Vet BLUE^{SM} – The Technique and Practical Everyday Case-based Applications

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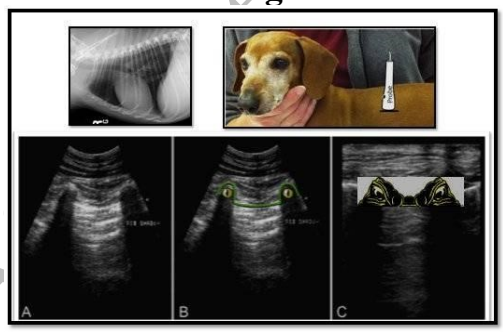
Text Focused Ultrasound Techniques for the Small Animal Practitioner, Wiley © 2014

Use of Lung Ultrasound Formats in Small Animals:
The reluctance to pro-actively apply lung ultrasound to small animals with respiratory distress is irrational in many respects. The overriding belief that air-filled lung creates insurmountable obstacles, and the continued belief in small animal medicine that imaging lung is difficult to perform leading to mistakes, perpetuate lung ultrasound's delayed use in small animals (dogs and cats). Thoracic FAST called TFAST was the first standardized abbreviated ultrasound exam of the thorax that included the Chest Tube Site (CTS) for lung surveillance for detection of PTX. Because of the finding of lung pathology found during TFAST, the author extended lung surveillance from the TFAST^{SM} CTS with the addition of 6 more lung views. The name of this novel regionally-based lung ultrasound exam is Vet BLUE^{SM} ("Vet" for veterinary and "BLUE" blue for cyanosis and bedside lung ultrasound exam). The Vet BLUE regional sites include the caudodorsal lung lobe region (Cd), the perihilar lung lobe region (Ph), the middle lung lobe region (Md), and the cranial lung lobe region (Cr). Each is named as a region because the naming do not directly correlate with anatomical names of lung lobes. This is important to appreciate because 2 parts of a lung lobe or 2 different lung lobes may be coming into view over the same Vet BLUE regional view with as an example dry lung then wet lung then dry lung then wet lung or dry lung and a shred and dry lung then a shred as the patient inspires and expires (this phenomenon in fairly common).

The "Gator Sign" – Basic Lung Ultrasound Orientation



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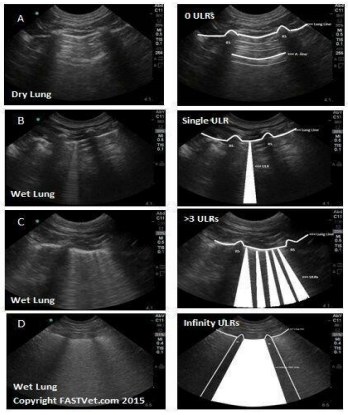
Probe Orientation, Type & Settings: Lung ultrasound orientation **is ALWAYS the same** with the visualization of the **Gator Sign** to **properly identify the pulmonary-pleural interface** or **the "Lung Line"** (the surface of the lung). The **probe is held** perpendicular to the long-axis of the ribs; **Depth** is generally set between **4-6 cm; Frequency** is generally set between **5-10 MHz;** and **a microconvex probe** is preferred over a linear probe because the probe is acceptable for AFAST[3], TFAST[3] and Vet BLUE (Global FAST[3]). A phase-array or sector probe is generally

not recommended because its focal point is too small. A linear probe may be used; however, it is not ideal for the AFAST[3] and TFAST[3] portions of Global FAST[3] (GFAST[3]). The rounded rib heads are likened to the eyes, and the pulmonary-pleural (PP-line) interface (also called the lung line) to the bridge of its nose, as a partially submerged gator (alligator) peers at the sonographer. The proximal white line is the focus of ALL lung ultrasound. The major orientation error is looking beyond the PP-line (or "lung line") and mistaking A-line artifacts for the PP-line or "lung line"or being over the abdomen and mistaking liver, stomach (especially when air-filled), or the gallbladder for lung pathology.

Vet BLUE[SM] Examination

The **Vet BLUE lung examination** is a **screening test** performed identically as the probe is positioned at the CTS view of TFAST[3]. The probe is then moved through regional locations that are bilaterally applied as follows: **caudodorsal lung region** (Cd - same as the TFAST[3] CTS view, upper third, 8-9[Th] intercostal space)), **perihilar lung region** (Ph – 6-7[th] intercostal space, middle third), **middle lung region** (Md – 4-5[th] intercostal space, lower thrid), and **cranial lung region** (Cr – 2[nd]-3[rd] intercostal space, lower third).



The **maximum number of ULRs** over the respective single intercostal space at each view is recorded. The counting system is as follows: **1, 2, 3, >3** (when ULRs are still recognized as individuals), and **infinity** ∞ (when the ULRs blend into one another becoming confluent [also called white lung]). Because most typing keyboards do not have an infinity symbol we use the "&" sign for infinity ULRs.

ULRs are counted because they have been shown to correlate with the degree of alveolar-interstitial edema on Computerized Tomography (CT).

Key Point: ***Best Way to Perform Vet BLUE Accurately*** is to locate the left TFAST Chest Tube Site directly above the xiphoid in the area of the 8-10[th] intercostal space in the upper 1/3[rd] of the thorax, cheating cranially to make sure over lung (and not over liver/stomach/abdominal contents). From the left TFAST CTS which is the same as the left Vet BLUE Cd lung point, draw a line (with your alcohol or acoustic coupling gel) to the elbow, halfway to the elbow is the Vet BLUE Ph point, and at the elbow is the Vet BLUE Md point. If the heart is in view at the

Vet BLUE Md point, slide above the heart until you see the lung line. The last point is the Vet BLUE Cr which requires pulling the foreleg cranially to get probe be placed in the 2nd-3rd intercostal space. Too low at the Cr point, you will see the striations of the pectoral muscles and too high and cranial at the Cr point, you will be in the thoracic inlet (soft tissue and vessels). The Gator Sign and the "lung line" must be appreciated to know you are in fact over lung. The Vet BLUE points are acquired in the same manner on the right side. *Perform the Vet BLUE the same way every time. We suggest that you begin on the LEFT and go from dorsal to ventral, move to the right side and do the same, dorsal to ventral. This allows you to think about the pattern in the same manner every time and helps you remember the findings at each site. Also, by completing the Vet BLUE at the right cranial lung lobe region (Cr) region increase your depth, and do your right TFAST pericardial view and proceed with the increased depth to AFAST and Global FAST (GFAST) is finished in < 4-5 minutes by the appropriately trained sonographer!*

Vet BLUE for Respiratory Distress – 5 Basic Lung Ultrasound Findings
"Wet Lung" vs. "Dry Lung" and The Shred Sign, Tissue Sign, Nodule Sign

Wet vs. Dry Lung: Basic easily recognizable lung ultrasound findings are categoriazed into **the Wet Lung** vs. **Dry Lung concept.** A Glide Sign with A-lines (reverberation artifact) at the lung line is considered **"Dry Lung"** only to be confounded with PTX (A-lines and No Glide Sign). However, many patients in which the probability of PTX is very low, then spending additional time finding the Glide Sign becomes less important and A-lines alone suffice. **Ultrasound Lung Rockets (ULRs)** are considered **"Wet Lung"** and oscillate to and fro with inspiration and expiration and must extend to the far field obliterating A-lines.

Rule Outs for DRY All Fields on Vet BLUE℠
RESPIRATORY
Pulmonary Thrombo-embolism (PTE)
Upper Airway Conditions (e.g., Collapsing Trachea, Laryngeal Paralysis), Obstruction (e.g., Mass)
Chronic Obstructive Pulmonary Disease (COPD), Feline Asthma
Centrally located lung pathology away from the lung line (missed by Vet BLUE)
CARDIAC
Cardiac Tamponade, Cardiac Arrhythmia, Dilated Cardiomyopathy (DCM)
UNDIFFERENTIATED HYPOTENSION
Anaphylaxis
Hemoabdomen, Hemothorax, Hemoretroperitoneum, other cavitary or hemorrhage in a space
OTHER NON-RESPIRATORY
Pyrexia or High Fever
Severe Metabolic Acidosis
Severe Anemia
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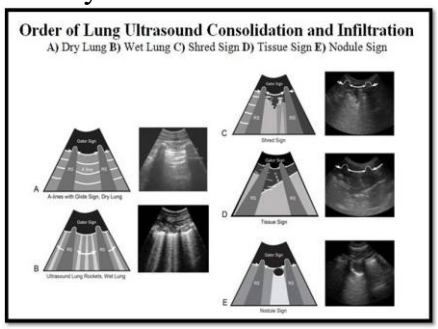
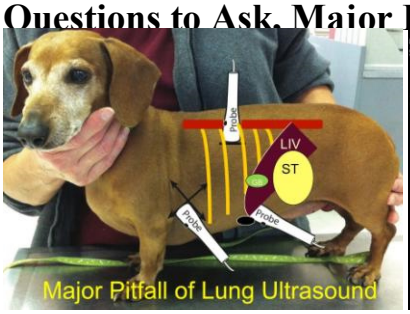
Consolidated/Infiltrated Lung – The Shred Sign, Tissue Sign and Nodule Sign: The Shred Sign is identified by a deviation from the expected linear continuity of the lung line (pulmonary-pleural line) and within the "Shred" has hyperechoic (white) foci indictaive of air movement through the bronchi. The Shred Sign is comparable to an air bronchogram on thoracic radiography. **The Tissue Sign** is more severe consolidation/infiltration in which no air movement is present and the lung likened to liver referred to as "hepatization" in many ultrasound textbooks. **The Nodule Sign** is the final sign and charcterized by an anechoic (black) circle (nodule) often with acoustic enahmacement thgrough the far field (often as a lung rocket).

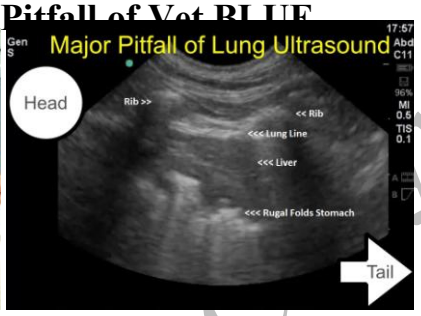
Not shown is a subset of the Shred Sign called the **Wedge Sign** which represents an infarct of lung and pulmonary thrombo-embolism at the lung surface.

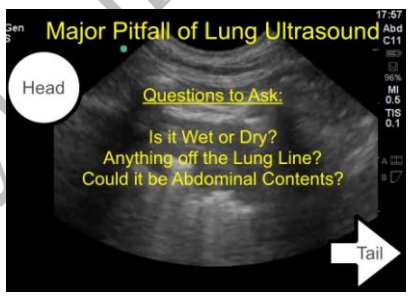


Regionally-based Respiratory Pattern Approach Using Vet BLUE – see Chapter 10: The Vet BLUE in Focused Ultrasound Techniques for the Small Animal Practitioner, Wiley ©2014

Questions to Ask, Major Pitfall of Vet BLUE

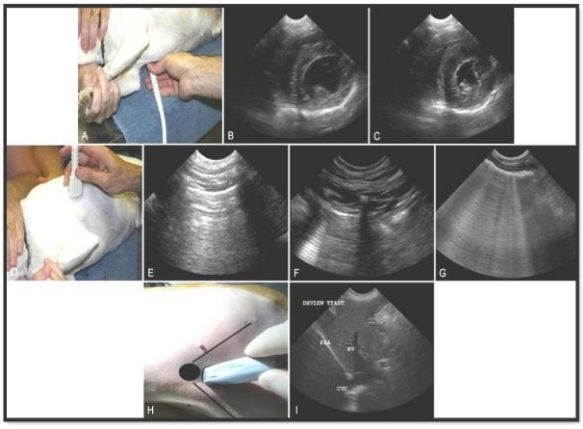






Pitfall of Lung Ultrasound. Surprisingly possible, abdominal contents can make it into your field of view during Vet BLUE at the Cd, Ph, and Md views especially in standing and sternal positioning. We recommend sliding an intercostal space cranial until abdominal contents are no longer entering your field of view. The image (center) shows what liver and stomach look like during Vet BLUE which can occur at the Cd, Ph, and Md views. **Pearl:** It is imperative to ***ALWAYS*** orient the probe with the head to the left and the tail to the right so that you always question whether anything entering from the right of the screen is abdominal contents. Shown in the image on the far right, are the questions to ask? **1)** Is it Wet or Dry Lung? **2)** Anything off the Lung Line? – Shred Sign, Tissue Sign, Nodule Sign and **3)** Could it be Abdominal Contents?

The Global FAST^{SM} Triad for Volume Status & Patient Monitoring



Top Row: The 3 Echo Views of TFAST are the Left Ventricular Short-axis View for Volume and Contractility (shown), the Right Ventricular to Left Ventricular Ratio on the Long-axis 4 Chamber View (not shown), and the LA:AO Ratio on the Short-axis View (not shown).

Middle Row: The presence of Dry vs. Wet Lung screens for Left-sided cardiac overload.

Bottom Row: The characterization of the Caudal Vena Cava and Hepatic Veins screens for Right-sided cardiac overload.

Global FAST^3 should be used for rapid evaluation of patient volume status pre-, during, and post- fluid resuscitation by using the "GFAST^3 Triad"; and use of the AFAST-applied fluid scoring system, and use of the AFAST-applied urinary bladder volume formula of Lenght (cm) x Width (cm) x Height (cm) x 0.625 is volume (mls).

References:

1. Lisciandro GR, et al. Frequency and number of ultrasound lung rockets (B-lines) using a regionally based lung ultrasound examination named vet blue (veterinary bedside lung ultrasound exam) in dogs with radiographically normal lung findings. *Vet Radiol and Ultrasound* 2014;55(3):315-22.
2. Lisciandro GR, Ward JL, DeFrancesco TC, Mann KA. Absence of B-lines on Lung Ultrasound (Vet BLUE protocol) to Rule Out Left-sided Congestive Heart Failure in 368 Cats and Dogs. *In Review, Abstract, J Vet Emerg Crit Care.*
3. Ward JL, Lisciandro GR, Tou SP, Keene BW, DeFrancesco TC. Evaluation of point-of-care lung ultrasound (Vet BLUE protocol) for the diagnosis of cardiogenic pulmonary edema in dogs and cats with acute dyspnea. *J Am Vet Assoc, accepted September 2015.*
4. Kulhavy DA, Lisciandro GR. Use of a Lung Ultrasound Examination Called Vet BLUE to Screen for Metastatic Lung Nodules in The Emergency Room. *Abstract, J Vet Emerg Crit Care, 2015.*
5. Lisciandro GR. Chapter 9: The Thoracic (TFAST) Exam; Chapter 10: The Vet BLUE Lung Scan. *In* Focused Ultrasound for the Small Animal Practitioner, Editor, Lisciandro GR. Wiley Blackwell: Ames IA 2014.
6. Lisciandro GR and Armenise A. Chapter 16: Focused or COAST^3 - CPR, Global FAST and FAST ABCDE. *In* Focused Ultrasound for the Small Animal Practitioner, Editor, Lisciandro GR. Wiley Blackwell: Ames IA 2014.