Article

The use of veterinary point-of-care ultrasound by veterinarians: A nationwide Canadian survey

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Abstract — This survey assessed how veterinary point-of-care ultrasound (VPOCUS), including abdominal and thoracic focused assessment with sonography for trauma (AFAST, TFAST), is used across Canada. Seventy-four veterinarians completed an online survey; 88% (65/74) used ultrasound, 94% (61/65) performed AFAST, and 69% (45/65) performed TFAST. Reasons for not performing VPOCUS included no machine/poor quality machine, lack of experience/confidence, and lack of training/education. Abdominal effusion, and pleural and pericardial effusion were the most frequently diagnosed AFAST and TFAST pathologies, respectively. Lung and cardiovascular ultrasound examinations were infrequently performed. Subpleural consolidation was rarely included in VPOCUS. Most respondents performed VPOCUS, with AFAST being more frequently and confidently preformed than TFAST. More training, education, and standardization of techniques appear to be key elements to help build confidence and experience, particularly with regard to TFAST applications and diagnosis.

Résumé — Utilisation de l'échographie au lieu d'intervention par les vétérinaires : une enquête pancanadienne. Cette enquête visait à évaluer comment l'échographie au lieu d'intervention vétérinaire (VPOCUS), incluant l'évaluation abdominale et thoracique avec l'échographe pour un trauma (AFAST, TFAST), est utilisée à travers le Canada. Soixante-quatorze vétérinaires ont complété une enquête en ligne; 88 % (65/74) utilisait l'échographie, 94 % (61/65) effectuaient AFAST et 69 % (45/65) effectuaient TFAST. Les raisons invoquées pour ne pas effectuer VPOCUS incluaient aucun appareil/équipement de pauvre qualité, manque d'expérience/confiance et manque de pratique/formation. Les effusions abdominales de même que les effusions pleurales et péricardiques étaient les pathologies AFAST et TFAST les plus fréquemment diagnostiquées, respectivement. Les examens échographiques pulmonaires et cardiovasculaires étaient effectués peu fréquemment. La consolidation sub-pleurale était rarement incluse dans les VPOCUS. La plupart des répondants réalisaient VPOCUS, avec AFAST effectué plus fréquemment et avec plus de confiance que TFAST. Plus de pratique, de formation et de standardisation des techniques semblent des éléments clés pour aider à bâtir la confiance et l'expérience, particulièrement en ce qui concerne les applications et le diagnostic des TFAST.

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Introduction

Focused assessment with sonography for trauma (FAST), or veterinary point-of-care ultrasound (VPOCUS), is a fast, non-invasive diagnostic tool frequently used in human and veterinary medicine. The value of these techniques for aid in early diagnosis and serial monitoring has been demonstrated numerous times (1). There are also many ways of performing a FAST scan, with repeatable results when performed in the same manner and identifying similar structures (1–3). Human medicine has been using ultrasound in the emergency room setting for many years. A study in human medicine demonstrated good standardization for the FAST scan process and interpretation, especially after taking a standardized course and performing at least 50 sonographic examinations (4).

The use of FAST scans in veterinary medicine is novel, with the first study published in 2004 demonstrating the value of abdominal FAST scans during triage of patients which suffered blunt force abdominal trauma (2). It has since been shown that veterinarians can perform FAST scans in a proficient and repeatable manner after as few as 20 scans (1). Scans such as these are also important for serial monitoring of emergency and in-hospital patients. This has helped to determine if free fluid is progressing or resolving following therapy, especially when serial abdominal fluid scores (AFS) are assessed (5). However, in veterinary medicine there is no standardized way to perform

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FAST scans; thus, repeatability within and between practices is an issue.

Veterinarians across the world have incorporated FAST scans into initial patient assessment, and some veterinary colleges have started to integrate it into the curriculum. Multiple studies have reported various FAST protocols which have evolved and been modified over time, creating conflicting views regarding what should be included in the FAST scan, as well as a lack of consensus on how to teach these formats to current and future veterinarians (3,5–7). As a result, veterinarians' method of performing a FAST scan and interpreting the results can vary. This has important implications when transferring patients between clinicians and practices, especially when serial monitoring is important for making treatment adjustments. Depending on which sites are examined, and the veterinarian's confidence level in their skills, a FAST scan can vary substantially.

In this study, a veterinary medical survey was distributed across Canada. The objective of this study was to assess what veterinarians incorporate in their AFAST and TFAST scans and determine the confidence level veterinarians express in their ability to diagnose various conditions using veterinary FAST scans. We hypothesized that the AFAST scan would be relatively standardized with a moderate to high level of confidence at diagnosing AFAST pathology, relative to a TFAST scan.

Materials and methods

The study population consisted of veterinarians across Canada. The survey was distributed using an electronic link attached to electronic and printed newsletters sent out by the Canadian Veterinary Medical Association, VCA Canada, Alberta Veterinary Medical Association, Nova Scotia Veterinary Medical Association, New Brunswick Veterinary Medical Association, CVMA — Society of BC Veterinarians Chapter, Ontario Veterinary Medical Association, and Manitoba Veterinary Medical Association. The anonymous medical survey was created using the Survey Monkey website and consisted of 29 questions focused on demographics, AFAST scan and TFAST scan. A complete list of the survey questions is available from the authors.

Informed consent was obtained from participants, with the option to opt-out of participating at any time. This survey was approved by the Human Ethics Review Board at the University of Calgary. The survey was distributed between March 4, 2019 and June 5, 2019. Results were collected and analyzed through the SurveyMonkey website.

Results

A total of 78 veterinarians participated and 74 completed the survey. The 74 veterinarians who completed the survey practice in Alberta (n = 22), Ontario (n = 19), British Columbia (n = 10), Quebec (n = 8), New Brunswick (n = 7), Manitoba (n = 3), Newfoundland and Labrador (n = 3), and Saskatchewan (n = 2). Most of the 74 participants were urban practitioners (n = 63), small animal focused (n = 64), general practitioners (n = 51), ER veterinarians (n = 29), specialist only (n = 20), or academics (n = 2). Participants could select more than one answer for these categories. None were practicing in industry. For education, participants were trained at the University of Guelph Ontario Veterinary College (n = 16), the University of Saskatchewan Western College of Veterinary Medicine (n = 22), l'Université de Montréal Faculté de Médecine Vétérinaire (n = 9), University of Prince Edward Island Atlantic Veterinary College (n = 9), University of Calgary Faculty of Veterinary Medicine (n = 2), other American Veterinary Medical Association accredited schools (n = 10), or other non-North American veterinary schools (n = 6). The participants had been practicing veterinary medicine for 0 to 5 y (n = 29), 6 to 10 y (n = 14), 11 to 20 y (n = 16), or $>$ 20 years (n = 14). One participant left this question blank. The estimated number of emergency cases seen each week and the number of hours of continuing education in FAST training are shown in Table 1.

The participants were then questioned regarding the use of ultrasound, in general, in their veterinary practice. Sixty-five participants performed ultrasound scans. The reasons for not performing ultrasound scans included lack of an ultrasound machine (n = 5/9), lack of training or education (n = 3/9), or other (not specified) (n = 1/9). Sixty-six particpants responded to the quesion regarding how many times per week they performed ultrasound (Table 1).

For AFAST specific questions, 61/65 participants who used ultrasound in their clinic performed AFAST scans. Of the 13 respondents who did not perform AFAST scans, the reasons for not doing so were no ultrasound machine (n = 5), lack of experience or confidence (n = 1), lack of training or education (n = 5), or other (not specified) (n = 2). Only 60 respondents who answered yes to performing AFAST scans completed all questions regarding the details of AFAST on the survey. The weekly numbers of AFAST scans performed are shown in Table 1. The sonographic windows scanned during an AFAST were the subxiphoid (DH) (n = 57), left paralumbar (SR) (n = 58), bladder (CC) (n = 60), right paralumbar (HHR) (n = 57), and flash umbilicus (n = 17). The position of patients during AFAST scan included left lateral (n = 26), right lateral (n = 35), sternal (n = 19), and dorsal (n = 47). Scanning longitudinally and transversely was performed by 86.67% (n = 52), while 13.33% (n = 8) scanned in one direction. Table 2 shows the pathology assessed during AFAST, and the confidence in diagnosing the pathology by respondents who performed AFAST scans. An abdominal fluid score was recorded by 40% (n = 24/60). Serial AFAST scans were performed by 66.7% (n = 40/60).

For TFAST specific questions, 45/65 participants who used ultrasound in their clinic also performed TFAST scans (69.2%). Among the 27 survey respondents who indicated that they did not perform TFAST (2 respondents who did not perform TFAST examinations answered this section), the reasons for not performing TFAST scans include no ultrasound machine (n = 5), poor quality machine (n = 1), lack of experience or confidence (n = 11), lack of training or education (n = 8), and other (not specified) (n = 3). Of those who performed TFAST scans, the weekly numbers of scans are shown in Table 1. Sonographic windows evaluated during TFAST scan included chest tube site (n = 26), pericardial site (n = 44), subxiphoid (DH) (n = 23), and other sites (not specified) (n = 14). Table 3 shows the findings assessed during a TFAST scan, and the confidence

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Table 1. Training of respondents and frequency of taking AFAST and TFAST scans.

	0	1 to 5	6 to 10	11 to 20	> 20
Emergency cases per week (N = 74)	2	30	7	4	31
Hours of FAST training (N = 74)	23	31	13	3	4
Times ultrasound was performed per week (N = 66)	3	31	13	8	11
Weekly number of AFAST scans (N = 60)	0	36	11	7	6
Weekly number of TFAST scans (N = 45)	0	30	6	6	3

FAST — Focused assessment with sonography for trauma; AFAST — Abdominal FAST, TFAST — thoracic FAST.

Table 2. Pathology assessed during routine AFAST examination and confidence in diagnosing pathology among the 60 survey respondents who performed AFAST.

Pathology on AFAST examination	Respondents who assessed for the pathology	Confidence in diagnosing the pathology
Peritoneal effusion	*n* = 59/60, 98.3%	*n* = 59/59, 100%
Gall bladder halo sign	*n* = 29/60, 48.3%	*n* = 24/29, 83%
Urinary bladder volume estimation	*n* = 38/60, 63.3%	*n* = 37/38, 97%
Bladder wall evaluation	*n* = 40/60, 66.7%	*n* = 36/40, 90%
Pyometra	*n* = 48/60, 80.0%	*n* = 47/48, 98%
Retroperitoneal injury	*n* = 20/60, 33.3%	*n* = 11/20, 55%
Pneumoperitoneum	*n* = 19/60, 31.7%	*n* = 11/19, 58%
Other	*n* = 19/60, 31.7%	*n* = 14/19, 74%

AFAST — Abdominal focused assessment with sonography for trauma.

Table 3. Pathology assessed during routine TFAST examination and confidence in diagnosing pathology by 45 survey respondents who performed TFAST.

Pathology on TFAST examination	Respondents who assessed the pathology	Confidence in diagnosing the pathology
Glide sign	*n* = 37/45, 82.2%	*n* = 25/37, 68%
Pleural effusion	*n* = 42/45, 93.3%	*n* = 42/42, 100%
Alveolar infiltrate	*n* = 33/45, 73.3%	*n* = 26/33, 79%
Pericardial effusion	*n* = 45/45, 100.0%	*n* = 44/45, 97.8%
La:Ao	*n* = 16/45, 35.6%	*n* = 10/16, 63%
Subjective CC	*n* = 20/45, 44.4%	*n* = 12/20, 60%
Subjective vascular volume (CVC diameter)	*n* = 7/45, 15.6%	*n* = 2/7, 29%
Subjective SP consolidation	*n* = 4/45, 8.9%	*n* = 2/45, 4.4%

TFAST — Thoracic focused assessment with sonography for trauma; La:Ao — Left atrial aortic ratio; CC — Cardiac contractility; CVC — Caudal vena cava; SP — Subpleural consolidation.

in interpreting those findings. For specific lung pathology, of 45 respondents 18 assessed for lung surface irregularities 4 for air bronchograms, 4 for pulmonary thromboembolism, 17 for lung nodule, 34 for B-lines (alveolar-interstitial disease), 13 for tissue signs/hepatization, and 5 for shred sign. For specific regional lung ultrasounds, 10/45 respondents included these scans as part of their TFAST scans.

Discussion

In this study, over 80% of survey participants performed ultrasound scans in their clinics, and most respondents were urban center, small animal general practitioners. In clinics in which ultrasound scans were performed the machines were used 1 to 5 times a week. In a similar study by DeFrancesco and Royal (8) in the southeastern United States, over 50% of veterinarian respondents performed ultrasound, and 45% of respondents performed it more than 5 times a week, which supports a growing trend of ultrasound use in veterinary medicine. The primary reason for not performing ultrasound scans was the lack of an ultrasound machine; other reasons included lack of training or experience. This is similar again to the DeFrancesco and Royal study (8), in which lack of training and prohibitive cost of ultrasound machines were the main reasons for not performing ultrasound scans in private practice. In a recent study by Aitken et al (9), not having learned VPOCUS within a veterinary school curriculum and lack of appropriate training were cited as the main reasons for a lack of confidence in performing cardiovascular VPOCUS techniques. This is consistent with the fact that many participants in this study sought continuing education courses in AFAST/TFAST to gain further training in this technique. This is reinforced by a study that found at least 20 scans were needed before a veterinarian could perform FAST scans in a repeatable and proficient manner (1). These observations suggest that further training may be needed in the DVM program to increase the confidence and skills of graduating veterinarians.

Ultrasound protocols taught to veterinary students and general practitioners include abdominal and thoracic FAST scans, which are predominantly used in emergencies to facilitate timely diagnosis and monitoring of patients throughout the hospital stay (1,5,7). In this study, both methods were analyzed for use by respondents, sites were reported, and pathology was identified. Over 80% of respondents who performed ultrasound, performed AFAST scans in their clinics between 1 and 5 times a week. Of the respondents who had an ultrasound machine but did not perform AFAST scans, the reasons for not performing AFAST scans were similar to those for not performing ultrasound at all and included lack of experience or confidence. When looking at the sites scanned during AFAST, 4 sites [subxiphoid (DH), left paralumbar (SR), bladder (CC) and right paralumbar (HHR) sites] were scanned over 95% of the time by respondents who performed AFAST. These are the sites frequently described for a complete AFAST scan in veterinary medicine and are used for an abdominal fluid score (0 to 4) and serial monitoring (4). This is important in serial monitoring (reported by over 60% of respondents who performed AFAST scans), but only 40% of respondents reported determining AFS. Lack of inclusion of the AFS may stem from the fact there are no clear recommendations or evidence in veterinary medicine to direct management or therapy in patients with a positive AFS. The fact that AFS is also not included in many veterinary AFAST protocols published or training courses may also account for the lower number of clinicians who include it in their scans (2,5,6). The 5th site, the AFAST umbilical site, was scanned by only 28.3% of respondents. This site is scanned in a lateral position and provides a gravity-dependent site for identifying free fluid (6). The 5th site was not included in many AFAST studies and has only recently been recommended, which may be the reason it is not routinely included in AFAST scanning (2,5–7).

The most common position of patients during AFAST scans was dorsal recumbency (78.3%). This position is preferred in human medicine as humans are oriented in anterior-posterior position, thus all 4 AFAST sites are gravity-dependent (4); the 5th site is not included in human protocols. Dorsal recumbency is not recommended for AFAST scanning as many patients requiring VPOCUS are unstable and dorsal recumbency may lead to deterioration of patients which are unstable because of cardiovascular or respiratory impairment (5). However, it is not known if dorsal recumbency was reserved for stable patients receiving an AFAST examination. In veterinary medicine, it has been recommended that the AFAST scan be performed in lateral recumbency, as this requires minimal restraint and allows abdominal structures to fall away from non-gravity-dependent regions, making imaging of target structures easier. Specifically, right lateral is preferred by some authors since this is the standard position for ECG evaluation, echocardiography, and avoids iatrogenic splenic puncture during abdominocentesis (1,4,7). Overall, the position of the animal is important for the sites viewed, but the position in which the animal is presented and the injuries of the animal will determine how the patient is positioned for the scan.

The development of AFAST examinations in veterinary medicine was predominantly to identify the accumulation of free fluid in the peritoneal space (2). However, the AFAST scan is being used in human and veterinary medicine as a complement to triage and basic physical examination to help timely diagnosis of other pathologies (5–7). In this study, respondents identified the pathologies for which they routinely assessed during an AFAST scan, and their confidence in diagnosing that pathology (Table 2). As expected, identifying free peritoneal fluid during AFAST had the highest frequency of assessment and confidence among respondents. A recent study reported a strong correlation between the original 2004 AFAST protocol and CT for detection of free fluid in dogs suffering trauma, which supports the use of this format in dogs and cats (10). The next most common conditions that were assessed and diagnosed were pyometra, urinary bladder volume estimation, and bladder wall evaluation. Respondents also assessed for gallbladder halo sign, pneumoperitoneum, retroperitoneal injury, and other pathology (not specified), to a lesser extent. This demonstrates that the AFAST scan is being applied beyond the detection of free abdominal fluid. A recent study supports the use of AFAST beyond abdominal trauma-induced injury, particularly in unstable patients, and the application of AFAST to include assessment of other organ systems and intravascular volume (1).

Fewer respondents who performed ultrasound performed TFAST scans in their clinics. The reasons for not performing TFAST scans were similar to those for not performing ultrasound in general and for not performing AFAST scans. This seems to reinforce that TFAST scans are more challenging to perform. The original TFAST publication reported that it requires more training and experience to develop proficiency compared with the AFAST scan, likely related to the effect of respiratory rate and character making the examination more difficult (3). In this study, the sites evaluated during the TFAST examination varied widely compared to AFAST examination. The most common sonographic window reported by respondents during the TFAST scan was the pericardial site (97.8%).

Previously described TFAST protocols describe a 4-point standardized examination, including the bilateral chest tube sites and pericardial site (4). Newer publications describe a 5-point TFAST protocol, including the bilateral chest-tube sites (between the 7th and 9th intercostal spaces on the caudal-dorsal aspect of the chest while in sternal or widest portion of the chest while in lateral) and pericardial sites (between the 5th and 6th intercostal spaces with the strongest heartbeat), and the addition of the subxiphoid (DH) view (focusing on thoracic structures) (4,6). The DH view was added to the TFAST evaluation due to its increased sensitivity in humans for detecting pleural and pericardial fluid (4). These sites are important for visualizing all possible pathologies assessed during the TFAST examination, although the sensitivity and specificity of these sites in dogs and cats to identify pleural and pericardial effusion have not been evaluated. These sites are also arbitrary and not standardized for TFAST scans, which could also add to the lack of sensitivity and specificity. Unfortunately, as TFAST has evolved, the specific sites used and patient positioning have changed (right lateral to sternal recumbency), as have the views used and the structures assessed. The ever-changing TFAST protocols likely explain the greater variation in sites evaluated by respondents, which along with the steeper learning curve for TFAST, explain the decrease in confidence using TFAST compared to AFAST.

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In this study, respondents routinely assessed for and confidently identified pleural effusion and pericardial effusion (Table 3). Other routinely assessed for, but less confidently identified findings include the glide sign, alveolar infiltrate (e.g., pulmonary fluid, masses) and subjective cardiac contractility. Those that were not routinely assessed, and had the least confident diagnosis, included left atrium-to-aorta ratio, subjective vascular volume estimation (vena-cava diameter) and sub-pleural consolidations (e.g., pulmonary thrombosis, shred sign, nodules, atelectasis). A recent study found similar results in interpreting cardiovascular findings, stating that obtaining the LA:Ao ratio was difficult for 41% of respondents, while 90% were unable to confidently obtain and interpret the CVC:Ao ratio (9). The study went on to report that the development of cardiovascular VPOCUS protocols would be considered beneficial by 74% of respondents, while 20% would require more information on the protocol to make a decision (9). The lack of confidence in identifying sub-pleural consolidation in the current study may be a reflection of the sites assessed during TFAST examinations. Most respondents assessed the pericardial sites (ventral-lateral thorax), which are the locations at which it is easiest to identify pericardial and pleural fluid, while only roughly 50% of respondents assessed chest-tube sites, which can be useful for assessing the pleural-pulmonary interface for glide sign (pneumothorax) and pulmonary/pleural disease, including sub-pleural consolidation (4). The fact the original TFAST paper, published in 2008, also only reported pleural effusion, pericardial effusion and pneumothorax, and did not assess the volume status, left atrial aortic ratio or lung pathology, may also explain why these sites are not routinely evaluated during TFAST examination (3). In human medicine, TFAST is helpful for differentiating "wet" lung (with B-lines or lung rockets) from "dry" lungs (glide sign and A-lines present) with high sensitivity and specificity (4). In regard to the glide sign specifically and the diagnosis of pneumothorax in this study, there was a substantial difference between those that looked for this pathology on TFAST (82.2%) and the confidence in diagnosing pneumothorax (68%). This could be related to the difficulty in assessment of this sign in panting patients, those with shallow respirations, and movement artifact of the probe by the clinician (must be held motionless) (6). In one study comparing peritoneal effusion, pleural effusion and pneumothorax identified by AFAST/TFAST scans and computed tomography (CT) scans, the TFAST scans had false negative and false positive results for pneumothorax compared with CT scans (10). This could contribute to the decreased confidence in diagnosing glide sign by veterinarians. Overall, in this study the TFAST scan was performed less, had less pathology identified, and less pathology confidently diagnosed in comparison to the AFAST scan.

Limitations of this study include low response rate and inability to reach all veterinarians across Canada. The low response rate could skew the results to not accurately reflect the use of ultrasound for FAST scans across Canada, leading to bias. Also, respondents who took the survey may have had an increased interest in ultrasound. There could be a bias towards certain provinces, as most respondents resided in Alberta and Ontario. Another limitation is that respondents had the choice to stop the survey at any point, as well as to skip some questions, thus leading to some incomplete surveys. Certain questions had options for "other" responses, but did not allow for further specifics, which could lead to missed explanations. Finally, the ability to assess confidence in findings by respondents was subjective. A more objective set of questions and/or a weighted scale may have allowed a more accurate assessment of operator confidence among the respondents who performed VPOCUS.

In conclusion, the abdominal FAST scan appears to be more standardized, with most veterinarians scanning the 4 standard sites and assessing for and confident in diagnosing peritoneal effusion among other pathology. The thoracic FAST scan appears to be less standardized, with only 1 of the 5 standard sites being scanned by most veterinarians. While pleural and pericardial effusions are being routinely assessed and diagnosed, many other thoracic pathologies are not being assessed and veterinarians are less confident in their diagnosis of thoracic conditions. Further standardization of VPOCUS scans and education of veterinarians should be assessed, in hopes of formulating a standard method for VPOCUS, similar to human medicine. Once a standardized method for VPOCUS scans is created, these could be instituted into veterinary curricula to promote a standard approach across the nation.

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