**TFAST® FUNDAMENTAL ECHOCARDIOGRAPHY**

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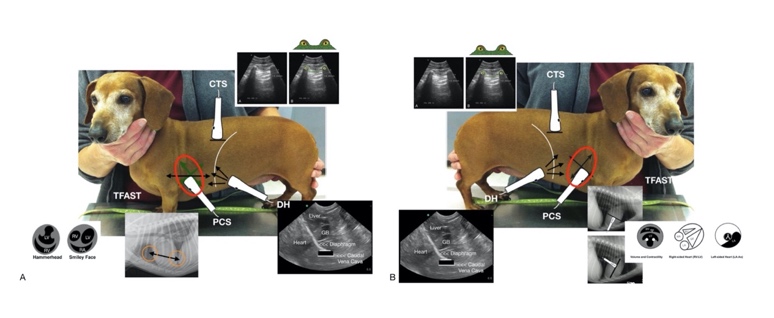
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**What is TFAST®?**

FAST is an acronym that stands for Focused Assessment with Sonography for Trauma. It is an ultrasound exam developed by trauma surgeons (yes trauma surgeons) in the 1990s and used in people as a screening test for the detection of free fluid in the abdominal cavity, ascites, and the pleural cavity including pleural effusion and pericardial effusion. In 2004 the translational study from humans to dogs was published by Boysen and colleagues out of Tufts. The next year TFAST® was developed as part of the speaker's clinical research requirement for his emergency and critical care residency training. This was the first FAST protocol developed for the thorax in veterinary medicine and called TFAST®. In fact, his TFAST® protocol exceeded the protocol for people called EFAST ("E" for "extended) by having TFAST® bilaterally applied Pericardial Site views. These unique TFAST® Pericardial Site views were used for pleural and pericardial effusion, pleural space abnormalities, and fundamental echocardiography. *See Proceedings for TFAST*® *for Pleural and Pericardial Effusion for more detail.*



**Figure 1.** TFAST® shown in a standing dog. Fundamental echocardiography is performed from the right and left Pericardial Site views. CTS, Chest Tube Site view; PCS, Pericardial Site view; DH, Diaphragmatico-Hepatic view. *This material is reproduced with permission of John Wiley & Sons, Inc.,* [*Point-of-Care Ultrasound Techniques for the Small Animal Practitioner*](https://www.amazon.com/Point-Ultrasound-Techniques-Animal-Practitioner/dp/1119460980/ref=sr_1_1?crid=2W3RO79YXBLKT&keywords=Lisciandro+ultrasound&qid=1674252243&sprefix=lisciandro+ultrasoun%2Caps%2C203&sr=8-1)*, 2nd Edition, Wiley ©2021 and Greg Lisciandro, Hill Country Veterinary Specialists, FASTVet.com.*

**TFAST**® **and Fundamental Echocardiography Views**

TFAST® echocardiography views are from the right PCS view and include the left ventricular (LV) short-axis “mushroom” view for volume status and contractility, the LV short-axis "Mercedes Benz view" for left atrial (LA) to aortic (Ao) assessment for left-sided problems (increased LA filling pressures), the long-axis 4-chamber view for right-sided problems (increased RV filling pressures), and the long-axis LV outflow tract (LVOT) and aortic valves (Figure 2, 3). The "eyeball method" in properly trained non-cardiologists has been shown to be effective as a screening test in people. These views also serve as a screening test for cardiac-related soft tissue abnormalities because the radiographic cardiac silhouette is unreliable. Importantly, when the sonographer is unable to obtain its echocardiography views, the absence of "Wet Lung" during Vet BLUE® rules out clinically relevant left-sided *congestive* heart failure; and absence of a "FAT" or fluid intolerant CVC rules out clinically relevant right-sided *congestive* heart failure.These Global FAST® Non-echo "Fallback" Views allow an approach that often is easier (and faster) than echocardiography in the unstable patient. Get our TFAST® Echo Charts Rogue and Classic [here](https://fastvet.com/tfast-echocardiography-chart-fastvet/).

A diagram of a medical chart

Description automatically generated with medium confidence

**Figure 2.** **Rogue TFAST® Echocardiography Chart.** The orientation is called "Rogue" but also "right" by the author as the head or cranial is to the left and the tail or caudal is to the right like all other imaging which makes centering the heart the same as centering abdominal structures. The FASTVetTM System uses our novel "clockface technique" of short axis and long axis "lines" that in a standing patient would be 4 o'clock and 1 o'clock, respectively, and fanning on those respective lines will give you all your veiws. The short axis levels of Mushroom View, Fishmouth View, and Mercedes Benz View are known to cardiologists. However, we added Bull's Eye View, Batman Sign View, and Windshield Wipers View to help clarify the short axis level that is being imaged. The Bull's Eye View is used for pericardial effusion because it will circle the apex of the heart and there is no confounding crescent-shaped right ventricle (RV) this low on the heart. The Batman View has no chordae tendinae and no valves and may be misinterpreted as poor volume when the level is inappropriate being below the Mushroom View. The Mushroom View is where volume and contractility (estimation of fractional shortening) is performed by the "eyeball method" and where M-mode measurements are formally done. The 2 bright white hyperechoic "dots" as the chordae tendinae and makes sense that just dorsal, to which the chordae tendinae are attached, are the mitral valves are seen that flap in synchrony like windshield wipers, thus the Windshield Wiper View. The mitral valves then form an annulus called the Fishmouth View and just dorsal to it is the Mercedes Benz view where one looks for the white line over the top of the aorta and left atrium to know where to measure. At the Mercedes Benz View is the RV and its outflow tract through the pulmonic valves and into the pulmonary artery (PA). When on valves on short axis, the probe is rotated 90 degrees to the long axis 4-chamber view where valves want to be viewed (thus valves short axis to valves long axis). The long axis 4 chamber view has 2 equal sized atria, and a small triangular RV and large triangular left ventricle (LV). The FASTVet landmark we teach is fan on the 1 o'clock line in standing patients for the bright white hyperechoic base of the interatrial septum. Once found, then fan cranially "opens to the outflow tract and aotra" and "fanning caudally closes to the white dot" and the long axis 4 chamber view. The outflow tract is used for any abnormalities within it and its associated aortic valves. From the left Pericardial Site view (bottom left-hand corner) is the left short axis view of the heart. The probe is held horizontally as shown in the overlay of the thoracic radiograph. The "lowest" level is the Hammerhead View (HH View) that has thickened gray ventricular walls. It is used for PCE that will completely encircles the HH View, a "Racetrack Sign." By fanning just dorsal, away from the HH View, the thick gray RV wall changes to thin white right atrial and right auricular wall called the Smiley Face View. It is used for right auricular masses as a screening test. These masses would be in the right commissure of the smile. *This material is reproduced with permission of John Wiley & Sons, Inc., Point-of-Care Ultrasound Techniques for the Small Animal Practitioner, 2nd Edition, Wiley ©2021 and Greg Lisciandro, Hill Country Veterinary Specialists, FASTVet.com.* Get our TFAST® Echo Charts Rogue and Classic [here](https://fastvet.com/tfast-echocardiography-chart-fastvet/).

***A picture containing diagram

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**Figure 3.** Global FAST® Fallback Views to help better interpret TFAST® echocardiography findings or when echocardiography is not possible. *This material is reproduced with permission of John Wiley & Sons, Inc., Point-of-Care Ultrasound Techniques for the Small Animal Practitioner, 2nd Edition, Wiley ©2021 and Greg Lisciandro, Hill Country Veterinary Specialists, FASTVet.com.* Click [here](https://fastvet.com/ecc-and-im-blog-global-fast-fallback-views/) to see our Blog with more detail.

***Recognizing Cardiac Abnormalities***

The radiographic cardiac silhouette is an unreliable screening test for many cardiac-related conditions that are likely under reported regarding prevalence because historically pre-TFAST® without complete echocardiography (or computed tomography), the condition would be missed. These conditions include intra- and extra-cardiac masses, intracardiac thrombi and echogenic smoke, dilated cardiomyopathy, pulmonary hypertension, and intracardiac heartworms and caval syndrome, all of which can be suspected/detected using the TFAST® approach. The caveat is that TFAST® serves as a screening test, and that artifacts and cardiac anatomy can mimic pathology, and that not finding these conditions does not definitively rule them out because more advanced imaging is necessary. However, there is tremendous value in using the TFAST® approach over, or in combination with, physical examination and radiography and the patient’s clinical profile.

***Pitfalls***

The right ventricle (RV) on short axis is probably the most important structure to acknowledge. The RV is crescent-shaped and has echogenic papillary muscles with associated chordae tendinea along this scanning plane. Moreover, the RV can image quite variably by the non-cardiologist sonographer with the RV appearing falsely enlarged, and its normal anatomical structures such as its papillary muscles mistaken for masses, thrombi, fibrin, lung and its chordae tendinae for heartworms. Its crescent-shape mimics PCE and PE (Figure [here](https://fastvet.com/fastvet-table-for-the-accurate-diagnosis-of-pericardial-and-pleural-effusion/)).

***Methods to Avoid Pitfalls***

* Respect the “Danger Zone” on right Pericardial Site short-axis and avoid diagnosing PCE and PE solely on this view. The axiom in human point-of-care ultrasound is “one view is no view.” In other words, other than the single diagnostic views of 1) the DH view and the "Racetrack Sign”, 2) the long-axis 4-chamber view, and 3) the Hammerhead view, you must see the abnormality on 2 different views.
* Memorize the FASTVetTM TFAST**®** Echocardiography Chart and double-check yourself at its short-axis levels by fanning a level ventral and a level dorsal to where you think you are located on the “cardiac (short-axis) ladder" (Figure [here](https://fastvet.com/fastvet-table-for-the-accurate-diagnosis-of-pericardial-and-pleural-effusion/)).
* Primarily assess RV chamber size at the right Pericardial Site view on the long-axis 4-chamber view because the scanning plane is more reliable using the author’s FASTVetTM “white dot method” over right Pericardial Site short-axis views (Figure [here](https://fastvet.com/fastvet-table-for-the-accurate-diagnosis-of-pericardial-and-pleural-effusion/)).
* Learn to fan on the short-axis and long-axis lines using the author’s FASTVetTM clockface methodology to image the heart and learn its expected appearance (Figure [here](https://fastvet.com/fastvet-table-for-the-accurate-diagnosis-of-pericardial-and-pleural-effusion/)) most consistently.
* Keep the direction of the head (cranial) to the left and the tail (caudal) to the right of the screen like all other imaging. Note that this contrasts with traditional echocardiography in which the orientation was reversed for some odd reason. This will not only help you spatially orient yourself as to the anatomy, which is like a lateral radiograph, but also help you center the heart on the screen identical to how you would center any other structure, i.e., gallbladder, kidney, urinary bladder, etc.
* Everyone looks at the screen. This includes the sonographer, restrainer, and patient because it is safer in case the patient is showing aggression, turns to bite or scratch, or is decompensating. Also, the sightline to the screen should be comfortable for the sonographer (avoid looking over your shoulder) and allows for the sonographer to physically see the external location of the probe and its scanning plane.
* Part the hair with minimal alcohol and then apply alcohol-based hand sanitizer gel so that the probe's footprint is as directly opposed to skin as possible to avoid "air trapping" which reduces image quality.
* Use your non-probe hand on the standing patient’s sternum as your "V-trough" to stabilize the patient or knuckling the probe if under the patient to help reduce probe pressure on the intercostal spaces when patients are in lateral recumbency.
* Follow the FASTVetTM TFAST**®** tenets for the accurate diagnosis of PCE and PE and avoid the trap of “it just looks like PCE or PE.”

**TFAST**® **and the Caudal Vena Cava**

*Volume Status*

Characterizing the caudal vena cava (CVC) in its longitudinal plane as it courses through the diaphragm and its associated hepatic veins estimates patient volume status by its respirophasic height change as follows: fluid responsive ("bounce"), a change of 35-50%; fluid intolerant ("FAT"), little change (<10%) and an increased maximum height; and fluid starved/hypovolemic ("flat"), little change (<10%) and a decreased maximum height (Figure 4). Hepatic venous distension, called the “Tree Trunk Sign”, is close to 100% specific for severely increased right-sided filling pressures in dogs and cats positioned in lateral, standing or sternal. In other words, the patient has right-sided congestive heart failure until proven otherwise. The "Tree Trunk Sign" plus a "FAT" CVC is easily recognized by properly trained non-radiologist veterinarians.Absolute measurements of the maximum CVC height have also been created; however, dynamic CVC characterization, i.e., FAT, flat and bounce, as a rule trumps maximum height measurements unless there is a "Tree Trunk Sign" of hepatic venous distension (Table [here](https://fastvet.com/fastvet-table-for-the-accurate-diagnosis-of-pericardial-and-pleural-effusion/)). More recently the maximum height of the feline CVC has been evaluated. The rule for maximum heights in dogs, small dogs, and larger dogs should be no more than 0.5 cm (cats), 1.0 cm (small dogs), and 1.5 cm (large dogs), respectively which is easy to remember ("Rule of 0.5-1.0-1.5 cm").

Diagram, timeline

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**Figure 4.** Characterization of the caudal vena (CVC) cava and hepatic veins. Shown is a "bounce" or fluid responsive CVC in A); a "FAT" and distended or fluid intolerant CVC in B); and "flat" or hypovolemic or fluid starved CVC in C). CVC, caudal vena cava; GB, gallbladder; HVD, hepatic venous distension ("Tree Trunk Sign"). *This material is reproduced with permission of John Wiley & Sons, Inc.,* [*Point-of-Care Ultrasound Techniques for the Small Animal Practitioner*](https://www.amazon.com/Point-Ultrasound-Techniques-Animal-Practitioner/dp/1119460980/ref=sr_1_1?crid=2W3RO79YXBLKT&keywords=Lisciandro+ultrasound&qid=1674252243&sprefix=lisciandro+ultrasoun%2Caps%2C203&sr=8-1)*, 2nd Edition, Wiley ©2021 and Greg Lisciandro, Hill Country Veterinary Specialists, FASTVet.com.*

**Table 2.** Reference Values for the Maximum Height of the Caudal Vena Cava (CVC) Measured in Longitudinal at the Subxiphoida view in 126 Healthy Dogs grouped into \*3 Body Weight Classes.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Size** | **Body weight (kg)** | **Expected CVC height measurement (cm) and range** |  | **Suggested CVC maximum height** **(cm)** for a **"flat" or hypovolemic, fluid-starved CVC** | **Suggested CVC maximum height (cm)** for a **"FAT" or fluid-intolerant CVC** (high central venous pressure) |
| Small/Toy | >9.0 | 0.55 (0.40-0.70) |  | <0.25 | >1.0 |
| Medium | >9–15kg | 0.85 (0.50-1.10) |  | <0.35 | >1.5 |
| Large/Giant | >15kg | 0.95 (0.80-1.20) |  | <0.50 | >1.5 |
| \*Data from the study by Darnis et al. (JVIM 2018) with their weight classes. Measurements listed created with permission by Lisciandro GR and Vientós-Plotts AI. These values are unproven but give some guidelines for veterinary clinicians to combine with the eyeball method – "Bounce", "FAT," and "flat."  aThe subxiphoid view is analogous to the FAST DH view and the CVC imaged in its longitudinal plane.  First published in Lisciandro GR. Cageside Ultrasonography in the Emergency Room and the Intensive Care Unit. *Vet Clin North Am* 2020;50(6):1445-1467. | | | | | |

**EPIC Guidelines - Beginning Pimobendan Prior to Left-sided CHF in Mitral Valve Disease Dogs**

More information may be found at the CardiacEductaionGroup.org which has an excellent summary article along images, imaging techniques and measurements, and the LVIDdN (Left Ventricular Internal Diameter in Diastole Normalization) Table with respective body weights. [Click here for the document.](https://fastvet.com/epic-guidelines-for-mitral-valve-disease-dogs-from-cardiac-education-group-ceg-org/) We have a full length instructional EPIC Guidelines Webinar on our website for our FASTVet Members that goes through the acquisition of the right parasternal short axis echocardiography views and how to perform the measurements. See our list of Webinars, click [here](https://fastvet.com/category/archived-webinars/), and Free Resources, click [here](https://fastvet.com/category/free-resources/).

**Final Comments**

TFAST® is low impact, cost effective, real-time information, rapid, radiation-sparing, point-of-care imaging that allows the veterinarian to “see” their problem list and thus better direct resuscitation, treatment, and streamline the diagnostic plan. TFAST® should be considered a screening test used for detecting obvious abnormal; however, its use has clear advantages in the acute triage setting and during patient rounds and rechecks over physical examination, laboratory test results, and radiography for many conditions. Global FAST® and its 15-views provide an unbiased set of data imaging points that prevent the common imaging mistakes of “satisfaction of search” and “confirmation bias” errors through TFAST® alone or selective POCUS imaging. Global FAST® should be used as an "extension of the physical exam" on a daily basis for nearly all patients in the clinical setting and preempt add-on POCUS examinations. How to Perform Global FAST® Efficiently [here](https://fastvet.com/global-fast-blend-how-to-do-global-fast-in-standing-and-most-efficiently/). Understand how to advantageously integrate the Global FAST® Non-echo Fallback Views principle by FASTVet, click [here](https://fastvet.com/ecc-and-im-blog-global-fast-fallback-views/).

**TFAST® and Recording Findings on Goal-directed Templates**

Goal-directed templates (GDTs) for recording your findings are a must for success. GDTs keep you disciplined and on task. TFAST® is performed the same order every time just like a cardiologist and a radiologist perform their ultrasound examinations the same way every time. GDTs also give you value for comparison to future exams for you and for your colleagues and show your TFAST® objectives. Examples of GDTs may be found at our website FASTVet.com on our Free Resources page and by clicking [here](https://fastvet.com/most-updated-global-fast-goal-directed-templates/).

**References & Further Reading**

1. **Figures** and **Tables** for these **TFAST®** **Proceedings** are [here](https://fastvet.com/fastvet-table-for-the-accurate-diagnosis-of-pericardial-and-pleural-effusion/).
2. **FASTVetTM** Free Resources [here](https://fastvet.com/category/free-resources/); Goal-directed Templates [here](https://fastvet.com/most-updated-global-fast-goal-directed-templates/); Webinars [here](https://fastvet.com/category/archived-webinars/); Global FAST® Training [here](https://fastvet.com/learn-in-person/); Video How to Perform Global FAST® Efficiently [here](https://fastvet.com/global-fast-blend-how-to-do-global-fast-in-standing-and-most-efficiently/); Anaphylactic Hemoabdomen Webinar in Dogs [here](https://fastvet.com/fastvet-monthly-webinar-july-2022-updated-information-on-medically-treated-canine-anaphylactic-hemoabdomen-presented-at-the-acvim-forum-2022/); other Free Resources [here](https://fastvet.com/category/free-resources/).
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\*A summary of all our 20+ peer-reviewed clinical studies may be found [here](https://fastvet.com/publications-references-validating-fastvet-techniques/).