

# Thoracic FAST (TFAST<sup>SM</sup>) – The Technique and Practical Everyday Case-based Applications

Gregory R. Lisciandro, DVM, Dipl. ABVP, Dipl. ACVECC  
Hill Country Veterinary Specialists & FASTVet.com, San Antonio, Texas USA

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Email [FastSavesLives@gmail.com](mailto:FastSavesLives@gmail.com), Website [www.FASTvet.com](http://www.FASTvet.com), Phone 210.260.5576

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## Introduction:

The clinical utility of TFAST<sup>3</sup> and its use for the rapid diagnosis of pleural and pericardial effusion, and pneumothorax (and the lung point concept) in trauma, triage (non-trauma) and tracking (monitoring) cases in the emergent and critical care settings will be reviewed. The T<sup>3</sup> designation encompasses these 3 patient subsets 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. Thus, TFAST<sup>3</sup> becomes a universal term that has exact clarity in the 5-acoustic windows used by the veterinary TFAST<sup>3</sup> sonographer.

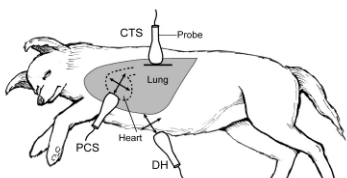
## Terminology:

See AFAST<sup>3</sup> Proceedings

## Patient Positioning and Preparation:

TFAST<sup>3</sup> may be performed immediately following AFAST<sup>3</sup> when AFAST<sup>3</sup> is performed in right lateral recumbency because the depth is essentially the same moving from the abdomen to the TFAST<sup>3</sup> left and right Pericardial (PCS) Site Views; and the right PCS view is optimized in lateral recumbency with the heart moving against the thoracic wall displacing air-filled lung allowing for the left ventricular short-axis “mushroom” volume status view. However, in respiratory distressed or compromised patients, the TFAST<sup>3</sup> format may be performed in sternal or standing position because it is generally less stressful and safer for an unstable or questionably stable, respiratory-compromised patient. In cases in which only TFAST<sup>3</sup> is needed initially, sternal and standing positioning is often adequate to answer the clinical questions regarding pleural and pericardial effusion and the presence or absence of pneumothorax (and its degree by the “Lung Point”). Fur is NOT shaved but rather parted and alcohol and/or gel applied. Alcohol should not be used if electrical defibrillation is anticipated.

## A Schematic of the TFAST<sup>3</sup> Exam:



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The TFAST<sup>3</sup> exam is shown on a dog in right lateral recumbency and in standing position, which is safer for respiratory-compromised dogs and cats. TFAST<sup>3</sup> consists of 5-views named as follows: the **stationary horizontally probe-positioned** Chest Tube Site (CTS) view; **and the**

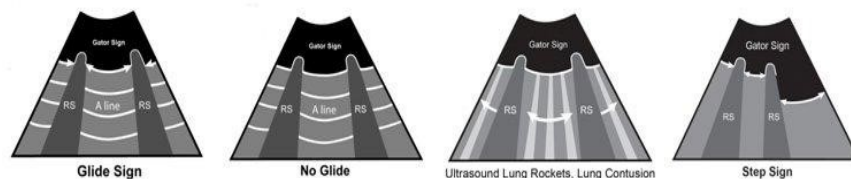
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*dynamically spotlighted* Pericardial Site (PCS) view, and *the dynamically spotlighted* DH view (used in both TFAST<sup>3</sup> and AFAST<sup>3</sup>). CTS and PCS views are bilaterally applied; however, the DH view is a single view.

### Strengths and Weaknesses of TFAST Views

The **CTS view** is best used to rule out pneumothorax (PTX) and survey for lung pathology (the wet lung vs. dry lung concept [see Vet BLUE Proceedings]). The CTS view is the highest point on the thoracic wall where lung may be visualized against the thoracic wall along an intercostal space where a cap of air would rise in the event that PTX was present. To avoid false positives, the search for the “Lung Point” next takes place (see below). The **PCS views** are best used to screen for the presence of pleural or pericardial fluid and are also used for volume status and contractility assessment (left ventricular short-axis “mushroom” view), right-sided problems (right ventricular to left ventricular ratio (RV:LV ratio)), and left-side problems (left atrial to aortic ratio (LA:Ao ratio)). However, Vet BLUE can rapidly rule out any clinically-relevant left-sided heart failure by the finding of “dry lungs all fields” (see Vet BLUE Proceedings). The **DH View** may be superior for the detection of pericardial (and pleural effusion) fluid because of less air interference from the lung at the PCS views; and the acoustic window provided by the liver and gallbladder. The DH strategy is to image near the solid muscular apex of the heart where a heart chamber is unlikely to be misinterpreted for pleural or pericardial effusion and air interference by lung is avoided. The finding has been described and referred to as the “Racetrack Sign” (see below).

### Basic Lung Findings at CTS View- Glide Sign, Pneumothorax, Lung Rockets & Step Sign



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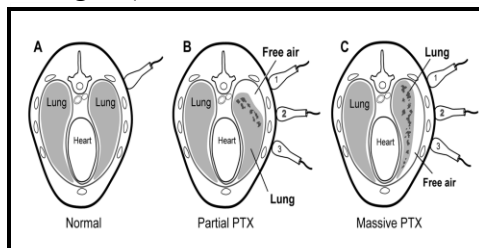
The illustrations depict in order from left to right 1) Normal dry lung (**Glide Sign** with A-lines) 2) Pneumothorax (PTX) (**No Glide** with A-lines) 3) **Ultrasound Lung Rockets** (ULRs, also called B-lines) (hyperechoic laser-like streaks that do not fade extending to the far-field obliterating A-lines and oscillating in synchronization with inspiration and expiration) ruling out PTX at that point on the thorax and further indicating that the lungs are wet (interstitial edema or lung contusion). *In trauma, ULRs represent lung contusions until proven otherwise.* 4) **Step Sign** representing deviation from the expected linear to and fro movement of the pulmonary-pleural interface suggesting chest wall (i.e. intercostals tear(s), fractured rib(s), subpleural hematoma) and pleural space disease or conditions (i.e. effusions, diaphragmatic hernia, masses) in trauma.

### Use of TFAST for the “Lung Point” – The Degree of PTX

**Cross-sectional canine thoraces (sternal recumbency)** depicting the **quantification of the degree of pneumothorax (PTX)** as **partial or massive** by searching for the **Lung Point** defined as the level at which lung re-contacts the thoracic wall. In the absence of the **Glide Sign** and absence of **Ultrasound Lung Rockets (ULRs)**, the probe is moved sequentially in a ventral manner as numerically labeled from dorsal to ventral. A) Normal thorax in which PTX has been

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excluded **B**) PTX has been determined at position 1 and the **Lung Point** is found at position 2 and thus PTX is determined to be “Partial.” **C**) PTX has been determined and a lung point is nonexistent at any of the 3 probe positions indicating “Massive” or considered indeterminate based on clinical signs (CTS, chest tube site; PTX, pneumothorax).

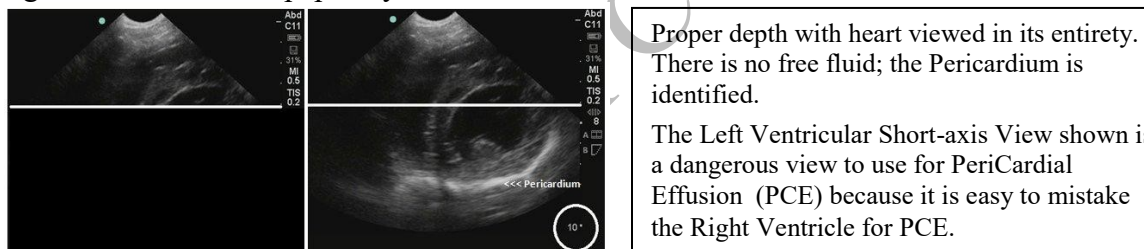


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**Key Point: Important:** Use the **distance of the Lung Point from the Chest Tube (CTS)** view to track (monitor) the worsening or resolution of PTX including post-invasive procedures (in place of thoracic radiography) including thoracotomy, thoracoscopy, chest tube placement/removal, thoracocentesis, lung lobe aspirate, etc.

### Basic Imaging Principles at the TFAST PCS view – Global Heart View with Its Pericardium

As far-fetched as it seems, the novice or hasty sonographer by not identifying the heart chambers, left and right ventricles, can easily mistake the right ventricle for pericardial or pleural effusion by not performing the orientation the same way every time, and by not identifying the right ventricle and its papillary muscle.



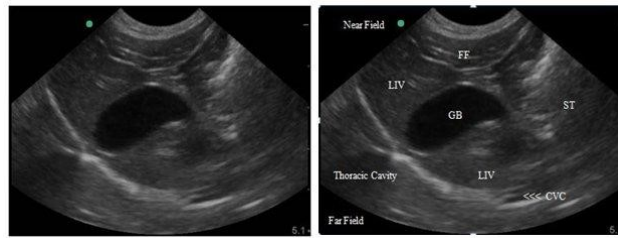
**Pitfall of the PCS View:** Shows how, by too shallow depth (**image on the left**), you can easily mistake heart chambers, here the right ventricle, for pericardial (or pleural effusion). To prevent this mistake, always increase depth (**image on the right**). By this recommended practice, the heart is seen in its entirety, confirmed by adequately imaging the pericardium as your landmark in the far field, as the brightest white line (labeled in image above). In differentiating between pleural and pericardial fluid, multiple views (right and left PCS and the DH view) prevent mistakes of misidentifying one for the other; or an enlarged right ventricle, or other heart chambers, for pleural or pericardial effusion; or the papillary muscle of the right ventricle for a mass.

### The FAST Diaphragmatico-Hepatic (DH) View

The classic DH view nicknamed the “**Designated Hitter**” since the DH is part of AFAST<sup>3</sup> and TFAST<sup>3</sup>. In dogs, the DH view begins with imaging the **gallbladder “kissing” the diaphragm**. Once this classic view is appreciated, fanning through the liver lobes, gallbladder, and the diaphragm should then take place while directing the **marker toward the patient’s head staying longitudinal** throughout the view (do not rotate the probe, it’s unnecessary). Because

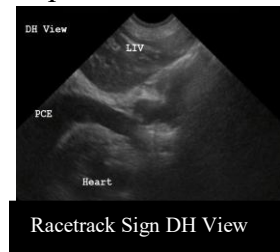
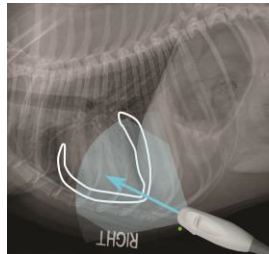
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the DH view advantageously (less lung [air] interference) serves as an acoustic window (via the liver and gallbladder) into the thorax. The orientation of the gallbladder immediately against the diaphragm is less reliable in cats.



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**ALWAYS look into the thorax** for the rapid detection of **pleural and pericardial effusion**. Depth should be adjusted on your machine so that the pleural and pericardial spaces (25-33% of the far-field) are routinely examined (may not be possible in larger dogs). Questionable findings within the thorax using the DH view should be confirmed via TFAST<sup>3</sup> (PCS view) or Vet BLUE or both or by serial exams (repeating once 4-hours later). Characterization of the **caudal vena cava** should also become part of the DH view (see AFAST Proceedings).

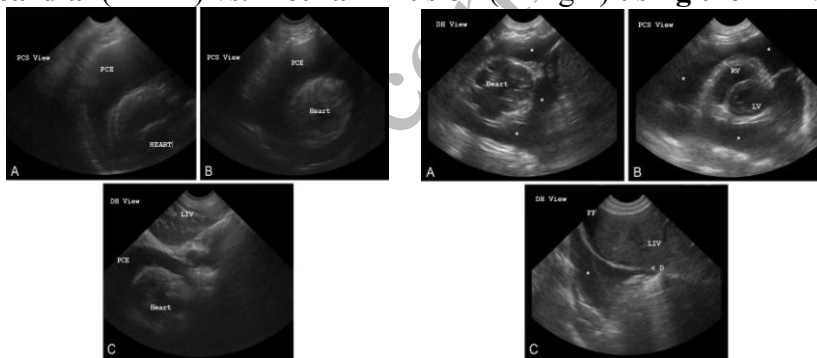


#### **Tenets for an Accurate Diagnosis of Pericardial Effusion**

- 1) Image toward the muscular apex of the heart – a) DH View – Racetrack Sign b) Right PCS View – Bull's Eye Sign
- 2) Use only the 4-chamber Long-axis View and Identifying ALL 4-chambers

\*AVOID Short-axis Views as it is too easy to mistake a heart chamber for free fluid (especially the right ventricle)

#### **Pericardial (on left) vs. Pleural Effusion (on right) using the TFAST PCS and DH Views**



Ultrasound is the Gold Standard for the Diagnosis of Pericardial Effusion. Radiography is insensitive.

Ultrasound is Sensitive for Pleural Effusion. Radiography is good and complementary.

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#### **Clinical Indications/Applications of TFAST<sup>SM</sup>:**

*\*The use of TFAST should be simply stated as an “extension of the physical exam” for nearly ALL dogs and cats that are abnormal. Blunt trauma, Penetrating trauma, Undifferentiated hypotension - Collapse, apparent collapse, Acutely decompensated cardiac case, detection of left atrial tears, Pulmonary contusions (Vet BLUE better, counting lung rockets as a “score system”), Post-interventional at-risk bleeding (surgery, percutaneous procedures (lung lobe aspirates), Thoracoscopy, chest tube), Post-interventional at-risk pneumothorax (surgery, percutaneous procedures (lung aspirates, tracheal wash), thoracoscopy, chest tube), Monitoring PTX, pleural and pericardial effusions, Detecting and monitoring forms of pulmonary edema*

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and respiratory distress (Vet BLUE better), Patient monitoring during fluid resuscitation and during hospitalized care (used in combination with AFAST<sup>3</sup> and Vet BLUE called Global FAST [GFAST<sup>3</sup>]).

### Goal-directed Template for TFAST<sup>SM</sup>

\*Right and left sides are listed in templates for the CTS and PCS views

|                          |                                                                                                                                                                                                                                                                                                                                      |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| *CTS glide sign:         | <b>Present</b> (normal) -- no Pneumothorax <b>or Absent</b> – Pneumothorax <b>or Indeterminate</b>                                                                                                                                                                                                                                   |
| *CTS lung rockets:       | <b>Present</b> (no PTX) – interstitial lung fluid (edema, hemorrhage) <b>or Absent</b> – no interstitial lung fluid (edema, hemorrhage) <b>Indeterminate</b>                                                                                                                                                                         |
| *CTS step sign:          | <b>Present</b> – concurrent thoracic wall trauma (rib fractures, hematoma, intercostal muscle tear) or pleural space disease is suspected <b>or Absent</b> - no concurrent thoracic wall trauma or pleural space disease is suspected <b>Indeterminate</b>                                                                           |
| *PCS view:               | <b>Absent</b> - no pleural or pericardial fluid<br><b>Present</b> - pleural or pericardial fluid or both (mild, moderate, or severe) <b>Indeterminate</b>                                                                                                                                                                            |
| LV filling (short-axis): | <b>Adequate</b> suggesting normovolemia <b>or Inadequate</b> suggesting hypovolemia <b>or Indeterminate</b>                                                                                                                                                                                                                          |
| DH View:                 | <b>Pleural effusion:</b> absent, present (mild, moderate, severe) or indeterminate<br><b>Pericardial effusion:</b> absent, present (mild, moderate, severe) or indeterminate<br><b>Hepatic venous distension:</b> present, absent or indeterminate<br><b>Caudal vena cava characterization:</b> FAT, flat or bounce or indeterminate |
| Cardiac tamponade:       | <b>Present or Absent or Indeterminate</b>                                                                                                                                                                                                                                                                                            |

Comments: \_\_\_\_\_

**KEY:** CTS = chest tube site; PCS = pericardial sac; LV = left ventricle, PTX = pneumothorax

(Note: The TFAST<sup>3</sup> exam is a rapid ultrasound procedure used to help detect major chest wall, lung, and pleural and pericardial space problems as a screening test in order to better direct resuscitation efforts or manage hospitalized critically ill patients. TFAST<sup>3</sup> exam is not intended to replace thoracic radiographs, or complete echocardiography.)

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