

Case-Based Applications of Abdominal FAST (AFAST) and Its AFAST-Applied Fluid Scoring System (AFS) for Trauma, Triage and Tracking I and II

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INTRODUCTION

The clinical utility of AFAST³ and the applied fluid scoring system trauma, triage (non-trauma) and tracking (monitoring) cases in the emergent and critical care settings (Lisciandro *et al.* 2009; Lisciandro 2011; Boysen, Lisciandro 2013; McMurray *et al.* 2014) will be reviewed. The T³ designation encompasses these 3 subsets (Lisciandro 2011; Boysen, Lisciandro 2013) and avoids the onslaught of confusing acronyms in human medicine in which similar abbreviated formats are given different acronyms when applied to different subsets of human patients (Lisciandro 2011). Thus, AFAST³ becomes a universal term that has exact clarity in the 4-acoustic windows used by the veterinary sonographer.

The AFAST³ ultrasound format has greater potential to positively guide clinical course and improve patient outcome by detecting conditions and complications otherwise occult based on traditional means of physical examination, laboratory and radiographic findings, and avoiding the delay associated with modes of more advanced imaging (jeopardizing patient care). Finally, AFAST³ findings are made more clinically relevant for the clinician, client, and referring veterinarian, by using a standardized ultrasound format (AFAST³), and standardized goal-directed templates for medical records (see below) (Lisciandro 2011; Boysen, Lisciandro 2013).

TERMINOLOGY

In the human literature, there has been a confusing onslaught of multiple acronyms for similar ultrasound examinations by non-radiologists (i.e., FFAST, EFAST, HHFAST, BOAST, INBU, FEEL, FALLS, FATE, RUSH, etc.) Veterinarians would be best served by using AFAST³, TFAST³ (thoracic) and Vet BLUE (lung exam) with T³ for Trauma, Triage and Tracking (monitoring). When all 3 formats are used together, the exam is referred to a Global FAST³ or GFAST³ (Boysen, Lisciandro 2013). Because any of the three GFAST³ ultrasound format (AFAST, TFAST, and Vet BLUE) may be diagnostic, the author suggests that comprehensive exams of the abdomen and thorax be designated as "complete abdominal ultrasound" and "complete echocardiography" respectively, similar to the human literature (formal used instead of complete). Finally, terms such as "focused" and "targeted" and "COAST³" (cage-side organ assessment with sonography for trauma, triage and tracking) have been used for specific sonographic interrogation of organs in both human and veterinary medicine.

PATIENT POSITIONING AND PREPARATION

Right lateral recumbency is recommended because right lateral recumbency is the standard positioning for electrocardiographic and echocardiography evaluation; the left kidney at the SR view is more easily and reliably imaged (vs. the more cranially located right kidney often under the rib cage); and the gallbladder via the DH view is readily imaged by directing the probe slightly toward the table top. Lastly, the spleen located predominantly left of midline is arguably less apt to incur iatrogenic puncture via abdominocentesis. AFAST³ should not be performed in dorsal recumbency because it invalidates the fluid scoring system and jeopardizes injured and critically ill patients by compromising their respiratory status and venous return. Fur is **not** shaved but rather parted and alcohol and/or gel applied. Alcohol should not be used if electrical defibrillation is anticipated.

SCHEMATIC OF THE AFAST³ (ABDOMINAL) ULTRASOUND EXAM

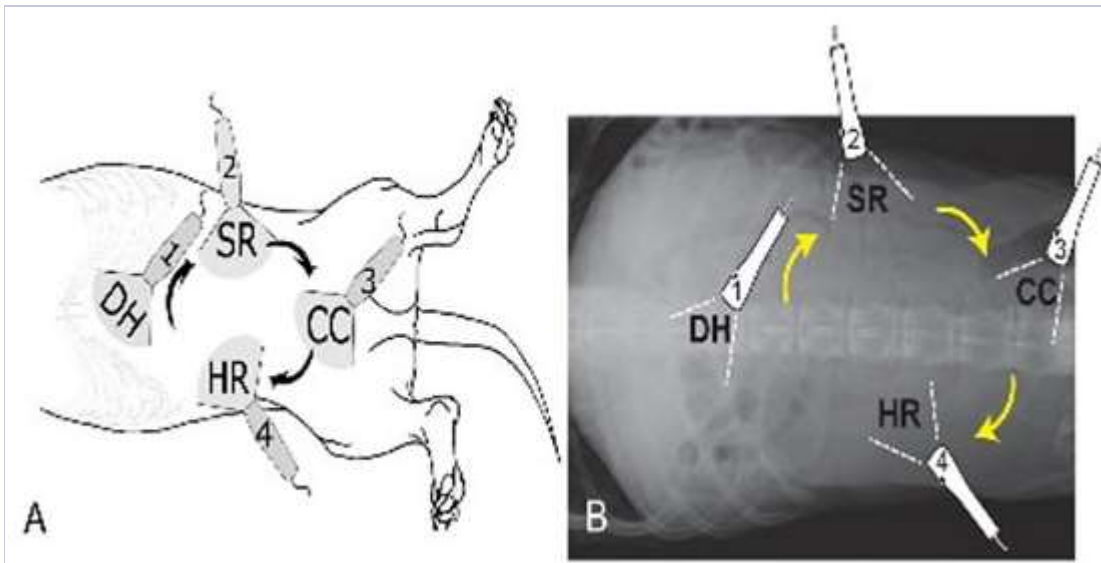


Figure 1. Schematic and translational representation of AFAST³

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The AFAST³ sites (right lateral recumbency is preferred but left lateral is acceptable. To the right of the pictorial labeled A) is a translational depiction on an abdominal radiograph of a dog. The AFAST³ should always be performed in a standardized counterclockwise manner as follows: 1) Diaphragmatic-hepatic (DH) view also used to image the pleural and pericardial spaces 2) Spleno-renal (SR) view also used as a window into the retroperitoneal space 3) Cysto-colic (CC) view and 4) Hepato-renal (HR) view which completes the AFAST³ exam. The HR view in higher-scoring dogs and cats is often a favorable site for abdominocentesis. All AFAST³ views are performed in the longitudinal (sagittal) orientation because it is easier to appreciate the anatomy of the respective target organs and less confusing especially for the novice sonographer. Importantly, Boysen *et al.* showed that when comparing longitudinal (sagittal) to transverse views, they matched 399/400 times. Thus, keeping it simple with fanning through only longitudinal expedites the learning process.

AFAST³-APPLIED FLUID SCORING SYSTEM

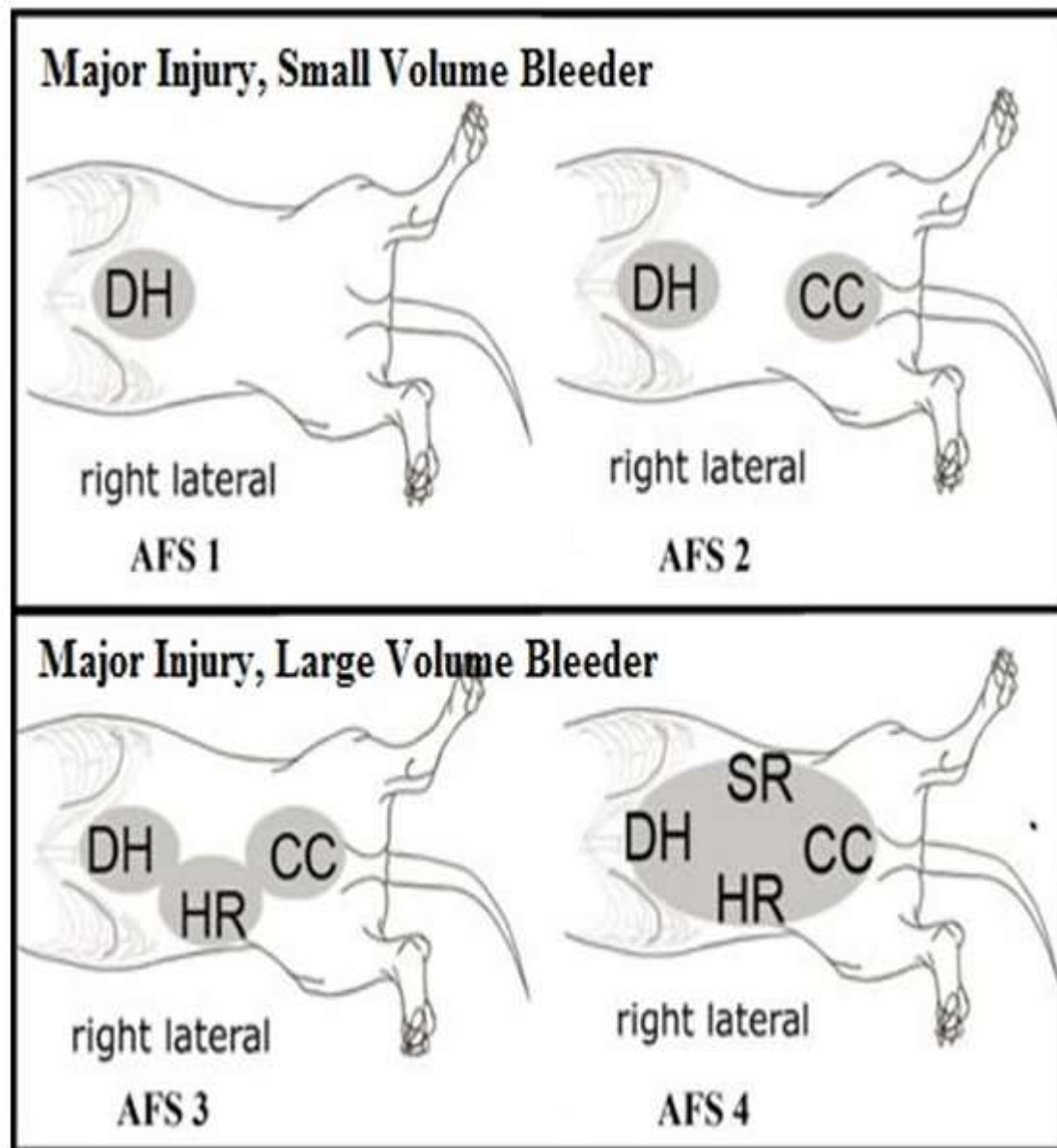


Figure 2. The AFAST³-applied fluid scoring system is defined as follows (4-point scale): abdominal fluid score (AFS) of 0 (AFS 0) means negative at all 4 views to a maximum score of AFS 4 means positive at all 4 views. Low-scoring AFS1 and 2, are considered major injury, small volume bleeders. High-scoring AFS 3 and 4, considered major injury, big or large volume bleeders.

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USE OF SERIAL AFAST³ EXAMS AND DETERMINING THE AFS

The use of serial AFAST³ and serial application of the abdominal fluid score is imperative to maximize information and improve sensitivity of the exam including searching for fluid, assessing the abdominal fluid score (0–4), and evaluating the presence or absence of the urinary bladder. The author performs 4-hour post-admission serial AFAST and AFS in all stable patients (sooner if unstable); and serial FAST exams are standard of care in human medicine (American College of Emergency Physicians Guidelines [2001]).

TRAUMATIC HEMOABDOMEN

The clinical utility of the AFAST³-applied fluid scoring system as predictor of anticipated degree of anemia and need for blood transfusion was shown in dogs with traumatic hemoabdomen (Lisciandro *et al.* 2009). Dogs with negative fluid scores (AFS 0), and as low-scorers (AFS 1 and AFS 2) that had no other sources of blood loss apparent on physical exam or AFAST³ and TFAST³ imaging (no free fluid in retroperitoneal, pleural and pericardial spaces), predictably did not develop anemia (no dogs were anemic on their admission packed cell volume [PCV]). For example, in dogs with normal admission packed cell volume, low-scoring AFS 1 and 2 dogs that remained AFS 1 and 2 during their hospitalization, rarely became anemic from their intraabdominal hemorrhage (and if anemia did occur it was mild > 30%). Therefore, a general guideline used by the author is that if the PCV < 30% in an AFS 1 or 2 dog (or cat), the attending should look elsewhere for the source of bleeding (retroperitoneal and pleural spaces, fracture sites), and only then consider the possibility of hemodilution. Although not determined in the AFAST³ study, clinicians should keep in mind that AFAST³ does not interrogate the intrapelvic region effectively and that significant bleeding in dogs and cats through pelvic fractures and femoral fractures is possible that could lead to anemia and missed by AFAST³ and TFAST³.

On the other hand, high-scoring AFS 3 and 4 dogs are more likely to develop anemia (~ 25% decrease in PCV from baseline [admission PCV]) with ~ 25% of high-scoring dogs becoming severely anemic (PCV < 25%); thus, are more likely to require blood transfusions (Lisciandro *et al.* 2009) and rarely emergent laparotomy (Lisciandro *et al.* 2009; Boysen *et al.* 2004). The AFAST³-applied fluid scoring system is simple and easy to remember and provides a semi-quantification of the degree of hemorrhage; and analogous hemorrhage scoring systems have been shown to also helpful in clinical-decision making regarding blood transfusion and need for surgery or advanced imaging in human patients. Importantly, bluntly traumatized (hit-by-car, kicked, stepped on, falls) dogs **rarely** need emergent laparotomy to control the hemorrhage and often are successfully managed with judicious fluid therapy and blood transfusion(s). Cats as a species typically do not survive large volume bleeds (Lisciandro 2012); and large volume effusions are more likely to be due to uroabdomen. Moreover, by using the abdominal fluid score and recording locations of positive sites, the volume may be semi-quantified, and source potentially localized, respectively.

NON-TRAUMATIC HEMOABDOMEN AND POST-INTERVENTIONAL BLEEDING DOGS AND CATS

The same concept may be applied to non-traumatic hemoabdomen (bleeding tumor, coagulopathic) and to at-risk post-interventional cases (surgical, percutaneous biopsy/aspirate, laparoscopy, interventional radiology, etc.). The abdominal fluid scoring system applied in serial manner allows for the detection of ongoing (increasing scores), static, and resolving hemorrhage (decreasing scores). Whereas bluntly traumatized dogs rarely need surgical intervention, post-interventional large volume bleeding **often** requires exploratory laparotomy and surgical ligation of the bleeding source.

OTHER ABDOMINAL EFFUSIONS

The use of the AFAST³- abdominal fluid scoring system also provides a means to detect and monitor response to therapy of other non-hemorrhagic effusive conditions including for example transudates (liver/GI disease), modified transudates (right-sided heart failure) and exudates (peritonitis). The use of the AFAST³-applied abdominal fluid scoring system also is helpful for the surveillance of postoperative patients at-risk for hemorrhage and peritonitis since ultrasound is superior in sensitivity to physical examination and abdominal radiography.

AFAST³ IS A CEREBRAL EXAM, NOT JUST FLUID-POSITIVE, FLUID-NEGATIVE

The diaphragmatico-hepatic (DH) view is loaded with information that is readily appreciated during the minutes it takes to perform the AFAST³.

1. The DH view is nicknamed the "designated hitter" because it is part of **both** the abdominal FAST (AFAST³) and thoracic FAST (TFAST³) formats.
2. The DH view is used for the rapid and confirmatory sonographic diagnosis of pleural and pericardial effusion (racetrack sign).
3. Patient volume status can be appreciated by observing the dynamics of the caudal vena cava as it passes through the diaphragm (FAT, flat or bounce) for evidence of right-sided volume overload and right cardiac insufficiency/failure, along with hepatic venous distension (tree trunk sign).
4. The gallbladder should be immediately against the diaphragm when starting the DH view in dogs. When the sonographer is unable to get this orientation in dogs, then liver enlargement should be suspected and when the gallbladder cannot be located, then its displacement (hernia) or its rupture or sonographically obscuring pathology (calculi/mineralization, emphysema) should be suspected. In cats, this orientation is less reliable but should be attempted.
5. The "gallbladder halo sign" can be supportive evidence for anaphylaxis; however, there are several causes of gallbladder wall thickening (the halo) including right-sided heart failure (Lisciandro, unpublished), pericardial effusion/tamponade (Lisciandro, unpublished), volume overload, 3rd spacing, primary gallbladder disease, and pancreatitis.
6. Liver masses can often be appreciated.

The spleno-renal (SR) view is unique since it interrogates both the abdominal cavity and retroperitoneal space. The left kidney is longitudinally fanned until it is lost in both directions. Linear stripes are generally not free fluid but rather small intestine or the great vessels. The transverse colon banks to become the descending colon at the SR view and an air-filled colon when present whites out (ultrasound does not transmit through air) everything through the far field. Hydronephrosis, mineralization and calculi, and masses and cystic structures are often readily suspected by performing the AFAST³ SR view in this repetitive manner. In smaller dogs and in many cats, **both** left and right kidneys may be imaged through the SR view.

The cysto-colic (CC) view lends itself to suspecting urinary bladder pathology similarly to the gallbladder at the DH view since both structures are often fluid-filled and ultrasound images best through fluid. The colon is a tricky structure that can cause mistakes by the air-filled colon appearing like bladder stones, the fluid-filled or fecal-filled colon like masses. Care should be taken because blood clots may also appear like, and be mistaken for, urinary bladder neoplasia. The CC view is the most common AFS-positive site in low-scoring AFS 1 and AFS 2 dogs (and cats) by directing the probe toward the table top into the "CC pouch" where the urinary bladder is immediately against the ventral abdominal wall.

The hepato-renal (HR) view completes the AFAST³ format and is called the "home run site" because in high-scoring dogs and cats the view will likely have abundant fluid amenable to abdominocentesis. Since ultrasound cannot sonographically characterize free fluid, sampling is necessary with fluid analysis, including cytology and chemistry analysis. The HR view is nicknamed by the author the "big lie" since routinely the right kidney and liver are not directly imaged but rather the probe is placed in the mid-section umbilical region and directed in the most gravity-dependent "HR pouch" for the detection of free fluid. In cases in which the right retroperitoneal space is of interest, then the author will interrogate the target-organs as a 5th AFAST³ view. It

has not been determined what clinical importance of routinely performing the AFAST³ 5th view is (low yield or high yield or if the left retroperitoneal space is adequate without the right retroperitoneal space since they are in such close proximity).

CLINICAL INDICATIONS/APPLICATIONS OF AFAST³

***The use of AFAST³ should be simply stated as an "extension of the physical exam" for ALL dogs and cats that are abnormal. FAST³ formats (AFAST³ and its applied fluid scoring system [AFS], TFAST³ and Vet BLUE) should be adopted as BASIC "screening tests" just as we have been trained to perform minimally basic blood tests (so-called quick assessment tests [PCV/TS, serum character, BUN, creatinine, blood glucose, and ALT]).**

Goal-directed Template for AFAST³

Patient positioning:	right or left lateral recumbency (right preferred)
Gallbladder:	present or absent, contour, wall, content, unremarkable or abnormal
Urinary bladder:	present or absent, contour, wall, content, unremarkable or abnormal
Positive of negative at the 4-views (0 negative, 1 positive)	
Diaphragmatico-Hepatic site:	0 or 1
Spleno-Renal site:	0 or 1
Cysto-Colic site:	0 or 1
Hepato-Renal site:	0 or 1
Abdominal Fluid Score: 0-4 (0 negative all quadrants to a maximum score of 4 positive all quadrants)	
DH View:	Pleural effusion: absent, present (mild, moderate, severe) or indeterminate
	Pericardial effusion: absent, present (mild, moderate, severe) or indeterminate
	Hepatic venous distension: present, absent or indeterminate
	Caudal vena cava characterization: FAT, flat or bounce or indeterminate

Comments: _____

(Note: The AFAST³ exam is a rapid ultrasound procedure used to detect the presence of free abdominal fluid (which is generally abnormal) as a screening test in order to better direct resuscitation efforts, detect complications, and manage critically ill patients. AFAST³ allows rapid but indirect assessment for evidence of major internal abdominal organ injury or disease. The AFAST³ exam is not intended to replace a complete abdominal ultrasound exam of the abdomen.)

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