

The Tale of Four Felines - Use of Vet BLUE and TFAST in Feline Respiratory Distress

ISVMA 2021, Virtual Conference

Gregory R. Lisciandro, DVM, Dipl. ABVP, Dipl. ACVECC

Hill Country Veterinary Specialists & FASTVet.com, Spicewood, Texas USA

Email LearnGlobalFAST@gmail.com

Cell 210.260.5576

Website FASTVet.com

Textbook [Point-of-care Ultrasound Techniques for the Small Animal Practitioner](#), 2nd Edition, Wiley

©2021

Learning Objectives

- Understand TFAST[®] and its 5 views and their use for pericardial and pleural effusion, pneumothorax, and echocardiography
- Understand the fundamental lung ultrasound orientation of the gator sign and its components
- Understand Vet BLUE[®] and its regional, pattern-based approach, B-line scoring system, and its visual lung language for wet vs. dry lung, shred sign, tissue sign, nodule sign, and wedge sign
- Understand the advantages of the TFAST[®]-Vet BLUE[®] approach for the respiratory feline over lung auscultation, breathing patterns and radiography

How to Perform Vet BLUE[®] and TFAST[®]

Patient Positioning & Preparation

Although Vet BLUE[®]-TFAST[®] may be performed in lateral recumbency, Vet BLUE[®]-TFAST[®] is almost always performed in standing or sternal recumbency unless the patient presents laterally recumbent due to their disease condition and moving them is risky. Sternal and standing is safer for cats in respiratory distress and those that are hemo-dynamically fragile or respiratory compromised. For ventral Vet BLUE[®] and TFAST[®] views, a roll of towels or paper towels under the forelegs of a sternal recumbent feline is an easily tolerated maneuver. No views are shaved. All images in the lecture were from unshaved cats. Smaller amounts of isopropyl alcohol are applied to hair to part the hair for direct exposure to the skin. This prevents air trapping. Then the author uses primarily alcohol-based hand sanitizer gel for coupling, a brilliant trick learned from Dr. Jennifer Gambino, DACVR, several years ago. Hand sanitizer gel avoids the noxious coldness and fumes of isopropyl alcohol and wipes off easily (and evaporates), especially when a cat is placed in the confines of an oxygen cage. Keep in mind that most ultrasound manufacturers warn against placing isopropyl alcohol directly on the probe head because of alcohol's potentially damaging effects so you can always place commercially available ultrasound gel to the probe head. To maximize the image quality, the probe head should be applied as directly as possible to the skin surface without hair in between the probe head and the patient's skin (minimizing air trapping in wetted hair while optimizing the image quality).

How to Perform TFAST[®] - Its 5 Acoustic Windows

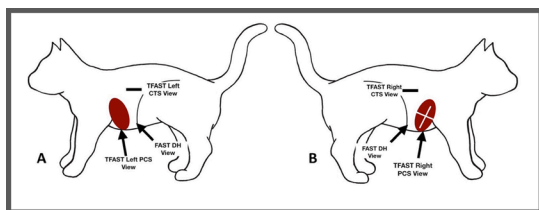


Figure. TFAST® - Its 5 Acoustic Windows. The TFAST® protocol consists of bilaterally applied Chest Tube Site views, Pericardial Site views, and then the singly applied Diaphragmatico-Hepatic view. *This material is reproduced with permission of John Wiley & Sons, Inc., Point-of-care Ultrasound Techniques for the Small Animal Practitioner, Wiley ©2014, 2021 and Dr. Gregory Lisciandro, FASTVet.com and Hill Country Veterinary Specialists.*

How to Perform Feline Vet BLUE® - Its 9 Acoustic Windows

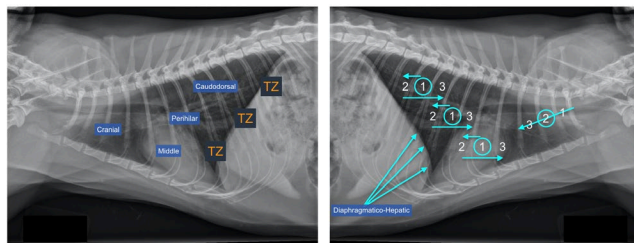


Figure. Vet BLUE® - Its 9 Acoustic Windows. Locate the *left* TFAST® Chest Tube Site. Place the probe perpendicular to the long axis of the ribs and identify the Gator Sign orientation. Find the Caudodorsal Transition Zone (CdTZ) by locating the Curtain Sign, where lung shadows over the abdominal structures with a mandatory linear caudal border. From the CdTZ, move 2-3 intercostal spaces (ICS) *cranially* from the Curtain Sign of the CdTZ to ensure the probe is over lung/pleural space and not over liver/stomach/abdominal contents. This is the starting point for the left Vet BLUE® caudodorsal (Cd) lung region view. Now slide one ICS caudally, then back to your starting point, and one ICS cranially to survey a minimum of 3 ICSs. To find the perihilar lung (Ph) region, draw an imaginary line or an actual line with your acoustic coupling medium to the cat's elbow. Approximately halfway to the elbow is the Vet BLUE® perihilar (Ph) lung region view, and near the elbow is the Vet BLUE® middle (Md) view. If the heart is imaged at the Vet BLUE® Md view, slide immediately dorsal to the heart until you see the "lung line." At each of these respective Vet BLUE® views make it a habit to slide caudally first because in doing so you ask yourself, "where is the transition zone of pleural and abdominal cavities?" defined by the Curtain Sign. The final view is the Vet BLUE cranial (Cr) lung region, which requires gently extending (and flexing) the foreleg cranially to image the 1st, 2nd and 3rd intercostal spaces. Find the soft tissue neck and its Cranial Transition Zone (CrTZ) with the pleural cavity. From the CrTZ the probe is slid caudally over the first 3 ICSs to accurately identify the Vet BLUE® Cr lung region. If too ventral at the Cr view, you will see the pinnate striations of the pectoral muscles. Our preference is to start high (dorsal) on the left hemithorax moving from Cd to Ph to Md to Cr, followed by the TFAST® left Pericardial Site view, the TFAST® Diaphragmatico-Hepatic (DH) View, and then performing Vet BLUE® analogously on the right hemithorax, ending with the TFAST® echocardiography views. We call this efficient approach the Vet BLUE®-TFAST® Blend. By always performing Vet BLUE® in the same manner, findings are better remembered, and with the author's recommended order, the most time consuming TFAST® echocardiography views are performed last in this sequence. Moreover, once at the TFAST® echocardiography views, the sonographer is already aware of lung pathology, the presence or absence of pleural and pericardial effusion, and volume status via the caudal vena cava and hepatic veins. Thus, the importance of the TFAST® echocardiography views is likely known using Global FAST® integration and the "Global FAST® Non-echo Fallback Views." *This material is reproduced with permission of John Wiley & Sons, Inc., Point-of-care Ultrasound Techniques for the Small Animal Practitioner, Wiley ©2014, 2021 and Dr. Gregory Lisciandro, FASTVet.com and Hill Country Veterinary Specialists.*

Fundamental Vet BLUE® Orientation - The Gator Sign

The Gator Sign is important to understand to ensure that the pulmonary-pleural interface, also referred to as the "lung line" by the author, is properly imaged. Mistaking air reverberation artifacts or another hyperechoic (bright white) structure for the lung line (stomach, liver, gallbladder, soft tissue, fascial planes and bone), makes your lung ultrasound ineffective and error prone. The probe is held stationary and perpendicular to the long axis of the ribs for identifying the Gator Sign.

Probe Type, Depth Settings, Preset

The depth is generally set between 4-8 cm depending on the size of the patient. In felines, depth is generally set between 4-6 cm. *Being in closer than 4 cm lends itself to missing pathology that extends from the lung surface deeper than your depth setting.* Frequency is generally set between 10-7 MHz. A microconvex probe is preferred over a linear probe because the microconvex probe is acceptable for the entire Global FAST® - combining AFAST®, TFAST® and Vet BLUE® – a concept and ultrasound imaging strategy gaining momentum on the human side because through the integration of unbiased imaging data points of both cavities, image interpretation errors are minimized. A linear probe will provide superior imaging of the lung surface; however, how much is gained over a microconvex probe is unknown. The linear probe is not effective for TFAST® echocardiography portions of Global FAST®. We prefer the abdominal preset for the entire Global FAST® examination because the longitudinal orientation is maintained with the head to the left and the tail to the right of the screen. A phased-array probe is not recommended for Vet BLUE® because it cannot accurately identify the Gator Sign orientation and count numbers of B-lines.

The Vet BLUE® B-line Scoring System and Its Visual Lung Language

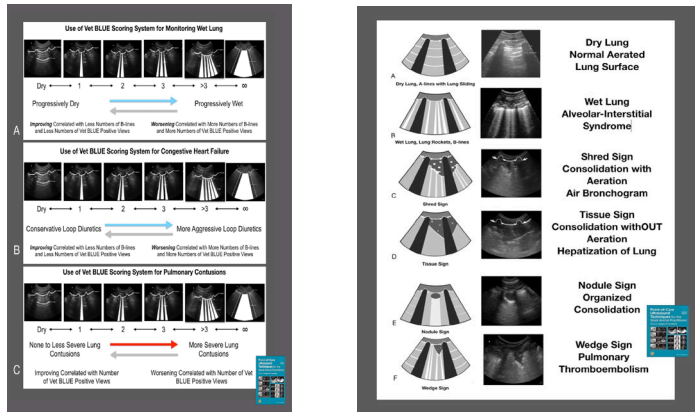


Figure Left. The Vet BLUE® B-line Scoring System and Counting B-lines. B-line numbers likely correlate with degree of alveolar-interstitial edema and the author's Vet BLUE® B-line Scoring System has been published in the literature in several peer-reviewed journals. The scoring is as follows: 1, 2, and 3 as "weak positives" and >3, and infinite as "strong positives." In cases with cardiogenic lung edema, B-line scoring better guides loop diuretic usage. In trauma, B-lines most commonly represent lung contusions until proven otherwise. The Vet BLUE® B-line Scoring System assesses severity of all Wet Lung conditions by combining B-line scoring with numbers of positive regional Vet BLUE® views. **Figure Right. The Vet BLUE® Visual Lung Language – Dry Lung, Wet Lung, Shred Sign, Tissue Sign, Nodule Sign and Wedge Sign.** This material is reproduced with permission of John Wiley & Sons, Inc., [Point-of-care Ultrasound Techniques for the Small Animal Practitioner](#), Wiley ©2014, 2021 and Dr. Gregory Lisciandro, [FASTVet.com](#) and Hill Country Veterinary Specialists.

Wet versus Dry Lung and Pseudo B-lines

Easily recognizable lung ultrasound findings are categorized into Wet Lung and Dry Lung. A-lines with lung sliding defines “Dry Lung” only to be confounded with pneumothorax (PTX), which is A-lines *with absent lung sliding*. B-lines (also called ultrasound lung rockets) are considered “Wet Lung” and by definition are vertical laser-like hyperechoic lines that do not fade through the far-field obliterating A-lines and oscillate to and fro with inspiration and expiration (Lisciandro 2011). The numbers of B-lines are counted (called the Vet BLUE® B-line Scoring System), and recorded over the most representative intercostal space at each Vet BLUE® acoustic window because there is evidence in human lungs that numbers of B-lines correlate with degree of alveolar-interstitial edema. The Vet BLUE® B-line Scoring System has been published in several clinical studies. Ingesta in the stomach and nodules also cause B-lines similar to the differences in acoustic impedance and cuffing of alveoli around fluid with forms of alveolar-interstitial edema. We call these “Pseudo B-lines” to differentiate them from types of alveolar interstitial edema.

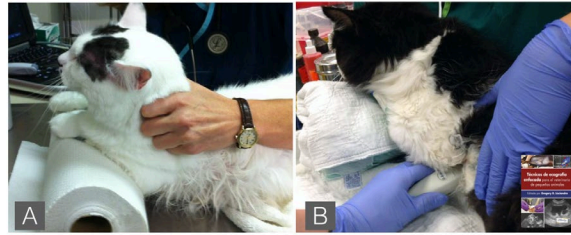
Differentials for Dry Lung All Views on Vet BLUE®	
Respiratory	Pneumothorax
	Dynamic Upper Airway Conditions (e.g., Collapsing Trachea, Laryngeal Paralysis)
	Intrathoracic Airway Collapse (e.g., Tracheal Collapse, Mainstem Bronchial Collapse, Lobar Bronchial Collapse, Bronchomalacia)
	Upper Airway Obstruction (e.g., Mass, Foreign Body, Oropharyngeal Swelling, Inflammation, Nasopharyngeal Polyp [cats], Granulomatous Laryngitis [cats])
	Tracheobronchitis (e.g., Infectious, Inflammatory, Irritant)
	Inflammatory Lower Airway Disease (e.g., Chronic Bronchitis, Asthma [cats], Eosinophilic Bronchitis [dogs], Bronchiectasis)
	Lung Pathology not Located at the Lung Surface at any Vet BLUE® view
Cardiac	Pericardial Effusion / Cardiac Tamponade
	Cardiac Arrhythmia
	Dilated Cardiomyopathy (DCM)
	Right-sided Congestive Heart Failure
Pulmonary Vascular Disease	Pulmonary Thromboembolism (PTE)
	Pulmonary Hypertension (PH)
Undifferentiated Hypotension	Canine Anaphylaxis
	Cavitary or Spatial Bleeding (e.g., Hemoabdomen, Hemothorax, Hemoretroperitoneum, Hemopericardium, Fracture Site)
	Gastric Dilatation-Volvulus /Bloat
	Sepsis
Other Non-respiratory	Pyrexia / Heat Stroke / High Fever
	Severe Metabolic Acidosis
	Severe Anemia
	Neurological Disease
	Pain
Gregory R. Lisciandro, DVM, Dipl. ABVP, Dipl. ACVECC and FASTVet.com ©2015, 2016, 2019, 2021	

Table. Dry Lung All Views Differentials. The most rapid and sensitive manner to *rule out* left-sided CHF *plus all other common wet lung conditions* (non-cardiogenic lung edema, pneumonia, lung hemorrhage and contusions) is the Vet BLUE® finding of Dry Lung all views. *This may be the greatest overall clinical strength of Vet BLUE®. This material is reproduced with permission of John Wiley & Sons, Inc., Point-of-care Ultrasound Techniques for the Small Animal Practitioner, Wiley ©2014, 2022 and Dr. Gregory Lisciandro, FASTVet.com and Hill Country Veterinary Specialists.*

Shred Sign, Tissue Sign, Nodule Sign, and Wedge Sign (PTE)

The 4 more severe Vet BLUE® signs we have described in progressive order of increasing consolidation/infiltration are the Shred Sign (air bronchogram, consolidation *with* aeration of the lung); the Tissue Sign (hepatization of lung, consolidation *without* aeration); the Nodule Sign (consolidation/infiltration into discreet nodules/masses); and the Wedge Sign (a subset of the Shred-Tissue Sign, triangular, and supports pulmonary thromboembolism (PTE), lung infarction when found in the *upper Cd and Ph* Vet BLUE® views).

Imaging Tricks for Cats - Important to Look High and Low



If You Can Place a Stethoscope, You Can Place the Ultrasound Probe

Figure. Elevating Forelegs. It is important to minimally “go high and go low” with the ultrasound probe on a feline thorax. In other words, the TFAST® Chest Tube Site views (go high) and the Pericardial Site views (go low) because **lung floats** and you will miss the pleural effusion. Most cats tolerate the roll of paper towels or a towel placed under the forelegs when they are then left alone as they concentrate on breathing. This trick was taught to me by Dr. Teresa DeFrancesco, DVM, DACVIM (cardiology), DACVECC.

Must Go High and Go Low on a Cat's Thorax or You Misinterpret Findings Must Go High and Go Low on a Cat's Thorax or You Misinterpret Findings

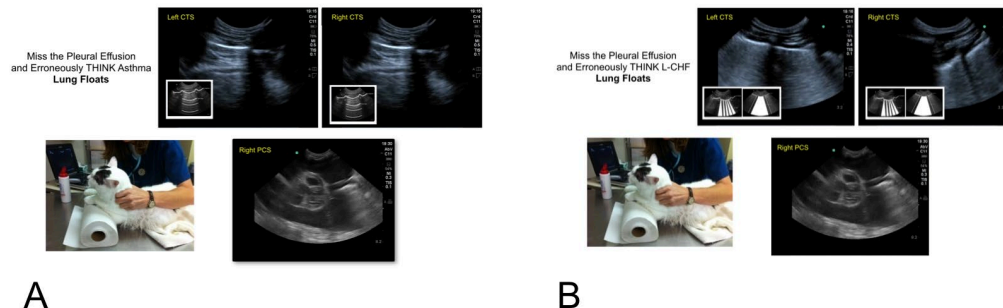


Figure. Example for Lung Floats and Misinterpreting POCUS Findings. In A) lung is dry and if only look high, you will erroneously think the feline has asthma missing the pleural effusion. In B) lung is a strong positive wet of >3 and infinite B-lines and if you only look high you will erroneously think the feline has left-sided congestive heart failure missing the pleural effusion. In both cats, the pleural effusion is likely the major player for respiratory distress and warrants an emergent thoracentesis as the lifesaving intervention. *This material is reproduced with permission of Dr. Gregory Lisciandro, FASTVet.com and Hill Country Veterinary Specialists Copyright 2021.*

The Tale of 4 Felines

The use of thoracic auscultation and breathing patterns for respiratory distress is insensitive and prone to error, coupled with the dangers of transport and restraint in radiology and thoracic radiographic interpretation, making the proactive use of the Vet BLUE®-TFAST® protocol an incredibly powerful tool for differentiating respiratory distress in cats. On physical examination (lung auscultation and breathing patterns) *all 4 felines look similar* with nostril flaring, abdominal breathing, and harsh lung sounds. However, each has a radically different Vet BLUE®-TFAST®- profile. *In felines with severe respiratory distress, “Go High (dorsal) and Go Low (ventral)” because lung floats and you miss the pleural effusion or pericardial effusion by only looking high (dorsal) at lung.*

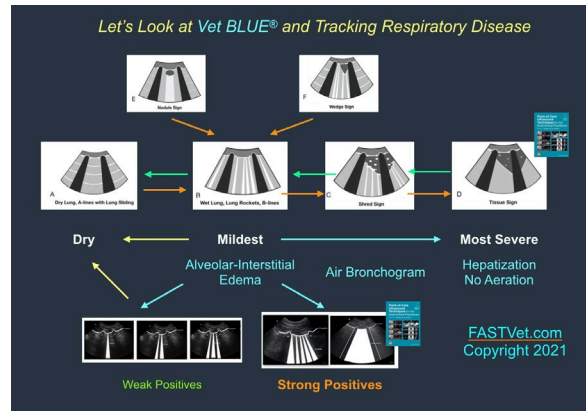
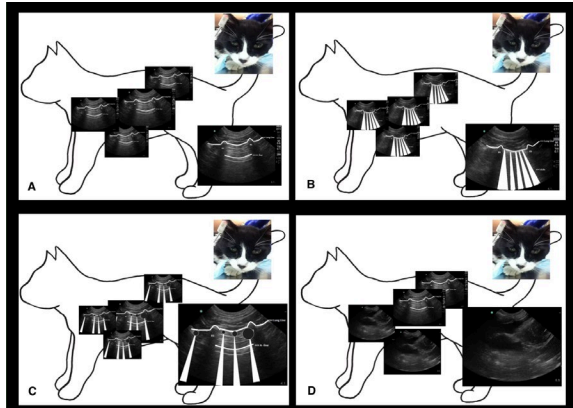


Figure Left. The Tale of 4 Felines. A) Feline Asthma, B) Left-sided CHF, C) Metastatic Disease, and D) Pleural Effusion. **Figure Right. Use of Vet BLUE® for Tracking Respiratory Conditions.** This material is reproduced with permission of John Wiley & Sons, Inc., *Point-of-care Ultrasound Techniques for the Small Animal Practitioner*, Wiley ©2014, 2021 and Dr. Gregory Lisciandro, FASTVet.com and Hill Country Veterinary Specialists.

Recording Vet BLUE® - TFAST® for the Medical Record - see "Free Resources" category at FASTVet.com

Vet BLUE® (Left Cd to Ph to Md to Cr THEN to the DH View and then to the Right Cd to Ph to Md to Cr) – Always same order!

Left: x, x, x, x

Right: x, x, x, x

Example likely Left-sided Heart Failure:

Left: >3, >3, >3, 0

Right: >3, >3, >3, 0

DH: > 3

Example likely Aspiration Pneumonia (left middle lung lobe):

Vet BLUE® (Cd, Ph, Md, Cr)

Left: 0, 0, >3, 0

Right: 0, 0, 0, 0

DH: 0

Example likely Feline Asthma:

Vet BLUE® (Cd, Ph, Md, Cr)

Left: 0, 0, 0, 0

Right: 0, 0, 0, 0

DH: 0

KEY: Sh= Shred Sign; Ti= Tissue Sign; Nd= Nodule Sign; Ff = Free Fluid Sign

*The maximum number of B-lines (0, 1, 2, >3 [still recognized as individuals but not filling the entire intercostal space], ∞ [infinite, blended all together]) is counted over a single intercostal space at each respective Vet BLUE® view.

Comparison of Vet BLUE® to Thoracic Radiography (TXR) and Computed Tomography (CT)

Vet BLUE® is proving itself as a more sensitive test than TXR for Wet Lung conditions (types of alveolar-interstitial edema) and pneumothorax, comparing much more closely to CT. We have several clinical studies published which are in press and in the process of being submission for peer review that support this statement. As for types of consolidation including nodules, more studies are needed to make a statement on the performance of Vet BLUE® to TXR and CT. One recent study of which the author was involved showed that Vet BLUE® was similar but not superior to TXR in sensitivity and specificity for pulmonary nodules; however, temporal comparison of the 3 imaging modalities was not ideal.

Always Strive for The GLOBAL FAST® Approach and Integration of Findings

Selective imaging leads to “confirmation bias error” and “satisfaction of search error” and is a major concern with the POCUS movement. Minimally, Vet BLUE® should be integrated with TFAST® findings, including TFAST® fundamental echocardiography, to determine the cause for Wet Lung. For example, diffuse Wet Lung with an enlarged left atrium supports left-sided congestive heart failure; however, in the absence of left atrial enlargement, other Wet Lung conditions need to be considered.

References & Further Reading

1. **Lisciandro GR**, Lisciandro SC. Chapter 22: POCUS: Vet BLUE-Introduction and Image Acquisition and Chapter 23: POCUS: Vet BLUE-Clinical Integration. *In Point-of-care Ultrasound Techniques for the Small Animal Practitioner*, 2nd Edition, Ed. Lisciandro GR. Wiley Blackwell: Ames IA 2021.
2. **Lisciandro GR**. Chapter 17: POCUS: TFAST-Introduction and Image Acquisition and Chapter 18: POCUS: TFAST-Clinical Applications. *In Point-of-care Ultrasound Techniques for the Small Animal Practitioner*, 2nd Edition, Ed. Lisciandro GR. Wiley Blackwell: Ames IA 2021.
3. Rodriguez D, **Lisciandro GR**, Lisciandro SC. Chapter 39: POCUS: Feline Abdomen and Thorax Differences. *In Point-of-care Ultrasound Techniques for the Small Animal Practitioner*, 2nd Edition, Ed. Lisciandro GR. Wiley Blackwell: Ames IA 2021.
4. **Lisciandro GR**, Puchot ML, Gambino JM, Lisciandro SC. The Wedge Sign: A Possible Lung Ultrasound Sign for Pulmonary Thromboembolism. *J Vet Emerg Clin Care, In Press, 2021*.
5. Ward JL, Murphy SD, **Lisciandro GR**, et al. Comparison of curvilinear-array (microconvex) and phased-array transducers for ultrasonography of the lungs in dogs. *Am J Vet Res, In Press, 2021*.
6. **Lisciandro GR**, Fulton RM, Fosgate GT, 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 cats with radiographically normal lung findings. *J Vet Emerg Crit Care 2017; 27(3): 267-277*.
7. 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 2017; 250(6): 666-675*.
8. **Lisciandro GR**, Ward JL, DeFrancesco TD, et al. Absence of B-lines on Lung Ultrasound (Vet BLUE protocol) to Rule Out Left-sided Congestive Heart Failure in 368 Cats and Dogs. *Abstract, J Vet Emerg Crit Care 2016; 26(S1): S8*.
9. Ward JL, **Lisciandro GR**, DeFrancesco TC. Distribution of alveolar-interstitial syndrome in dyspneic veterinary patients assessed by lung ultrasound versus thoracic radiography. *J Vet Emerg and Crit Care 2018; 28(5): 415-428*.
10. 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; 25(S1);S14*.

11. Ward JL, **Lisciandro GR**, DeFrancesco TD, et al. Evaluation of Point-of-care Thoracic Ultrasound and NT-proBNP for the Diagnosis of Congestive Heart Failure in Cats with Respiratory Distress. *J Vet Intern Med* 2018; 32(5): 1530-1540.
12. **Lisciandro GR**. Evaluation of initial and serial combination focused assessment with sonography for trauma (CFAST) examination of the thorax (TFAST) and abdomen (AFAST) with the application of an abdominal fluid scoring system in 49 traumatized cats. Abstract, *J Vet Emerg Crit Care* 2012; 22(2): S11.