ARTICLE

Annelies Valcke, Pamela Manning, Soren Boysen, Kris Gommeren

# Confidence level of Australian veterinarians with point-of-care ultrasound before and after a training course


## ABSTRACT

### Objective

To determine if a short, hands-on, point-of-care course improves confidence of veterinary practitioners (VPs) in performing basic point-of-care ultrasound (POCUS) applications and diagnosing specific POCUS pathologies.

### Procedure

A 2-day POCUS course was offered, including 6 h of lectures and 4 h of hands-on training. A self-assessment survey, using a 4-point Likert scale, was administered before and after the course, to study VPs' confidence in attaining ultrasound skills and diagnosing pathologies.

### Results

One hundred and thirteen participants answered the surveys: 65 (57.5%) completed pre- and post-practical surveys. Difference in confidence levels was assessed on paired pre-and post-practical surveys. Self-confidence increased significantly for each of the questions and for each field [pleural and lung POCUS (PLUS), abdominal POCUS, cardiac POCUS, and ultrasound-guided IV access] ($P < 0.0001$). Self-confidence was significantly higher for abdominal POCUS than for PLUS, cardiac POCUS and IV access before ($P < 0.0001$), but not following, completion of the course ($P = 0.81$).

### Conclusion

A short, 2-day course significantly increased the confidence level of VPs in the realization and interpretation of PLUS, abdominal POCUS, and cardiac POCUS questions, and vascular access procedures. Following completion of the course, there was no significant difference in confidence levels among POCUS fields. This suggests the course allowed practitioners to obtain equal confidence across all POCUS applications.

## RÉSUMÉ

### Niveau de confiance des vétérinaires australiens avec l'échographie au point de service avant et après une formation

### Objectif

Déterminer si une formation courte et pratique au point de service améliore la confiance des vétérinaires praticiens (VP) dans la réalisation d'applications de base d'échographie au point de service (POCUS) et le diagnostic de pathologies POCUS spécifiques.


Department of Small Animal Veterinary Clinical Sciences, University of Liège, B42, Vallée District 2, Avenue de Cureghem 7A-7D, 4000 Liège, Belgium (Valcke, Gommeren); Sydney School of Veterinary Science, Faculty of Science, The University of Sydney, Sydney, New South Wales 2006, Australia (Manning); Faculty of Veterinary Medicine, University of Calgary, 3280 Hospital Drive NW, Calgary, Alberta T2N 4Z6 (Boysen).

Address all correspondence to Annelies Valcke; email: annelies.valcke@uliege.be

Unpublished supplementary material (Tables S1–S4, Figures S1–S2, Appendices 1–2) is available online from: Supplementary Materials

**Procédure**

Un cours POCUS de 2 jours a été proposé, comprenant 6 h de cours magistraux et 4 h de formation pratique. Une enquête d'auto-évaluation, utilisant une échelle de Likert à 4 points, a été administrée avant et après le cours, pour étudier la confiance des VP dans l'acquisition de compétences en échographie et dans le diagnostic des pathologies.

**Résultats**

Cent treize participants ont répondu aux sondages : 65 (57,5 %) ont répondu aux sondages pré- et post-pratiques. La différence dans les niveaux de confiance a été évaluée à l'aide d'enquêtes appariées avant et après la pratique. La confiance en soi a augmenté de manière significative pour chacune des questions et pour chaque domaine [POCUS pleural et pulmonaire (PLUS), POCUS abdominal, POCUS cardiaque et accès IV échoguidé] ($P < 0,0001$). La confiance en soi était significativement plus élevée pour le POCUS abdominal que pour le PLUS, le POCUS cardiaque et l'accès IV avant ($P < 0,0001$), mais pas après la fin du cours ($P = 0,81$).

**Conclusion**

Une courte formation de 2 jours a considérablement augmenté le niveau de confiance des VPs dans la réalisation et l'interprétation des questions PLUS, POCUS abdominales et POCUS cardiaques, ainsi que dans les procédures d'accès vasculaire. Une fois le cours terminé, il n'y avait aucune différence significative dans les niveaux de confiance entre les domaines POCUS. Cela suggère que le cours a permis aux praticiens d'obtenir une confiance égale dans toutes les applications POCUS.

(Traduit par Dr Serge Messier)

Can Vet J 2024;65:910–919

## INTRODUCTION

Point-of-care ultrasound (POCUS) is a powerful diagnostic tool that is applied in real time at the patient's side by the attending clinician. It is used in emergency and intensive-care settings to answer focused, clinical questions and integrate findings into decision-making and patient management. Rapid assessment of hemodynamic stability and respiratory disease, and guidance of invasive procedures are also frequently described applications (1,2). Since the early 1990s, POCUS has been extensively studied and applied in critically ill human patients (3). In veterinary medicine, several recent studies support its utility as a diagnostic and patient-management tool. The use of POCUS continues to expand in both human and veterinary medicine (4,5).

Point-of-care ultrasound is often subdivided into 3 fields: abdominal POCUS, pleural space and lung ultrasound (PLUS), and cardiac POCUS. Ultrasound-guided procedures, including vascular access and nerve blocks, represent a fourth and recently established field. The veterinary health-care provider, usually a non-imaging specialist, combines abdominal POCUS, PLUS, and cardiac POCUS to gather additional information regarding the animal's clinical status, to direct and monitor therapy in the emergency unit or to perform serial examinations during hospitalization. Abdominal POCUS in veterinary medicine was first used to detect free abdominal fluid, but now includes different applications, such as identification of free abdominal air, identification of gallbladder wall edema, assessment of gastrointestinal motility, and calculation of urinary bladder volume (6–10). With PLUS, a range of pleural space and lung pathologies, such as a pneumothorax, pleural effusion, and alveolar-interstitial syndrome, can be detected (11–14). The goal of cardiac POCUS is the identification of gross functional cardiac pathology by subjectively estimating left atrial size, left ventricular lumen and wall dimensions, cardiac contractility, and right-sided heart changes (15). Other applications lie in the detection of pericardial effusion and the diameter and collapsibility of the caudal vena cava (16–18). Vascular access can be more easily obtained with the help of ultrasound when perivascular hematoma formation, subcutaneous edema, or obesity make digital vascular palpation difficult (19). In human emergency medicine, ultrasound-guided techniques are preferred because they are faster and associated with higher success rates and fewer complications (20).

Point-of-care ultrasound is fast and safe, has low impact, and is radiation-sparing (2). Moreover, POCUS is designed to answer closed, often binary response questions, and is reported to be easy to learn, in contrast to traditional

comprehensive formal or consultative ultrasound examination, which requires years of expertise to master (21,22). In human medicine, consensus is lacking regarding the required number of examinations needed to gain proficiency in POCUS. Suggested numbers vary from 50 to 400 examinations, depending on the clinician's previous ultrasound experience and learning curve (23,24). Adequate training recommendations include theoretical training and hands-on training followed by supervised examinations of patients in the clinical setting (25). In human medicine, the American College of Emergency Physicians demands that POCUS be mastered during residency training. Unfortunately, veterinary POCUS training courses are only intermittently available and do not provide real-time or continuous interaction between the instructor and the trainee outside training sessions (1). Indeed, after not owning or having access to a portable ultrasound machine, the lack of training is reported to be the second-greatest barrier to the application of POCUS in both human and veterinary clinical practice (26–28). A recent study of POCUS in the United Kindom indicated that 1/2 of the respondents were self-taught. Only 7% of respondents had participated in POCUS training courses. The few studies conducted in veterinary medicine showed that written instructions, teaching through videos, and in-person training all led to an increase in ability to perform POCUS (29,30), though a higher succes rate in certain areas of POCUS was reported for in-person training (31).

However, in Australia, little hands-on or experiential instruction is offered to veterinary medical students and veterinary graduates. As far as the authors are aware, most postgraduate veterinary ultrasound training courses in Australia are comprehensive in nature, and no veterinary point-of-care hands-on courses were available at the time this study was conducted. The objective of this study was to determine if a short veterinary point-of-care hands-on training course would improve the confidence of veterinary practitioners (VPs) in performing basic POCUS applications and identifying specific POCUS pathologies. We hypothesized that a 2-day course would significantly increase the confidence level of VPs in performing POCUS.

## MATERIALS AND METHODS

We developed a 2-day POCUS course, geared toward novice sonographers, which included theoretical lectures that could be accessed either live or online (6 h on Day 1) and hands-on skills training with live animals and phantom models (4 h on Day 2) (Figure S1, available online from: Supplementary Materials). As a preparatory step, a train-the-trainer session was carried out to ensure instructors were familiar with the POCUS material being taught and to standardize the training among instructors. This session was led by an expert POCUS operator with $>$ 20 y of experience with POCUS application in veterinary medicine. Four other POCUS faculty were recruited from different parts of Australia based on their prior experience in teaching ultrasound and recognition as experts in the field of ultrasound, including POCUS.

The theoretical part of the course consisted of a 30-minute introduction to POCUS, followed by a detailed description (1 to 2 h) of each POCUS field (abdominal, pleural space and lung, and cardiac), covering the most common pathologies. One hour was spent describing POCUS findings specific to cats. The last 30 min of the course included attendee self-assessment through presentation of video clips and clinical cases requiring interpretation by VPs (Table S1, available online from: Supplementary Materials).

The practical training included 6 hands-on stations. Each station took 35 min to complete and included a demonstration, 1 focused cardiac POCUS station, 2 PLUS stations, 2 abdominal POCUS stations, and 1 ultrasound-guided IV access chicken phantom station. At the cardiac POCUS station, VPs were taught how to acquire the long-axis 4-chamber view and 2 right parasternal short-axis views (the left ventricular short axis or "mushroom view" and the left atrial to aorta ratio view). The PLUS stations were divided into 2 stations where attendees were instructed on the characteristics used to diagnose i) pneumothorax, B-lines and lung consolidations, and where to locate these pathologies using sonographically defined PLUS scanning borders; and ii) pleural effusion, with an emphasis on locating the pericardio-diaphragmatic window and costophrenic recess, and where to locate pleural effusion using sonographically defined PLUS scanning borders. A change in the probe orientation to locate smaller volumes of gravity dependent pleural effusion was also demonstrated. Abdominal POCUS was divided into 2 stations to demonstrate the binary response questions asked at i) the subxiphoid, umbilical, and urinary bladder sites, and their associated possible (organ) abnormalities; and ii) the right and left paralumbar sites and their associated possible (organ) abnormalities (Appendix 1, available online from: Supplementary Materials). The ultrasound-guided vascular access station included a raw chicken breast phantom model that used fluid-filled twisting balloons to allow

participants to practice in- and out-of-plane ultrasound-guided vascular sampling and catheter placement techniques. At each station, there was a 5-minute demonstration at the start of the session, followed by a total of 30 min during which the 4 participants practiced the objectives for each station (~7.5 min of active scanning time/participant/station). The faculty-to-learner ratio was 1:4. The remaining 30 min of the 4-hour course were consumed at the start of the sessions, when probe manipulations and machine functions were quickly reviewed (15 min), and 15 min were reserved to allow attendees to rotate between stations.

### Subjects

Veterinary practitioners from both general and emergency practice enrolled from the surrounding areas of Sydney (New South Wales) and Gatton (Queensland). Invitations were sent out *via* email and attendees registered through an online registration platform.

### Data collection

Each VP completed a written self-evaluation survey (4-point Likert scale) before and after the practical portion of the course, to assess their confidence in performing POCUS examinations (Appendix 2, available online from: Supplementary Materials). The pre-practical surveys were completed following the theoretical course but before the hands-on training, which corresponded to the start of Day 2 of the course. The post-practical surveys were completed following the hands-on training, at the end of Day 2 of the course.

Animal ethical approval for the hands-on training was granted by the New South Wales Secretary's Animal Care and Ethics Committee. Concerning human ethics, according to the National Health and Medical Research Council's National Statement on Ethical Conduct in Human Research (2023) and consultation with the Research Integrity & Ethics Administration, Human Research Ethics Committee at the University of Sydney, the project was considered lower-risk and met the following conditions exempting it from ethics review: The research involved the use of collections of information or data from which all personal identifiers had been removed prior to being received by the researchers and where researchers explicitly agreed i) not to attempt to reidentify those with whom the information or data is associated, ii) to take all reasonable steps to prevent reidentification of the information or data for unauthorized purposes or access to the information or data by those who are not authorized, and iii) that any sharing of any research data during or after the project will not create any additional risks of reidentification of the information or data. Informed consent was verbally obtained from study subjects before participation, with further confirmation through submission of the voluntary survey, which was taken as consent to participate. Data collected did not include any personal data and were collected using printed materials, and individual results were anonymous, adhering to the National Health and Medical Research Council's general data protection regulation.

### Statistical analysis

Questions were analyzed separately and grouped into abdominal POCUS, PLUS, and cardiac/vascular access POCUS fields. Differences in confidence levels between the different POCUS questions and fields at the beginning and the end of the practical course were analyzed, as well as the change in confidence over the duration of the practical course. Results are presented as boxplots. Comparisons of the changes in confidence level were assessed by analyzing only paired pre- and post-practical course surveys (unpaired surveys were excluded from this aspect of the statistical analysis). The changes in confidence level were analyzed using ordinal logistic regression with repeated measurements (genmod model), with time as the fixed factor and identifier the random factor. This genmod analysis was repeated on all surveys. Calculations were done on the maximum available observations. Results were considered statistically significant at the 5% significance level ($P < 0.05$). We used SAS software version 9.4 (SAS Institute, Cary, North Carolina, USA) for all statistical analyses and R software version 4.2.1 (R Foundation for Statistical Computing, Vienna, Austria) to create all figures.

## RESULTS

A total of 175 surveys were completed: 85 pre- and 90 post-practical course. One hundred thirteen distinct participants answered the surveys: 65 (57.5%) answered both pre- and post-practical surveys, 23 (20.4%) answered only the pre-practical survey, and 25 (22.1%) answered only the post-practical survey. Difference in confidence level was assessed on 65 paired pre- and post-practical surveys.

### Pre-practical survey responses

Among the VPs who answered the pre-practical survey, the majority performed only 1 to 3 scans (45.9%) or no scans at all (21.2%) in the year before the course, and

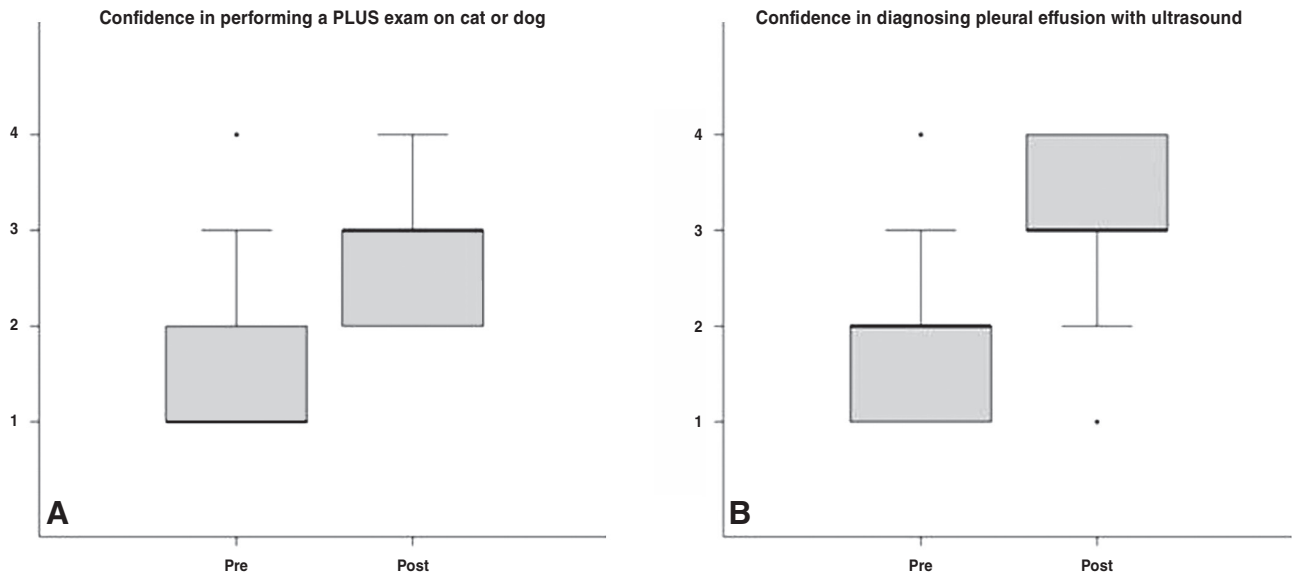


**FIGURE 1.** Confidence levels pre- and post-practical course for performing a pleural space and lung ultrasound (PLUS) exam (A) and diagnosing pleural effusion (B) in a cat or dog.

32.9% performed 4 to 10 scans or more than 11 scans before the course (Table S2, available online from: Supplementary Materials).

Before the practical course, VPs were significantly more confident in performing abdominal POCUS (14.9% confident or very confident) than PLUS (7.0% confident or very confident), cardiac POCUS (6.9% confident or very confident), or ultrasound-guided catheter placement (3.4% confident or very confident) (Table S3, available online from: Supplementary Materials) ($P < 0.0001$).

For most of the fields, the VPs did not feel confident: PLUS examination (62.8%), abdominal POCUS examination (43.7%), cardiac POCUS (78.2%), ultrasound-guided catheter placement (85.1%). Also, regarding the specific questions asked in each subgroup, the VPs did not feel confident: sonographically diagnosing pleural effusion (47.7%), pneumothorax (75.0%), interstitial-alveolar pathology (63.4%), free abdominal air (86.6%), locating and subjectively assessing the left atrial/aortic ratio (76.8%). For diagnosing free abdominal effusion with ultrasound, some of the VPs were somewhat confident (32.9%), confident (29.3%), or very confident (12.2%) (Table S3, available online from: Supplementary Materials).

## Post-practical survey responses

Following the practical course, VPs tended to be more confident in performing PLUS (70.0% confident or very confident) and abdominal POCUS (72.2% confident or very confident) than in performing cardiac POCUS (55.5% confident or very confident) and ultrasound-guided catheter placement, but this difference was not significant ($P = 0.81$).

For most of the fields and questions, the VPs were confident after the practical course: PLUS examination (60.0%), abdominal POCUS examination (53.3%), ultrasound-guided catheter placement (53.4%), sonographically diagnosing pleural effusion (50.0%), interstitial-alveolar pathology (46.7%), free abdominal effusion (50.0%), locating and subjectively assessing the left atrial/aortic ratio (52.2%). For basic cardiac POCUS examination, most VPs were somewhat confident (43.3%) or confident (42.2%). For sonographically diagnosing pneumothorax or free abdominal air, the majority of VPs were somewhat confident (45.6% and 45.6%, respectively) (Table S4, available online from: Supplementary Materials).

## Comparison of pre- and post-practical survey responses

A significant increase in confidence was noted for each of the 10 questions asked and for each field (PLUS, abdominal POCUS, cardiac POCUS, and IV access) ($P < 0.0001$) (Figure S2, available online from: Supplementary Materials).

Self-confidence was significantly higher for abdominal POCUS than for PLUS, cardiac POCUS, and IV access before the course ($P < 0.0001$); this difference was no longer present following completion of the course ($P = 0.81$).

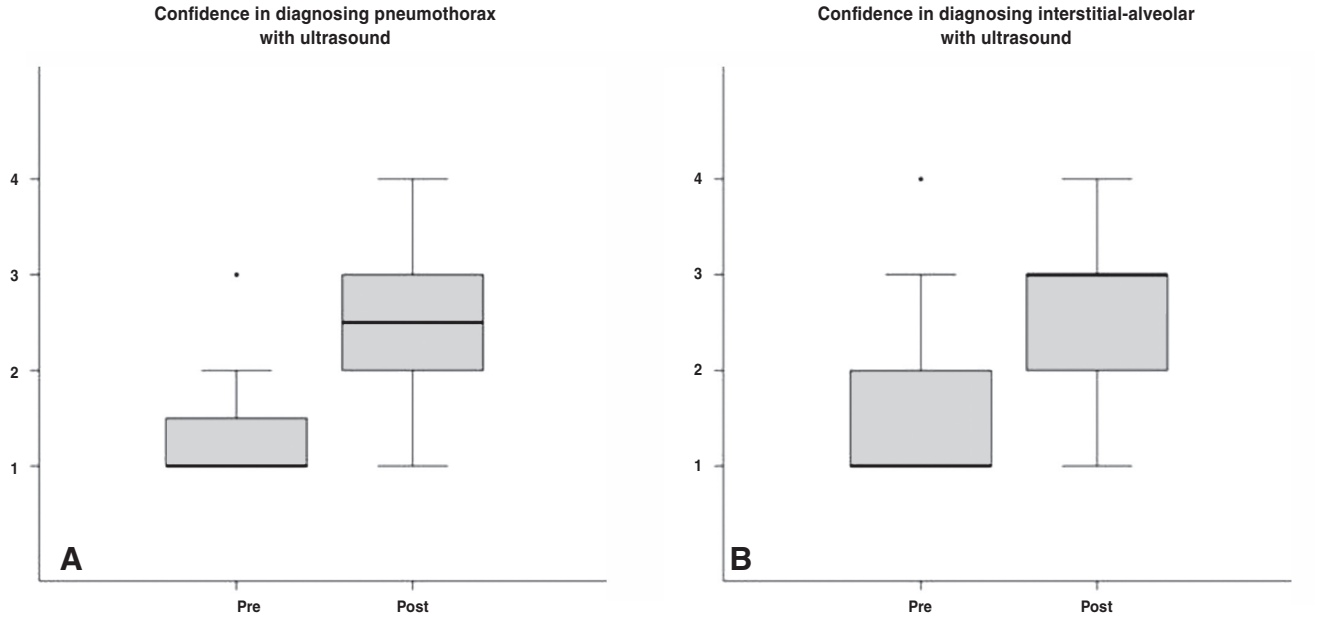


**FIGURE 2.** Confidence levels pre- and post-practical course for diagnosing pneumothorax (A) and interstitial-alveolar (B) with ultrasound.

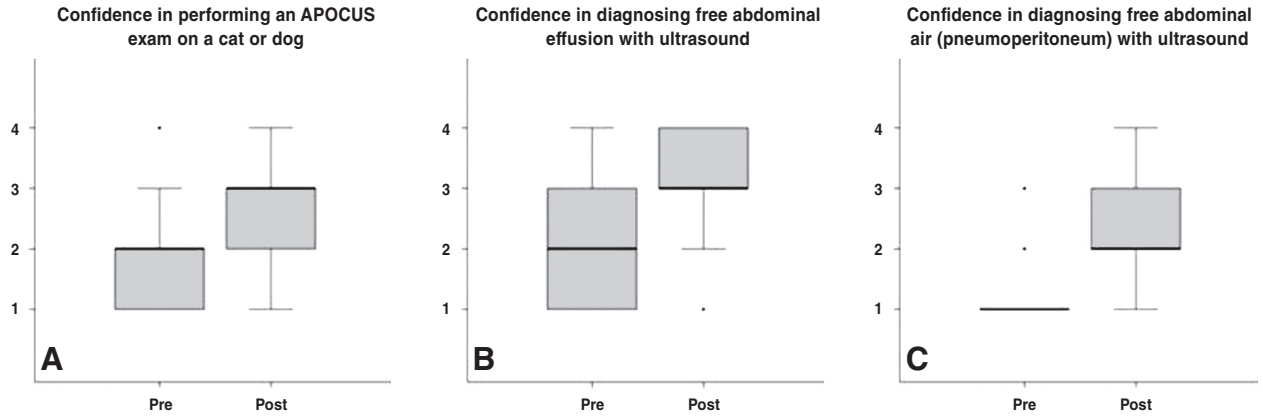


**FIGURE 3.** Confidence levels pre- and post-practical course in performing abdominal point-of-care ultrasound (APOCUS) (A), diagnosing free abdominal effusion (B), and diagnosing free abdominal air (pneumoperitoneum) (C) in a dog or cat.

For confidence in performing a PLUS examination on a cat or dog, it was noted that 60 (93.7%) VPs increased their confidence level and 4 (6.3%) remained somewhat confident. The proportion of confident or very confident VPs increased from 1.6% to 67.2% (Figure 1). For the sonographic diagnosis of pleural effusion, a total of 58 (89.2%) VPs improved their confidence level, 5 (7.7%) that were not already very confident did not, and 2 (3.1%) were already very confident. The proportion of confident or very confident VPs increased from 15.4% to 75.4% (Figure 1). For pneumothorax, almost all (96.7%) VPs improved their confidence level. Only 2 (3.3%) remained not confident. The proportion of confident or very confident VPs increased from 6.6% to 54.1% (Figure 2). Regarding interstitial-alveolar, a total of 55 (88.7%) VPs improved their sonographic confidence level, 6 (9.7%) did not change, and 1 (1.6%) became not confident. The proportion of confident or very confident VPs increased from 8.1% to 58.1% (Figure 2).

When assessing confidence level in performing abdominal POCUS, 57 (87.7%) VPs increased their confidence level, 7 (10.8%) did not improve, and 1 (1.5%) was already very confident. The proportion of confident or very confident VPs increased from 12.3% to 75.4% (Figure 3). A total of 39 (62.9%) improved their confidence level for diagnosing free abdominal effusion with ultrasound, 16 (25.8%) did not change, 6 (9.7%) were already very confident, and 1 (1.6%) became not confident. The proportion of confident

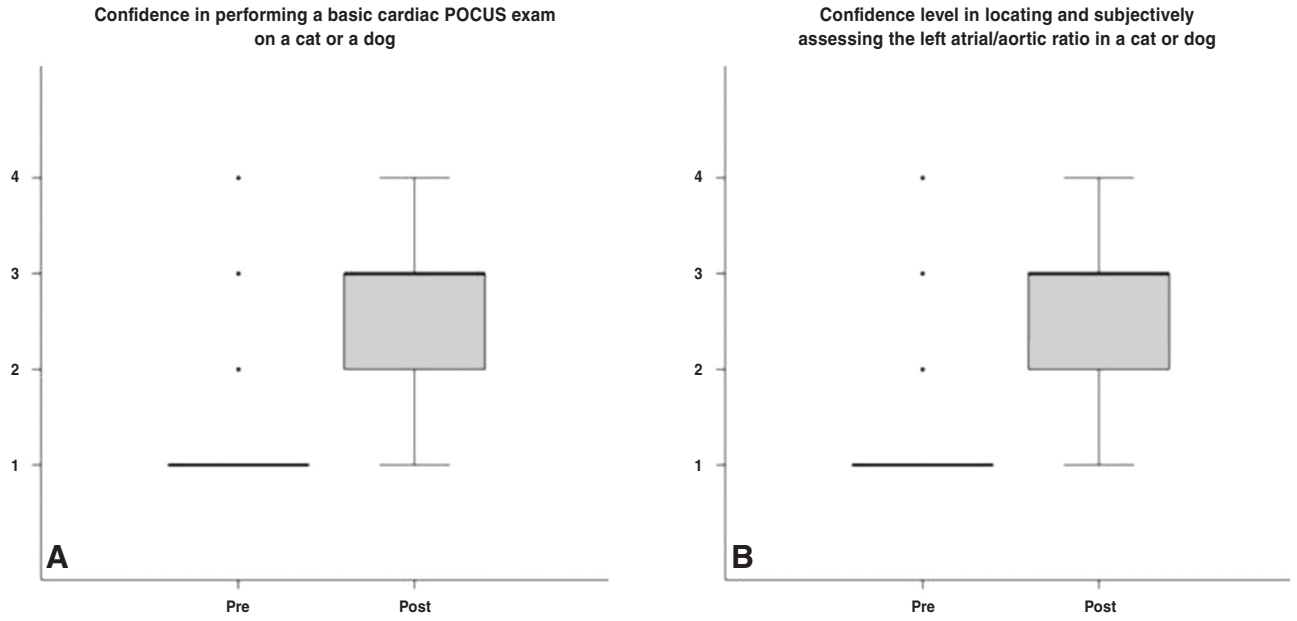


**FIGURE 4.** Confidence levels pre- and post-practical course for performing a basic cardiac point-of-care ultrasound (POCUS) exam (A) and locating and subjectively assessing the left atrial/aortic ratio (B) in a cat or dog.

or very confident VPs increased from 40.3% to 79.0% (Figure 3). For the sonographic diagnosis of free abdominal air (pneumoperitoneum), we observed an improvement in confidence in 49 (79.0%) VPs, no change in 12 (19.4%), and a loss of confidence in 1 (1.6%). The proportion of confident or very confident VPs increased from 0% to 33.9% (Figure 3).

For confidence in performing a basic cardiac POCUS examination on a cat or a dog, there was an improvement in confidence for 60 (92.3%) VPs and no change for 4 (6.2%); 1 (1.5%) VP was already very confident. The proportion of confident or very confident VPs increased from 1.5% to 53.9% (Figure 4). Confidence in locating and subjectively assessing the left atrial/aortic ratio in a cat or dog increased for 58 (93.5%) VPs and did not increase for 3 (4.8%); 1 (1.6%) VP was already very confident. The proportion of confident or very confident VPs increased from 1.6% to 64.5% (Figure 4). Confidence in performing ultrasound-guided catheter placement in a cat or a dog improved for almost all VPs (60, 95.2%). Only 3 (4.8%) did not improve their confidence level. The proportion of confident or very confident VPs increased from 1.6% to 66.7% (Figure 5).

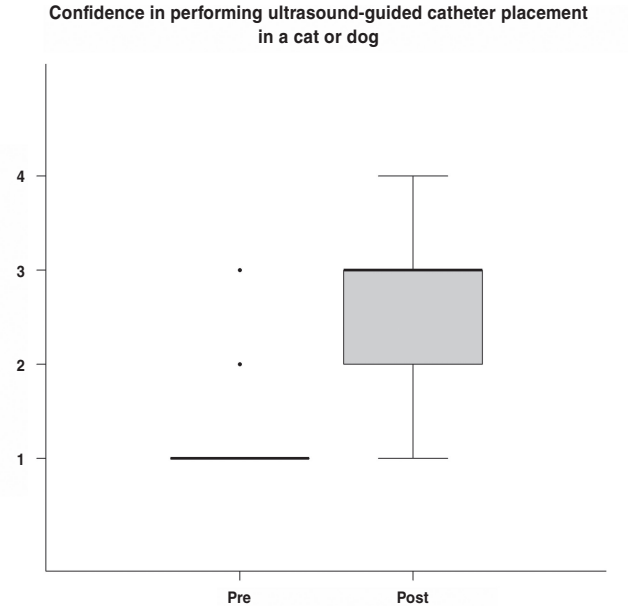


**FIGURE 5.** Confidence levels pre- and post-practical course in performing ultrasound-guided catheter placement in a cat or dog.

## DISCUSSION

Results of the current study demonstrated that most VPs who enrolled in a 2-day POCUS course were not confident in their POCUS skills following 6 h of didactic lectures, but their confidence was significantly improved for most POCUS fields and questions assessed following a 4-hour hands-on practical training course.

The response rate of our study was 57.5%, which can be considered moderate compared to other POCUS surveys. A United Kingdom survey on the training and use of POCUS had a 76.8% survey completion rate (32), whereas a POCUS study from the United States had only a 29.8% response rate (27). Finally, a meta-analysis of online surveys in

human medicine demonstrated a 44.1% average response rate. Most practitioners (67.1%) completed a very low number of scans (0 to 3) in the year before the 2-day course, which could explain the lack of confidence and may also be the reason most VPs enrolled in the course. Although confirmation of ultrasound skill level was not verified through formal assessment [*e.g.*, observed structured clinical examination scoring (33)], previous POCUS studies in human medicine demonstrated an association between increased self-confidence and increased skill (34,35).

Despite the proven benefit of training, a lack of training is commonly cited as a reason not to routinely implement POCUS in the emergency and intensive-care settings (26–28). Our study showed that a short, 2-day course on POCUS significantly increased confidence level in performing examinations and identifying pathologies. Similarly, published studies in human medicine reported steep learning curves when clinicians performed POCUS in emergency cases or when assessing the appendix and the gallbladder with POCUS (36–38). Studies in human medicine suggested that medical students could significantly increase their skills in performing POCUS after only a short training period (39). This highlights the importance of implementing POCUS training in the curriculum of (veterinary) students. Even with minimal training, important progress can be made.

The optimal training method for students or VPs is unknown and may vary by learner. A study by Davy *et al* (2019) assessing differences in skills between veterinary students who received online theoretical training only and students who had hands-on training determined that theoretical training was sufficient for teaching basic concepts. However, for the assessment of more complicated views, the hands-on approach was a superior training method. The authors therefore suggest a mixed approach in which theoretical training is followed by practical training (30). The current study used this approach.

It should be noted that VPs were significantly more confident in performing abdominal POCUS than PLUS, cardiac POCUS, or ultrasound-guided catheter placement before enrolling in the course. This is in agreement with surveys regarding the confidence of VPs in the United Kingdom and Canada, where abdominal POCUS was performed more often and with more confidence than PLUS (26) or cardiac POCUS (40). A possible explanation for this could be that pleural and cardiac POCUS (26,41) are generally considered more complicated examinations to perform (42). Alternatively, these examinations may not be taught as routinely in veterinary school curriculums. Following completion of the course, there was no longer a significant difference between confidence levels in performing abdominal POCUS compared to PLUS, cardiac POCUS, or ultrasound-guided catheter placement. This suggests that the course was sufficient to allow practitioners to gain confidence equally across all POCUS fields taught.

Although the overall confidence level remained equal or increased for all participants, there was 1 individual who lost confidence for diagnosing interstitial-alveolar diseases and detecting free abdominal fluid and free abdominal air. The reason for this decline in confidence was not entirely clear, but it is possible the practitioner may have realized their previous assumptions were inaccurate.

This study had several limitations. First, the VPs were asked to assess their confidence in performing certain skills. This may not have reflected the actual skills the practitioners mastered, and we cannot exclude the possibility that the VPs over- or underestimated their own performance. A formal means of assessment testing their abilities to obtain and interpret images would have provided further clarity. Second, the post-practical course survey was completed directly following completion of the course. It is possible that VPs felt increased confidence immediately upon completion of the course that may not have been retained over time, and may even have returned to pre-practical survey levels without continued application and practice. However, it is equally possible that VPs would have gained even more confidence with time and practice. Third, practitioners voluntarily enrolled in the course, which may have led to a selection bias, if less confident veterinarians were more likely to subscribe to the course. This could explain the low confidence levels reported before the course. However, this would not prevent the increase in confidence levels post-course. On the other hand, it is also possible that veterinarians who were more motivated to improve their skills chose to participate, which could have influenced their willingness to pay attention and learn in a positive way. A fourth limitation was the fact that the response rate of 57.5% added a potential source of bias, as VPs experiencing a bigger change may have been more likely to respond. However, the response rate in our study was comparable with a meta-analysis of human medicine surveys that demonstrated a 44.1% average response rate (43). Last, the practitioners were asked to complete the surveys following the theoretical course (before the practical course), and not before any course training. This could have falsely increased or decreased the VPs' confidence before the practical session of the course, and thus interfered with

the estimation of their true confidence levels before enrolling in the course. The survey also assessed the confidence of participants before and after the practical, hands-on session, which did not include the effect of the didactic lectures on confidence. It is possible the lectures biased respondents to overestimate the increase in their confidence following the hands-on training, as any increase in confidence following the lectures was not clearly distinguished from the increase in confidence gained from the hands-on training. An additional survey on confidence levels regarding performing POCUS and identifying pathology before the lectures would have helped clarify this potential bias. However, our goal was to assess the change in confidence level after practical, hands-on POCUS training. Therefore, we wanted every participant to have a similar understanding of the pathologies and abnormal findings to look for.

In conclusion, to the authors' knowledge, this is the first study examining the increase in VP confidence level after a combined lecture-based and hands-on POCUS training course. Based on our results, it can be concluded that a 4-hour hands-on practical training course delivered following 6 h of online lectures significantly increased the confidence level of VPs regarding the realization and interpretation of key abdominal POCUS, PLUS, cardiac POCUS, and vascular access questions and procedures. Future studies should aim to assess the true capacities of VPs to obtain proper POCUS windows and interpret common pathologies and determine long-term retention of skills learned during theoretical and practical POCUS courses.

## ACKNOWLEDGMENTS

Ultrasounds were provided by Medicalplus. Statistical analyses were performed by Laurence Seidel from the Biostatistics and Research Method Center of ULiège and CHU of Liège. CVJ

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