

Research Article

A Novel Point of Care Ultrasound (POCUS) Training for Pediatric Hip Effusion Assessment by Instructional Video with Portable Ultrasound Machine

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Abstract

Background: Point-of-care ultrasound (POCUS) training in pediatrics varies greatly. The instructional-video training with the advancing technology of portable ultrasound machine is a novel method of POCUS training. Objective: We sought to investigate an effective, time-efficient method of POCUS training for pediatric hip effusion assessment; traditional in-person training (IPT) versus instructional-video training (IVT).

Methods: The study enrolled participants with no prior POCUS experience/training on hip effusion assessment. They were randomized to the IPT group or the IVT group. For the IPT group, a hands-on training session was provided with a skill assessment at the end of the session. As an efficacy measure of the training method, each participant's ultrasound skill was classified into poor, good, or expert. For the IVT group, each participant was provided with an instructional video and a portable ultrasound machine for 5 days. The identical skill assessment was performed upon completion. Each participant logged the amount of time spent for the training.

Results: The study enrolled 12 participants. For the IPT group, all participants were trained in one of two group training sessions taking 80 minutes and 75 minutes, respectively. For the IVT group, the total time spent ranged from 30 minutes to 120 minutes with the average time of 71 minutes. All 6 participants from each group achieved expert level for the POCUS skill.

Conclusions: The study revealed that the instructional-video training with a portable ultrasound machine was as effective and time-efficient as the traditional in-person training but was less resource intensive.

INTRODUCTION

Point-of-care ultrasound (POCUS) is defined as medical sonography performed and interpreted at the patient's bedside to facilitate diagnostic and/or resuscitation decisions, and the safe and expeditious performance of procedures [1]. It allows clinicians to integrate clinical examination findings with real-time sonographic imaging as a diagnostic and procedural adjunct [2]. It is distinct from the formal diagnostic ultrasound conducted by radiologists who perform thorough sonographic evaluation of all anatomic structures related to an organ or organ system.

The use of POCUS in pediatric emergency medicine is expanding rapidly [3] and pediatric-specific applications are increasingly being described and studied [4,5]. In 2013, Vieira et al. [6], published a consensus educational guideline for pediatric emergency medicine fellow training in POCUS. However, while

many pediatric subspecialists are achieving considerable competence in their systems of expertise and the increasing number of non-specialist pediatric health care professionals is starting to adopt POCUS for more common diagnostic applications, the POCUS training/education continues to vary significantly due to multiple factors including the lack of training time and training personnel [3].

The instructional-video training is a novel method of POCUS training that utilizes the advancing technology of portable ultrasound machine and digital video. We sought to investigate an effective, time-efficient method of POCUS training for pediatric hip effusion assessment, comparing traditional in-person training (IPT) versus instructional-video training (IVT).

METHODS

This study enrolled 12 participants (2 fourth-year medical

students, 2 first-year pediatric residents, 2 second-year pediatric residents, 2 third-year pediatric residents, 2 pediatric hospitalists, and 2 pediatric emergency physicians). The exclusion criteria included any physical conditions that would interfere with performing the POCUS examination and having prior POCUS training for hip effusion assessment. Within each training level, the study participants were randomized via a coin flip to IPT group or IVT group. Verbal consent was obtained from each participant.

For the IPT group, study participants attended one of two group training sessions, which was comprised of a 20-minute lecture, discussion, and a hands-on POCUS examination training on a 12-year old patient model volunteer using a hand-held portable ultrasound machine. The participants interacted actively with two instructors throughout the session. The instructors were the study coordinators who completed a POCUS training session for pediatric hip effusion assessment in the radiology department prior to the study. A skill assessment was performed at the end of the training session that included the basic operation of the ultrasound machine, identification of anatomical and sonographic landmarks, identification of the joint capsule, and measuring the distance from the cortical layer of femoral neck to the joint capsule bilaterally in a different patient model (a healthy 6-year old male) volunteer. Each participant's ultrasound examination skill was classified into one of three categories (poor, good, or expert) by the two instructors based on their operation of the ultrasound machine and their measurement of the hip joint space. "Poor" was defined as a subject who had difficulty identifying the synovial joint space (Figure 1) or had difficulty measuring the distance. "Good" was defined as a subject who was able to make the measurement accurately but took some time to get the best images and the measurements. "Expert" was defined as a subject who was able to obtain accurate measurements with no hesitation. The time spent for the entire training session was recorded as a time-efficiency measure.

For the IVT group, an instructional video was created that was as similar as possible to the IPT session. Video sequences were recorded in 1080 high definition video, composed, and edited by the study investigators (no professional video staff were used). Each participant was provided with the same hand-held portable ultrasound machine used in the IPT and the instructional video in the form of a DVD disk or USB drive to take home for a maximum of 5 consecutive days. An identical skill assessment was performed within the 5-day training period. Each participant logged the amount of time spent for the training in minutes. During the training period, training from the instructors was prohibited.

This study protocol was approved by the institutional review board (IRB) of this medical center (Western IRB, Olympia, WA). The study was performed from October 2015 to May 2016. The IRB had concerns over the repetitive groin exposure of the child models, even though they were not technically study subjects. The research team limited the number of exposures for the child models and created special garments for them; a swim shorts that had quick release closures on the sides that could be opened so they would not have to remove their shorts. Under the shorts, they wore athletic supporters which were not removed during the study (Figure 2). The IRB also required an independent

research observer trained in research compliance be present for all training and assessment sessions in which the child models were used. The small sample size is a consequence of the IRB's concern about the exposure by the child models, the limited availability of the single ultrasound machine, and the extreme difficulty to simultaneously schedule the model, the model's parents, the independent observer, the study subject(s), and the research team.

RESULTS

The study enrolled 12 participants. The participants were 6 males and 6 females. 7 participants had some kind of previous POCUS training (3 in the IPT group and 4 in the IVT group), and 5 did not. No participants had POCUS training related to hip effusion assessment. For the IPT group, all participants were trained in one of the two group sessions that lasted a total of 80 and 75 minutes, respectively. For the IVT group, the total time spent ranged from 30 minutes to 120 minutes with the average time of 71 minutes (Table 1). All 12 participants (i.e., 6 in both groups) achieved an expert level rating for the hip effusion POCUS examination skill.



Figure 1

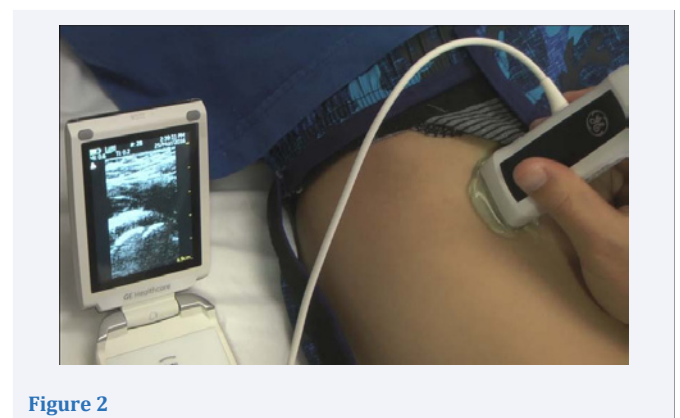


Figure 2

Table 1: Training times utilized by study subjects.

	IPT Group	IVT Group
4th-year Medical Student	80 min	120 min
1st-year Pediatric Resident	75 min	65 min
2nd-year Pediatric Resident	80 min	75 min
3rd-year Pediatric Resident	75 min	90 min
Pediatric Hospitalist	75 min	45 min
Pediatric Emergency Physician	75 min	26 min
Average Time	78 min	70 min

* 1 study subject in each cell

DISCUSSION

In this study, all participants achieved an expert level of performing the POCUS procedure for hip effusion suggesting that the both methods of training have similar efficacy. The training times were similar. To the best of our knowledge, this study is one of the first training trials to compare the traditional IPT method with an IVT coupled with a hand-held portable ultrasound machine with respect to their effectiveness and the time-efficiency for hip effusion POCUS assessment.

This study found that the IPT method of POCUS training was more resource intensive. To have all six participants in the IPT group undergo a group training session, two training sessions had to be held in a simulation room that was reserved ahead of time. Each session was run by the two instructors. One volunteer patient model participated in each session for the hands-on practice. On the contrary, the participants in the IVT group required only the instructional video and the portable ultrasound machine. This method achieved the same level of training proficiency with reduced resources, effectively leveraging the advantage of the hand-held portable ultrasound machine and video that can be played repetitively as needed. Multiple ultrasound instructional videos are available on formal ultrasound training sites and informal online video sharing sites such as YouTube. The instructional video that was produced was based on the appropriate evidence by expert groups. This has the potential to set the standard of POCUS practice not only within a certain training program but across the nation including the programs that lack in the training personnel. Although the video making consumed many hours of our time in script composition, video recording, and editing, the effort becomes more efficient for large numbers of trainees. A video alone without an ultrasound machine, however, is likely not sufficient. In this study, we did not provide the IVT group participants with a manikin or a model. The participants either tried it on themselves, their children, or their partners during their video training. Having the ultrasound machine to practice is an important component of the video instruction option for ultrasound training. We did not have a video alone group (i.e., video with no ultrasound machine) for the study, because we did not think that this was a fair comparison (i.e., it lacks equipoise).

This study also showed that the total amount of training time spent by both training groups was similar, suggesting that the time-efficiency of each training method was equivalent.

However, there was a crucial difference to note with respect to which timeframe of the day was spent for the training. The two group training sessions for the IPT group took place during the normal business hours on weekdays. The 3 residents in the group had to be excused from their clinical duty/training to participate in the session. In the IVT group, all 6 participants trained after 7:00 PM and the total training time were separated over 2 nights for 3 participants. The training time was accommodated in flexible fashion by the daily schedule of the participants without interfering with their clinical responsibilities. The American College of Emergency Physicians (ACEP) stated in its emergency ultrasound guideline in 2009 [7] that an 8- to 16-hour course with education and hands-on experience is a standard foundation for introductory ultrasound training and the statement is supported by other publications [8,9]. However, Marin JR et al. [3], reported based on the survey from 60 pediatric emergency medicine fellowship programs in the United States that one of the most common barriers to learning POCUS was "a lack of time". The instructional-video training with a portable ultrasound machine has the potential to address this time constraint.

A limitation of this study is the applicability of the IVT method to other POCUS examinations, particularly more anatomically complex organs such as the appendix and heart. POCUS examinations in these organs certainly require thorough anatomical knowledge and experience to reveal the target structure and to understand the orientation on a two-dimensional ultrasound image. The IVT with a portable ultrasound machine alone is likely not sufficient but should be combined with the other methods of training including bedside teaching, scanning, and image review. The ultrasound examination for a hip effusion is much simpler, permitting us to demonstrate similar efficacy of an alternate training method with a much smaller sample size of study subjects.

CONCLUSION

In conclusion, the instructional video POCUS training when coupled with a hand-held portable ultrasound machine was found to achieve similar procedural competency when compared to the traditional in-person POCUS training.

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