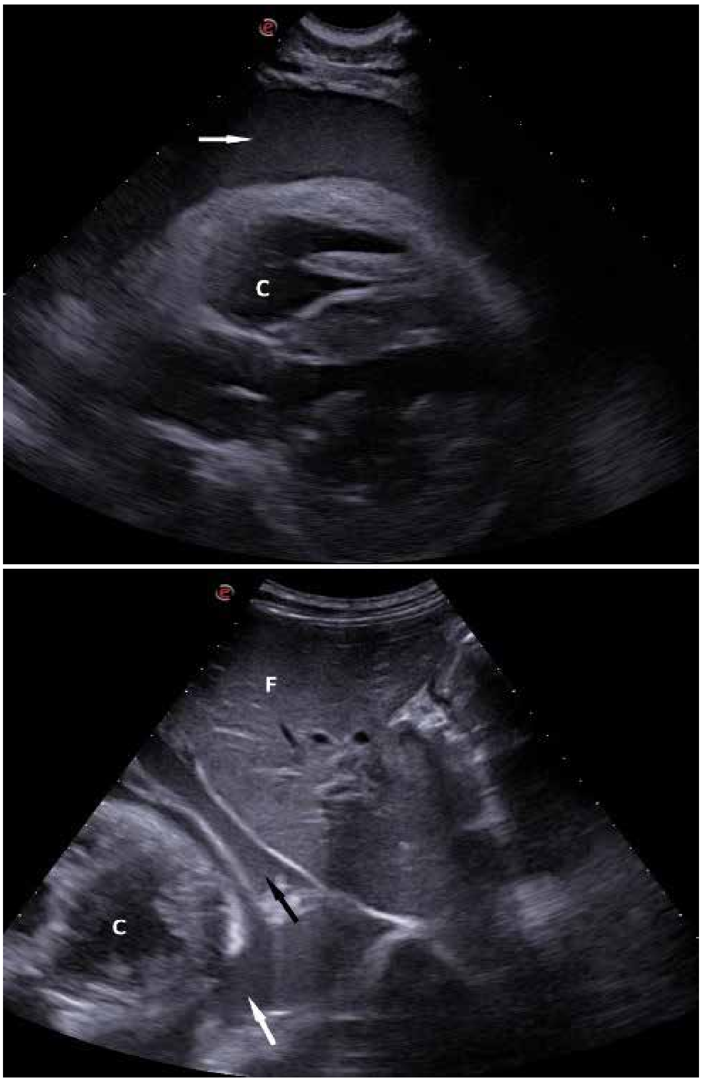


Fig. 12 "C" heart, "F" liver. Corpuscular pericardial effusion (white arrow) evidenced by the PCS (top figure) and DH (bottom figure) approach, through which it can be distinguished from pleural effusion (black arrow)

Interventional procedures

Thoracentesis and pericardiocentesis have both a diagnostic and therapeutic function in the case of respiratory distress and cardiac tamponade respectively, the latter being identified sonographically as the collapse of the right atrium and/or ventricle in the diastolic phase. (Fig. 13) Intrapericardial pressure depends not only on the amount of fluid that has accumulated, but also on its rate of formation and the physical characteristics of the pericardium. Small volumes of pericardial effusion accumulating over a short period of time cause a rapid increase in intrapericardial pressure, whereas large volumes of fluid accumulating over a longer period of time may not cause significant hemodynamic imbalances, even for a long time.[11]

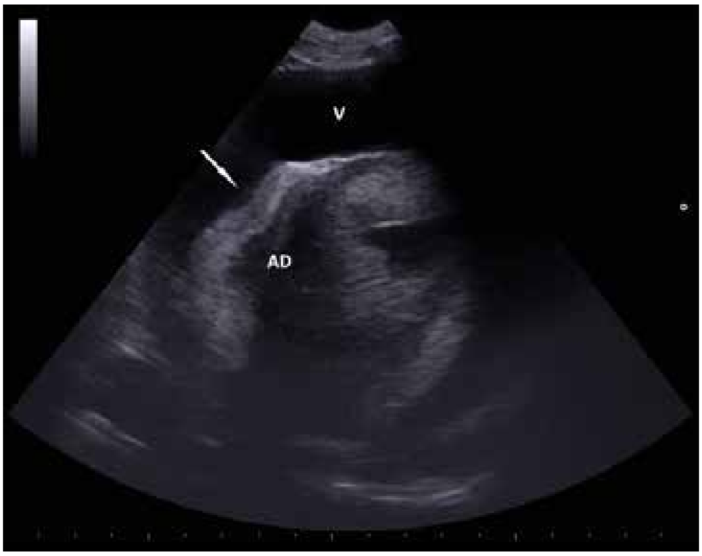


Fig. 13 Pericardial effusion (V) with evidence of collapse (arrow) of the right atrium (AD)

All interventional procedures should be performed after thorough surgical preparation of the field using sterile technique, resulting in relatively safe maneuvers with a low incidence of complications. Thoracentesis is performed via intercostal approach, using 20-22G needles attached to a three-way extension to which a syringe is connected.

Pericardiocentesis should be performed with the patient in left lateral decubitus, using a right intercostal approach, to avoid accidentally tearing the extramural coronary artery. In dogs, the use of a 14-18G catheter connected to a syringe by an extension tube is recommended, while in cats, the use of a 22G butterfly is recommended. The catheter should preferably be inserted dorso-cranially to minimize the risk of accidental puncture of the heart and by applying gentle negative pressure with the syringe plunger. Complications of pericardiocentesis are generally rare; sedation may be necessary to reduce the incidence, especially in feline patients.[8-11]

Conclusions

The increasingly widespread use of FAST protocols has undoubtedly greatly increased diagnostic sensitivity in critically ill patients and allows their constant close monitoring. It has become an integral part of the clinical evaluation of patients admitted to intensive care. However, it should not be forgotten that these rapid scanning protocols have precise indications and applications, so they cannot be considered as rapid alternatives for a full specialist ultrasound scan.

Bibliography

1. Gregory R. Lisciandro, DVM, DABVP, DACVECC *Abdominal and thoracic focused assessment with sonography for trauma, triage, and monitoring in small animals* Journal of Veterinary Emergency and Critical Care 21(2) 2011, pp 104–122
2. Boysen SR, Rozanski EA, Tidwell AS, et al. *Evaluation of focused assessment with sonography for trauma protocol to detect abdominal fluid in dogs involved in motor vehicle accidents*. J Am Vet Med Assoc 2004;225(8):1198–204
3. Lisciandro GR, Lagutchik MS, Mann KA, et al. *Evaluation of an abdominal fluid scoring system determined using abdominal focused assessment with sonography for trauma in 101 dogs with motor vehicle trauma.* J Vet Emerg Crit Care 2009;19(5):426–37
4. Søren R. Boysen, DVMa, *, Gregory R. Lisciandro, DVMb *The Use of Ultrasound for Dogs and Cats in the Emergency Room AFAST and TFAST* Vet Clin Small Anim 43 (2013) 773–797
5. Lisciandro G. *Evaluation of initial and serial combination focused assessment with sonography for trauma (CFAST) examination of the thorax (TFAST) and abdomen (AFAST) with the application of an abdominal fluid scoring system in 49 traumatized cats.* Abstract J Vet Emerg Crit Care 2012;22(2):S11.
6. Gregory R. Lisciandro, DVM, DABVP, Michael S. Lagutchik, DVM, MS, DACVECC, Kelly A. Mann, DVM, MS, DACVR, Andra K. Voges, DVM, DAVCR, Geoffrey T. Fosgate, DVM, PhD, DACVPM, Elizabeth G. Tiller, DVM, Nic R. Cabano, DVM, Leslie D. Bauer, DVM and Bradley P. Book, DVM, DABVP *Evaluation of a thoracic focused assessment with sonography for trauma (TFAST) protocol to detect pneumothorax and concurrent thoracic injury in 145 traumatized dogs* Journal of Veterinary Emergency and Critical Care 18(3) 2008, pp 258–269
7. Deborah Silverstein Kate Hopper *Small Animal Critical Care Medicine* 2nd edition Saunders 2014
8. Dominique Penninck, Marc-André d'Anjou *Atlas of small animal ultrasonography* 2nd edition Blackwell 2015
9. Tobias Schwarz, Victoria Johnson BSAVA *Manual of canine and feline thoracic imaging*
10. G.R Lisciandro *The use of the diaphragmatico-hepatic (DH) views of the abdominal and thoracic focused assessment with sonography for triage (AFAST/TFAST) examinations for the detection of pericardial effusion in 24 dogs (2011–2012)* Journal of Veterinary Emergency and Critical Care 26(1) 2016, pp 125–131 doi: 10.1111/vec.12374.
11. J. Gidlewski, JP Petrie *Therapeutic Pericardiocentesis in the dog and Cat* Clin Tech Small Anim Pract 20:151-155 © 2005 Elsevier Inc

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