Crit Ultrasound J (2011) 3:135–140
DOI 10.1007/s13089-011-0085-0

ORIGINAL ARTICLE

Descriptive analysis of a bilingual and cross-cultural introductory ultrasound course facilitated by simultaneous translation

Maxime Maignan · Xuejun Shuai · Michel Galinski · Shujuan Cheng · Tao Zhang · Tomislav Petrovic · Claude Lapandry · Frederic Lapostolle

Received: 7 July 2011 / Accepted: 1 November 2011 / Published online: 8 December 2011

Abstract
Study objective The increasing use of focused ultrasonography by non-specialists emphasizes the need for standardized trainings. We analyze physicians' skill acquisition after the implementation of an ultrasound introductory course. As part of an international educational collaboration, we also investigate the impact on training efficiency of language and cultural differences.
Methods We organized a 2-day training for emergency physicians. Lectures were given in French with simultaneous Chinese translation. At the end of the training, physicians were asked to conduct, on healthy live models, a complete ultrasound examination including 11 images and two procedures (cardiac, abdominal, vascular and bone ultrasonography). Quality was assessed by two independent observers and a 60-s time limit per view/procedure was set. Ultrasound examination was successful only if both quality and length objectives were achieved.
Results Seventeen attending emergency physicians participated in the study. None withdrew from the training. The overall success rate of image and procedure acquisition was 97.3% (364 out of 374). Six physicians had failed cases and mainly on cardiac examination (eight failures out of ten). Failure rate for the complete sequence (1 or more failure out of the 11 images/procedure) was 24% (8/34). Median time to capture a single image was 13 s (5–24), while the whole examination took 182 s (141–238) excluding time for probe change.
Conclusion A 2-day introductory course on focused ultrasonography leads to very good skill acquisition. Language and cultural differences do not seem to alter training efficiency.

Keywords Ultrasound · Emergency · Training · Cultural

M. Maignan · M. Galinski · T. Petrovic (✉) · C. Lapandry · F. Lapostolle
SAMU 93, EA 3409, Avicenne Hospital, 125 rue de Stalingrad, 93009 Bobigny Cedex, France
e-mail: tomislav.petrovic@avc.aphp.fr

X. Shuai · S. Cheng · T. Zhang
Sino French Emergency and Disaster Medicine Training Center, Beijing, China

X. Shuai
Emergency Department, Tongern Hospital, Beijing, China

S. Cheng
Emergency Department, Anzhen Hospital, Beijing, China

T. Zhang
Emergency Department, Meitan Hospital, Beijing, China

Introduction

Background

Since the first description of Focused Assessment with Sonography for Trauma (FAST), ultrasound examination by non-radiologists have considerably expanded to include, for example, deep venous thrombosis assessment, echocardiography and long bone fracture diagnosis [1, 2]. Interest in goal-directed sonography has also spread to primary care in remote areas [3–5], even when performed by non-medical staff and combined with telemedicine [6, 7].

Importance

The development of focused sonography in many specialities, leads to an increased diversity of practitioners and a

broad new range of applications [2, 8]. This emphasizes the need for developing evaluation, standardization and quality control of training [8]. Additionally, the development of International Emergency Medicine and educational collaborations plead for a global consensus on ultrasound curriculum and physicians' accreditation [8, 9]. In a Boston (MA, USA) and Tuscany (Italy) cooperative study, teaching language proficiency and intercultural communication were identified as key issues to be overcome for attaining training achievement [10]. Language and cultural barriers between teachers and learners, between the on-site ultrasound practitioner and referral radiologist, may impact on training efficacy, practitioner proficiency and interpretation of results.

Goal of this investigation

As part of a Sino-French educational collaboration, we set up a focused sonography introductory course. Firstly, we sought to determine if the training was effective and, secondly, if it was affected by simultaneous translation and cultural differences between French teachers and Chinese learners. The primary end point was the overall success rate of ultrasound image acquisition according to quality and time assessed by independent observers.

Materials and methods

Study design

This study had a single-setting, prospective, observational cohort design. It was approved by our institutional research ethics review board (Anzhen Hospital, Beijing, China).

Setting

The study was completed at the Sino-French Emergency Training Center (Beijing, China). Managed by both Chinese and French emergency medicine experts, the center provides training sessions for Chinese emergency physicians. Lectures and hands-on courses are given by French specialists, therefore requiring translation.

We organized a 2-day training session on goal-directed emergency sonography. The content and organization of this kind of training have been previously validated [11]. The curriculum is in accordance with the guidelines for implementation of an introductory emergency ultrasound course for emergency physicians [2]. It consisted of five lectures based on physics and ultrasound device handling, FAST, and cardiac, vascular and bone sonography (Table 1). Each lecture was followed by hands-on training on two live models during which participants were separated into two groups (maximum of five students per instructor). The ratio between didactic and hands-on sessions was 1:2. Total duration of the training was approximately 16 h.

During the hands-on session, participants were trained to perform the newly taught procedure, but they also rehearsed every procedure they had already learned since the beginning of the seminar. In addition, students reviewed all ultrasound procedures once on each model, at the beginning and the end of every day. For example, before the final evaluation, students had practiced on at least 12 FAST examinations (Table 1).

Selection of participants

Instructors (MG and FL) were two experienced French emergency physicians, fellowship trained and board

Table 1 Training program

Topic	Approximate length of lecture (min)	Approximate length of hands-on training (min)	Total number of rehearsal during the whole training (*n*)
Day 1			
Physics and ultrasound device handling	45	60	16
FAST	90	120	14
Basic echocardiography	120	120	12
End of day 1 rehearsal		60	
Day 2			
Beginning of day 2 rehearsal		60	
Vascular sonography	45	90	6
Long bone sonography	30	60	4
End of day 2 rehearsal		60	
Total	330	630	

FAST Focused assessment with sonography for trauma

certified in emergency ultrasonography. They had already performed more than 12 emergency ultrasonography training sessions and had published on its scope [11]. Learners were Chinese physicians practicing in Beijing. We required all participants to have at least 2 years of emergency medicine practice as an attending physician. None of them was a registered diagnostic medical sonographer, and none had hospital credential to perform emergency ultrasonography. Simultaneous translation (Chinese–French) was mainly performed by a professional Chinese interpreter with a master's degree, but no medical background. Specific vocabulary translation was made by an attending physician who had completed a 1-year emergency medicine residency in France. Teaching aids were in English. Presentations projected for lectures were in Chinese. Live models were two healthy Chinese men. Every participant involved in this study gave their written informed consent.

Methods of measurement

The final evaluation was scheduled to be done at the end of the training. Students were asked to perform an ultrasound examination on live models resting in a supine position. More precisely, emergency physicians had to obtain all the 11 following standard views (Fig. 1):

1. FAST: Morrison's pouch, perisplenic, pelvic and subxiphoid view.
2. Cardiac: long and short axis, parasternal view; four and five chambers, apical views.
3. Vascular: identification of the internal jugular vein and location of a potential ideal puncture site [12]; identification of the popliteal vein and compression test as indicated for evaluation of deep vein thrombosis [13].
4. Bone: transverse and longitudinal view of the radius; performance of a 10-cm cortical examination [14].

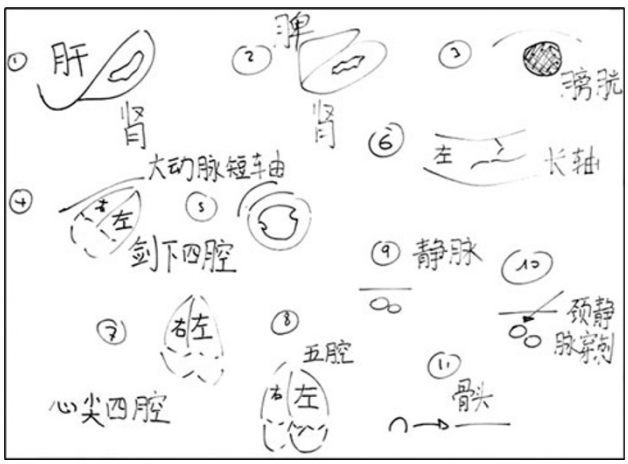

Fig. 1 Eleven ultrasound views/procedure diagrams at the learners' disposal

The examination was timed from the first probe contact with the model's skin. Students searched for the standard view and performed, when indicated, ultrasound test (vascular and bone). Students froze the image when they felt that they had achieved the objective. When the time was complete, the investigators assessed the appropriateness and quality of the image. If the view and/or procedure were considered incorrect, the timing was restarted and students resumed the examination. After 60 s, if the test was considered as failed, investigators helped students to find the right view or to properly accomplish the ultrasound procedure. Each student performed the whole examination once on both live models.

Physicians used a LogiQe ultrasonographer (General Electrics, Milwaukee, MI) with appropriate probes: 2–5 MHz probe for abdominal (3C-RS), 3 MHz probe for cardiac (3S-RS) and 4–10 MHz probe for vascular and bone views (8L-RS).

Primary data analysis

We mainly used descriptive statistics including frequencies, means, medians and appropriate estimation of certainty. The aim of this study was to estimate the efficiency of an ultrasonography introductory course. The overall success rate of image and procedure achievement was the primary outcome. Most articles on the evaluation of ultrasound courses report pre/post tests and image acquisition outcome without time limit [15–19] We define and use a composite overall success rate, which include both quality and time criteria. This combined outcome allowed us to take into account not only the image interpretability, but also emergency medicine time constraints. We arbitrarily set up a cutoff point for overall success rate at 90% to assert that the training was efficient.

We tested the hypothesis of a difference in the success rate between the two live models (chi square test) and compared the time for image capture (Mann–Whitney test). Analysis was performed using Statistical software for Windows 7.0 (StatSoft Inc., Tulsa, USA).

Results

Characteristics of study subjects

Two sessions of 2 days each were organized. Eighteen Chinese emergency physicians attended the training (eight and ten participants for each). One attendee was on-call and did not attend the entire course. None of the applicants

withdrew because of language or cultural issues. A total of 17 students, from 10 Beijing academic hospitals, participated in the study. Both out-of ($n = 3$) and in-hospital ($n = 14$) emergency practitioners were involved. The 17 students completed the whole study protocol.

The two live models were Chinese Han, 21 and 25 years old, with a body mass index equal to 21 and 22 kg/m^2, respectively.

Main results

A total of 374 standard images were obtained and analyzed. Appropriate images and procedures were acquired in less than 60 s in 97.3% (364 out of 374). Investigators interrupted students in ten cases related to six different views, most of them during cardiac ultrasonography (Table 2). Six students were responsible for these cases: one physician failed three times, two failed two times, and three failed one time. These results corresponded to a 24% (8/34) complete sequence failure (1 or more of the 11 images/procedures exceeded 60 s).

Median cumulate time to obtain the 11 images and procedures was 182 s (141–238) (Fig. 2). Time to get the specific views of each examination category was 35 s (21–60) for the four abdominal views, 69 s (53–117) for the four cardiac views, 34 s (21–52) for the two vascular views with corresponding ultrasound procedures and 26 s (16–39) for the long bone procedure. Median time to capture a single image was 13 s (5–24). The time to obtain each view is detailed in Table 2. The difference in failure rate was not significant between the two models (6/187 vs. 4/187). There was no statistically significant difference between the two live models regarding the time to obtain a single image, perform a specific category of examination or complete the whole examination protocol ($p > 0.2$ for every comparison).

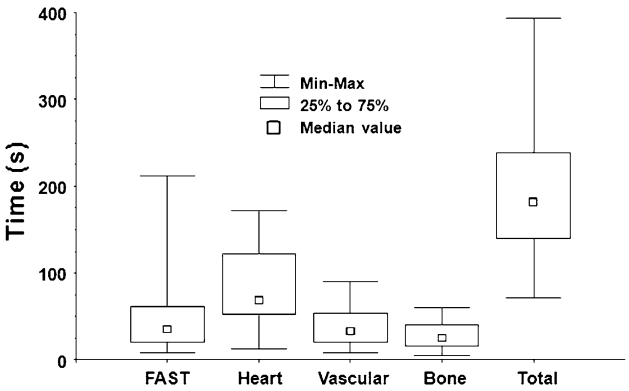

Fig. 2 Time needed to acquire ultrasound images according to the examination category

Table 2 Number of failed examinations and median time for image acquisition

Images	Number of failed examinations (n)	Time for image acquisition (s)
Abdominal ($n = 136$)		
Morrison's pouch view	1	7 (4–15)
Perisplenic view	1	7 (3–13)
Pelvic view	0	4 (2–8)
Subxiphoid view	0	8 (3–17)
Cardiac ($n = 136$)		
Short axis parasternal view	3	11 (6–18)
Long axis parasternal view	2	13 (7–29)
Four chambers apical view	1	14 (6–32)
Five chambers apical view	2	15 (7–19)
Vascular ($n = 68$)	0	
Popliteal vein and compression ($n = 34$)	0	13 (7–17)
Internal jugular vein and puncture site ($n = 34$)	0	18 (9–28)
Bone ($n = 34$)	0	
Radius identification and cortical test	0	26 (16–39)
Total ($n = 374$)	10	182 (141–238)

Limitations

The main limitation of this study is the lack of clinical proof of its efficiency. Even if the overall success rate was excellent, examinations were made on healthy live models and no pathological image acquisition was performed. However, we have previously published an increase in diagnosis performance after the implementation of a similar ultrasound training and on completion of 25 examinations [11]. The learning curve for focused sonography is known to flatten only after 20–70 procedures, so that we can reasonably expect that physicians' performance will increase after a clinical training period [2]. Besides, this high success rate in image capture could be highly relevant to the context of telemedicine and remote area health care, in which practitioners perform only the examination, the interpretation being the specialist's prerogative.

A randomized study comparing ultrasound tutorials with and without simultaneous translation would have increased the power of the study. The final goal was not to demonstrate the specific role of translation. The goal was to demonstrate that a bilingual ultrasound course was feasible. Many factors contributed to the success of the training, such as knowledge and understanding of anatomy, translation of slides and direct discussion with few Chinese physicians speaking English.

Course registration was on a voluntary basis and all the participants were from academic hospitals. Thus, we cannot exclude a selection bias and our results may have been different with less skilled people. However, this is unlikely, as performance disparity between various experienced practitioners was not detected after a previous study on an ultrasound introductory course [15].

The objectives were basic ones. For example, participants had to capture the four main cardiac views, but no Doppler or time-motion acquisition was required. Compression test during vascular examination was performed only on a single site, while the diagnosis of deep vein thrombosis relies on at least four compression sites [13]. The results of this study must be understood as the validation of an introductory course of focused sonography and are reliable only for basic applications (FAST, visual assessment of pericardial effusion and ejection fraction, long bone fracture…).

Discussion

Our ultrasound introductory course led to excellent skill acquisition despite translation and cross-cultural constraints, reaching a success rate superior to 97% in obtaining images and validating procedure. To our knowledge, it is the first time that such training efficiency has been evaluated with a composite primary outcome including quality and time limitation. Numerous researches have analyzed training effectiveness through pre/post course quiz, static image interpretation and/or images achievement [15–19]. In our protocol, we integrated a time limit to be in line with time-sensitive diseases typically encountered in emergency medicine and in remote area primary care. Despite this additional judgment criterion, learners failed to achieve the image/procedure in only 3% and full-sequence acquisition had a 76% success rate. In daily life, examination accomplishment would even be enhanced as a single image acquisition failure does not necessarily lead to the failure of the overall examination, and the time to obtain difficult views is balanced by a rapid capture of other images. Moreover, in focused sonography like FAST, not all the views are mandatory to reach a diagnosis, one positive being sufficient to conclude and others only increasing the sensibility of the examination [20].

Besides the overall success rate, the total time to perform a sonography examination may also be pertinent to evaluate a physician's skill. Some authors reported a mean time of 4.9 min to complete a FAST scan, while others described a median time of 9 min 53 s to complete an all-coming focused ultrasound examination [20, 21]. In our study, learners obtained a single image in less than 30 s in 97% of the cases and, excluding time for probe change, achieved the whole ultrasound protocol in less than 4 min. Even if image goals were simple ones (but cornerstones of FAST examination), these results greatly satisfied common practice requirements. Finally, it is worth noting that more complex examinations, such as cardiac sonography, had a good success rate and were not time-consuming, supporting the legitimacy of basic echocardiography teaching in ultrasound introductory courses [2]. Using practical repetition as a learning process may have a key role in this good training performance. In laparoscopic and thoracostomy training, repetition has been shown to effectively increase success rate and reduce the length of the procedure [22, 23].

Our secondary objective was to evaluate the effect of language and cultural differences on training effectiveness. Translation accuracy, unfamiliar abbreviations and subtleties of language are all known to possibly affect training success [10]. Divergences on cultural norms and teaching styles may also alter the learning process [10, 24]. In Asia, the shift from a teacher-centered to a subject-oriented teaching has been involved in education programs' improvement [25, 26]. Despite all these potential barriers, no student withdrew from our training and, as stated above, the overall success rate of image acquisition was excellent. One key point was certainly the association of a professional interpreter, who cared about general translation, and a French speaking Chinese physician, who was in charge of translation of complex medical terms. Besides, the training characteristics themselves, with practical and visual learning, avoid many language and cultural pitfalls and make ultrasound courses a good candidate for international emergency medicine programs. Especially, focused ultrasound training lends itself to a repetition learning process and thus eludes many communication difficulties. However, the real challenge will remain in the implementation, in daily life, of ultrasound practice by non-specialists. In China, like in other parts of the world, traditional sonographers are against the spread of focused ultrasound, regardless of international guidelines and multiple proofs of clinical and economic efficiency [2, 8].

In conclusion, after a 2-day introductory course, non-traditional imagers as emergency physicians are able to capture basic ultrasound images in a time consistent with daily practice. Subject to professional translation and highly practical learning, language and cultural barriers do not seem to alter such training efficiency. Furthermore, a time limit appears to be an objective and reliable criterion to help in the assessment of training efficacy, especially in a bilingual and cross-cultural context. Further studies are needed to define the importance and the extent of time limit, but we think that every training efficiency and learning curve studies on focused sonography should integrate a time criterion.

Conflict of interest None.

References

1. Kristensen JK, Buemann B, Kühl E (1971) Ultrasonic scanning in the diagnosis of splenic haematomas. Acta Chir Scand. 137:653–657
2. ACEP emergency ultrasound guidelines. American college of emergency physicians web site. Available at: http://www.acep.org/workarea/downloadasset.aspx?id=32878. Accessed June 19, 2009
3. Wordsworth S, Scott A (2002) Ultrasound scanning by general practitioners: is it worthwhile? J Public Health Med 24:88–94
4. Mindel S (1997) Role of imager in developing world. Lancet 350:426–429
5. Blaivas M, Kuhn W, Reynolds B et al (2005) Change in differential diagnosis and patient management with the use of portable ultrasound in a remote setting. Wilderness Environ Med 16:38–41
6. Mair F, Fraser S, Ferguson J et al (2008) Telemedicine via satellite to support offshore oil platforms. J Telemed Telecare. 14:129–131
7. Nikolić N, Mozetić V, Modrcin B et al (2006) Might telesonography be a new useful diagnostic tool aboard merchant ships? A pilot study. Int Marit Health 57:198–207
8. Langlois Sle P (2007) Focused ultrasound training for clinicians. Crit Care Med 35:S138–S143
9. Arnold JL, Corte DF (2003) International emergency medicine: recent trends and future challenges. Eur J Emerg Med 10:180–188
10. Weiner SG, Kelly SP, Rosen P et al (2008) The Eight Cs: a guide to success in an international emergency medicine educational collaboration. Acad Emerg Med 15:678–682
11. Lapostolle F, Petrovic T, Catineau J et al (2005) Training emergency physicians to perform out-of-hospital ultrasonography. Am J Emerg Med 23:572
12. Abboud PA, Kendall JL (2004) Ultrasound guidance for vascular access. Emerg Med Clin North Am 22:749–773
13. Tracy JA, Edlow JA (2004) Ultrasound diagnosis of deep venous thrombosis. Emerg Med Clin North Am 22:775–796
14. Marshburn TH, Legome E, Sargsyan A et al (2004) Goal-directed ultrasound in the detection of long-bone fractures. J Trauma 57:329–332
15. Mandavia DP, Aragona J, Chan L et al (2000) Ultrasound training for emergency physicians: a prospective study. Acad Emerg Med 7:1008–1014
16. Noble VE, Nelson BP, Sutingco AN et al (2007) Assessment of knowledge retention and the value of proctored ultrasound exams after the introduction of an emergency ultrasound curriculum. BMC Med Educ 7:40
17. Jones AE, Tayal VS, Kline JA (2003) Focused training of emergency medicine residents in goal-directed echocardiography: a prospective study. Acad Emerg Med 10:1054–1058
18. Noble VE, Lamhaut L, Capp R et al (2009) Evaluation of a thoracic ultrasound training module for the detection of pneumothorax and pulmonary edema by prehospital physician care providers. BMC Med Educ 9:3
19. Fernández-Frackelton M, Peterson M, Lewis RJ et al (2007) A bedside ultrasound curriculum for medical students: prospective evaluation of skill acquisition. Teach Learn Med 19:14–19
20. Ingeman JE, Plewa MC, Okasinski RE et al (1996) Emergency physician use of ultrasonography in blunt abdominal trauma. Acad Emerg Med 3:931–937
21. Blaivas M, Theodoro D (2003) Comparison of perceived and actual times spent by residents performing ultrasound examinations on patients. Acad Emerg Med 10:397–399
22. Homan CS, Viccellio P, Thode HC Jr et al (1994) Evaluation of an emergency-procedure teaching laboratory for the development of proficiency in tube thoracostomy. Acad Emerg Med 1:382–387
23. Derossis AM, Fried GM, Abrahamowicz M et al (1998) Development of a model for training and evaluation of laparoscopic skills. Am J Surg 175:482–487
24. Arnold LK, Alomran H, Anantharaman V et al (2007) Knowledge translation in international emergency medical care. Acad Emerg Med 14:1047–1051
25. Majumder AA, D'Souza U, Rahman S (2004) Trends in medical education: challenges and directions for need-based reforms of medical training in South-East Asia. Indian J Med Sci 58:369–380
26. Pilotto LS, Duncan GF, Anderson-Wurf J (2007) Issues for clinicians training international medical graduates: a systematic review. Med J Aust 187:225–228