Global FAST Ultrasound: How to Perform & Unique Feline Differences

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INTRODUCTION

The use of Global FAST in cats poses some unique species differences that will be reviewed. See additional Figures in the Global FAST for Monitoring and the Vet BLUE Tale of 4 Felines Proceedings.

PATIENT POSITIONING AND PREPARATION

Right lateral recumbency is recommended because right lateral recumbency is the standard positioning for electrocardiographic and echocardiography evaluation; and the left kidney at the SR view (commonly the right kidney too), and the gallbladder and caudal vena cava at the DH view, are more easily and reliably imaged. Lastly, the spleen located predominantly left of midline is arguably less apt to incur iatrogenic puncture via abdominocentesis.

AFAST should not be performed in dorsal recumbency because it is dangerous; and not only invalidates the fluid scoring system, but jeopardizes injured and critically ill patients by compromising their respiratory status and venous return.

Figure. Allow cats to remain in standing or sternal

For the ventral acoustic windows of TFAST and Vet BLUE, place roll of paper towels (or a towel) as shown.

In respiratory compromised patients, TFAST and Vet BLUE are performed in sternal or standing prior to AFAST and a cursory or delayed or standing or sternal AFAST is then performed. The AFAST target-organs when imaged in standing or sternal invalidate the abdominal fluid scoring system, but can still answer the binary question effectively of whether fluid is present or absent. Of note, the gravity-dependent regions relative to the probe are different between lateral recumbency and standing/sternal positioning and must be understood by the sonographer (and positioning should be recorded on the goal-directed template). AFAST target-organs may be similarly evaluated by fanning through them as would be done in lateral recumbency. The abdominal fluid score (AFS) may be calculated when the patient is more stable in fluid-positive cats.

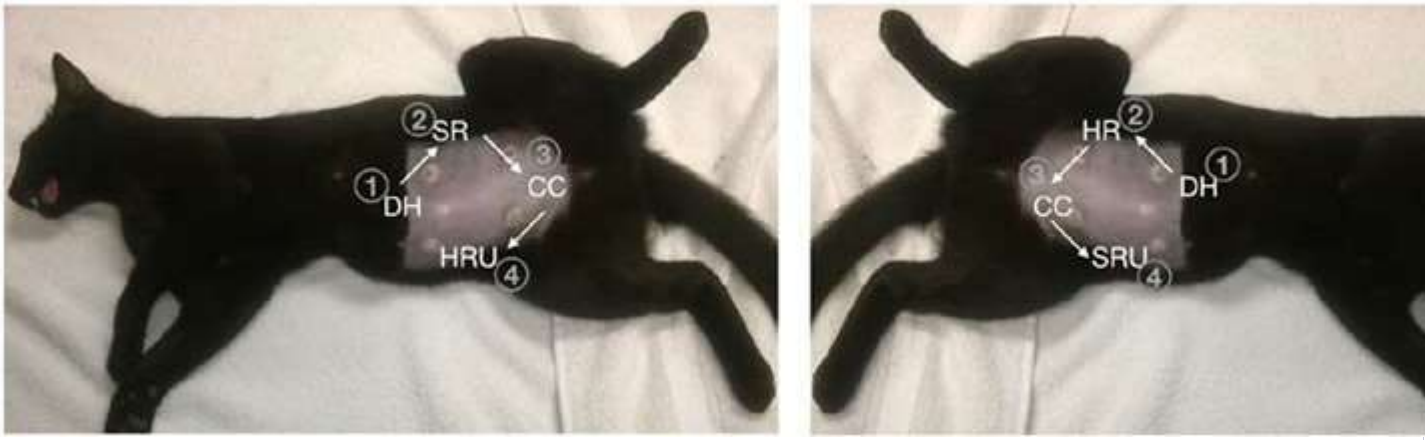
Fur is not shaved but rather parted and alcohol and/or gel applied; and hand sanitizer is an option that does not have the alcohol fumes of 70% alcohol and wipes off much easier than acoustic coupling gel. This is especially more comfortable for cats placed in the confines of an oxygen cage. Every attempt should be made to have the probe head directly on skin without fur in between minimizing air trapping. All images in this talk are from unshaved patients. Alcohol should not be used if electrical defibrillation is anticipated.

THE AFAST® EXAM - A CEREBRAL EXAM, NOT JUST A FLASH OF FLUID-POSITIVE OR FLUID NEGATIVE

The AFAST should always be performed in a standardized counterclockwise manner as follows when in the preferred positioning of right lateral recumbency: 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 Umbilical (HRU) View which completes the AFAST exam. The HR Umbilical view in higher-scoring cats is often a favorable site for abdominocentesis. The left lateral recumbent positioning renames the views as: 1) DH, 2) HR, 3) CC, and 4) SRU (umbilical).

All AFAST 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 397/400 times for the detection of free fluid. Thus, keeping it simple with fanning through only the longitudinal plane expedites the learning process.

Figure. The AFAST view shown in a sedated cat in right and left lateral recumbency with the respective AFAST views labeled



Shaving is unnecessary and in this case was performed at induction for a spay procedure and not specifically for AFAST.

THE DIAPHRAGMATICO-HEPATIC (DH) VIEW

The DH is a view of **both** AFAST® and TFAST®. Abdominal differences in felines include the gallbladder location (more parallel to the long axis of the ribs) and shape (may be bilobed in normalcy), and the common bile duct (may be tortuous in normalcy). The use of the caudal vena cava for volume status is the same in cats as dogs.

Regarding the imaging of the thorax via the DH view, the feline heart does not consistently rest against the diaphragm. Thus, the heart and its pericardial sac may not be sonographically visualized because of air interference from interposing lung between the heart and the diaphragm in normalcy or in small volume pericardial effusions. However, in most cases of clinically relevant **pericardial** effusion in felines, the diagnosis is made via the DH view because the fluid-distended pericardial sac moves against the diaphragm displacing

lung. Moreover, when diagnosing feline pericardial effusion (and pleural effusion), the DH view helps avoid mistaking heart chambers, the most catastrophic of mistakes if centesis is performed on the heart, for pericardial effusion (and pleural effusion) because the solid muscular apex of the heart is closest to the diaphragm, rather than fluid-filled heart chambers at the TFAST transthoracic right and left PCS views. The most common cause of pericardial effusion in cats is heart failure and the amount of pericardial effusion is usually <5 mm; thus, pericardiocentesis is uncommonly indicated in felines.

The Spleno-Renal (SR) View

The SR view includes the visualization of both the spleen, which is in the peritoneal cavity, and the left kidney, which is in the retroperitoneal space. However in cats the head of the spleen is less reliably seen and less robust than dogs. Through the SR view, commonly **both** the left and right kidneys may be advantageously imaged. Care must be taken to accurately differentiate left from right kidneys. In cats, the right kidney is more readily appreciated since it is not cupped (and more hidden sonographically) in the hepatic renal fossa of the caudate liver lobe as in dogs.

The Cysto-Colic (CC) View

The urinary bladder in the feline can have lipid droplets that mimic sediment. The feline urethra has a longer course within the abdominal cavity and is amenable to ultrasound imaging. Reproductive organs are different in that prostatic disease is rare in the male cat (both intact and neutered).

The Hepato-Renal Umbilical (HRU) View

The feline spleen is less robust than the dog and thus is less reliably seen at this view. At the HRU view, the spleen should be searched for after assessing for the presence of free fluid by a mid-abdominal sweep. If the feline spleen is visualized, do a focused spleen **after** completing AFAST and the fluid score. The feline spleen should be no more than 10 mm in thickness.

The AFAST-Applied Abdominal Fluid Scoring System

Blunt Trauma

The abdominal fluid score (AFS) is as follows (4-point scale): AFS 0 (negative at all 4 views) to the highest score of AFS 4 (positive at all 4 views). In cats with traumatic hemoabdomen from blunt trauma, the abdominal fluid score should be used as follows: lower-scoring AFS 1, 2 cats are characterized as small volume bleeders because if they remain AFS 1, 2 on serial exams they are **not** expected to become anemic from their intra-abdominal hemorrhage. Thus, if the feline patient becomes anemic, the attending veterinarian should look elsewhere such as the pleural cavity, pericardial and retroperitoneal spaces during Global FAST; and consider fracture site(s), external bleeding, etc., for the additional source of bleeding. In fact there are the following scenarios:

1. The cat had preexisting anemia

2. The feline is bleeding somewhere else (use Global FAST for internal sources)

3. Hemodilution has taken place (much less common with currently taught graduated fluid therapy strategies)

4. Lab error

On the other hand, higher-scoring AFS 3, 4 bluntly traumatized cats are characterized as large volume bleeders that predictably become anemic. The most common sites in low-scoring AFS 1, 2 bluntly traumatized cats are the **non-gravity dependent** DH and CC views in the author's experience. **Lastly, in any positive scoring cat from blunt (and penetrating) trauma, major injury, independent of the AFS, is present until proven otherwise; and in cats surviving trauma with large volume effusions, uroabdomen is generally more common than hemoabdomen different than in dogs**.

Penetrating Trauma

Penetrating trauma is much different than blunt trauma because with crushing, tearing, ripping of tissue, blood clots rather than being rapidly defibrinated, appear as free fluid, as in blunt trauma. Clotted blood is commonly indistinguishable from adjacent soft tissue and thus often missed during Global FAST (at least initially). However, in time blood clots will defibrinate and become free fluid, ruptured or punctured viscous organs will leak, and the free fluid will likely be recognized during Global FAST much sooner than radiographically (fluid actually seen and not suspected). For penetrating trauma, serial exams as often as every 4 hours may be necessary for up to 24–48 hours or longer even 2–7 days later to determine if a cat is medical vs. surgical (e.g., to better not miss developing septic peritonitis and pyothorax when cats return for recheck exams).

Post-interventional Bleeding

In cats that are bleeding post-interventionally, the AFS small volume vs. large volume bleeder concept can help guide decision-making in whether the case not only needs blood transfusion(s) but also guides decision-making for surgical exploration and definitive ligation of the bleeder(s). For example, a post-op spay procedure with an AFS 3,4 is generally best re-explored rather than waiting for the case to decompensate and then need resuscitation, blood products and ultimately surgical exploratory. The delay in taking the bleeding post-interventional case to surgery likely leads to increased morbidity and cost with much more patient risk during anesthesia.

In contrast, the same cat having and AFS 1,2 may be better managed by using serial AFAST exams and serial scoring (AFS) to see if the hemorrhage is static, worsening, or resolving. Lastly, AFAST use post-operatively/interventionally is generally not confounded by the presence of free air in lateral recumbency that generally can be avoided by moving the probe more ventrally away from where the free air would rise (SR view in right lateral recumbency).

Non-traumatic Hemoabdomen

The same AFS concept of small volume bleeder (AFS 1,2) vs. large volume bleeder (AFS 3,4) may be applied to non-traumatic intra-abdominal bleeding cats (e.g., bleeding masses and coagulopathy). For example, if a cat has a hemoabdomen with an AFS 2 and a PCV of 12%, then the cat has other sources of hemorrhage or had preexisting anemia.

Ultrasound Cannot Diagnose the Fluid Type

Fluid sampling with characterization (fluid analysis) must be performed when free fluid is safely accessible. Always spin down bloody effusions for a comparative packed cell volume and total solids (PCV and TS) since the PCV can be as low as 3–5% and make a blood-contaminated sample look grossly like true hemorrhage. If free fluid is inaccessible, do serial exams.

Other Non-hemorrhagic Effusions

The use of the abdominal fluid scoring system (AFS) may help with tracking (monitoring) non-hemorrhagic effusive conditions of the abdomen and patient response to therapy (static, decreasing or increasing score [AFS]). The AFS may also be used for tracking (monitoring) postoperative/post-interventional patients at risk for peritonitis, bleeding and other abdominal effusions. AFAST use is an advantageous format for scanning by non-radiologists since ultrasound is superior in sensitivity to physical examination and abdominal radiography (and nearly equal to computed tomography [CT]) for the detection of free-fluid.

TFAST® AND VET BLUE®

The TFAST® Exam

The feline heart generally is beating much faster than canines and eyeballing chamber size and left ventricular filling is difficult. Freeze the image and roll the cine ball to improve your characterization for volume and contractility as well as chamber sizes.

TFAST for the "Lung Point" – The Degree and Monitoring of Pneumothorax (PTX)

Anytime PTX is suspected, move the cat to sternal or standing if they are laterally recumbent. By dividing the thorax into thirds when searching for the Lung Point, a subjective assessment of partial vs. massive PTX may be made. Moreover, when PTX is suspected at the CTS view, by locating the Lung Point sensitivity is increased and smaller pneumothoraces may be monitored or tracked by using/recording the distance from the CTS to the Lung Point. Generally, a Lung Point in the upper 1/3 is clinically insignificant (monitor) in contrast to the Lung Point in the middle 1/3 or lowest ventral 1/3 (perform thoracocentesis). We generally consider upper 1/3 trivial and monitor, middle and lower 1/3 significant warranting thoracocentesis.

Vet BLUE for Respiratory Suspects, Distress, and Managing Left-sided CHF

Vet BLUE® is an effective manner in cats to rule in (Se 87% and 89%, Ward *et al*. JAVMA 2017) and rule out (Se 96%, Lisciandro *et al*. 2016) left-sided congestive heart failure (CHF) through the use of wet vs. dry lung concept, an effective way to rapidly point-of-care distinguish feline asthma from left-sided CHF with little to no feline restraint, and for monitoring the use of diuretic therapy. Furthermore, Vet BLUE should be used to look beyond pleural effusion to better assess for lung pathology often obscured radiographically.

GLOBAL FAST IN CATS

In summary, the feline species poses unique differences that should be known to the Global FAST sonographer. See the Global FAST for Monitoring and the Vet BLUE Tale of 4 Felines Proceedings for additional information and Figures.

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SPEAKER INFORMATION

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