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# Comparative Analysis of Simulated versus Live Patient-Based FAST (Focused Assessment With Sonography for Trauma) Training

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**OBJECTIVE:** To investigate whether simulated patient (SP)-based training has comparable efficacy as live patient (LP)-based training in teaching Focused Abdominal Sonography for Trauma (FAST) knowledge and skill competencies to surgical residents.

**DESIGN:** A randomized pretest/intervention/posttest controlled study design was employed to compare the participants' performance in written and practical examinations regarding FAST examination after SP-based versus LP-based training.

**SETTING:** University-based general residency program at a single institution.

**PARTICIPANTS:** A total of 29 general surgery residents of various training levels and sonographic experience were recruited by convenience sampling.

**RESULTS:** There was no correlation between subjects' baseline training level or sonographic experience with either the posttest-pretest score difference or the percentage of subjects getting all 4 windows with adequate quality. There was no significant difference between the improvement in written posttest-pretest scores for SP and LP group, which were 33 $\pm$ 9.6 and 31 $\pm$ 6.8 ($p = 0.40$), respectively. With regard to performance-based learning efficacy, a statistically higher proportion of subjects were able to obtain all 4 windows with adequate quality among the LP than the SP group (6/8 vs 1/8, $p = 0.01$).

**CONCLUSION:** SP- and LP-based FAST training for surgical residents were associated with similar knowledge-based competency acquisition, but residents receiving LP-based training were better at acquiring adequate FAST windows on live patients. Simulation training appeared to be a valid adjunct to LP practice but cannot replace LP training. Future investigations on how to improve simulation fidelity and its training efficacy for skill-based competencies are warranted. (J Surg Ed ■:■■■-■■■. © 2017 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

**KEY WORDS:** surgical education, Trauma, FAST (Focused Abdominal Sonography for Trauma), simulation training

**COMPETENCIES:** Patient Care and Procedural Skills, Medical Knowledge

## INTRODUCTION

Focused Abdominal Sonography for Trauma (FAST) is one of the most commonly used imaging modalities during modern workup for blunt abdominal trauma to rule out hemorrhage in the peritoneal cavity.[1] It has established its role as an initial screening tool, in comparison to peritoneal lavage or computed tomography, due to its noninvasiveness and time-efficiency. According to large prospective studies, FAST was found to have a range of 63% to 96% sensitivity and 92% to 95% specificity for detecting hemoperitoneum.[1-3] The wide variation observed in the accuracy of FAST mainly stemmed from variable experience of the

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**TABLE 1.** Pretest and Posttest Content Sections

| Variable | Description |
|---|---|
| Anatomy (5, 13a-13g) | Identify organs on an abdominal diagram |
| Scanning of planes (6, 7, 8, 15a-15c) | Provided with images to identify transverse, sagittal, and coronal planes |
| Ultrasound probe placement (11, 12, 16a-16c) | How to aim the indicator on the transducer |
| Echogeneity (3, 4) | Hypo vs hyperechoic |
| Artifact recognition (33, 34) | Provided with images of ultrasound scanning artifacts |
| Free fluid recognition (9, 10) | Location and appearance of free fluid on US |
| Anatomical interpretation of FAST windows (14a-14j, 17a-17f) | Provided with images of 4 quadrants and asked to label the anatomy |
| Identification of FAST window quadrant (18-32 part a) | Provided with images and asked to identify quadrant |
| Diagnostic interpretation of FAST windows (18-32 part b) | Provided with images and asked if free fluid is present |

operator. Studies have shown significant variance in FAST quality, both in window acquisition and image interpretation, when performed by physicians of different specialty[4] and sonographic experience.[5]

As greater than 80% of trauma admissions present with blunt injuries across trauma centers in the United States,[6] FAST became an essential skill for prospective surgeons to acquire.[7] Learning curve studies have recommended a minimum of 10 to 30 FAST case experiences before an acceptable accuracy is reached.[5,8,9] However, because of the multidisciplinary nature of modern trauma activations and resident duty hour limitations, most current surgical residents are performing as little as zero to fewer than 2 sonographic examinations per month.[6] The need for further training in FAST is commonly acknowledged by surgical residents in a national questionnaire study.[10]

Simulation training has been gaining prevalent use in surgical education owing to its comparative lack of logistics and time restraints imposed by coordinating live model patients or animals.[11] It has been commonly applied for teaching laparoscopic skills,[12] 3-dimensional reconstruction of anatomic structures,[13] scenario-based training such as management of medical codes,[11,14] or mass casualty events.[15] SonoSimulator is a simulator-based virtual ultrasound training system for FAST developed in collaboration with the UCLA National Center for Research on Evaluation, Standards and Student Testing (CRESST) and the UCLA Center for Advanced Surgical and Interventional Technology (CASIT). It has been previously tested on novices with no sonographic training experience and found to be valid in increasing probe time and exposure to images of various anatomy and disease states in a time-efficient manner.[16,17] We hypothesized that similar learning effects could be observed among surgical residents of various training levels and sonographic experience, and that these effects would approximate or exceed those achieved with live patient-based training.

We undertook the following study to investigate the hypothesis that simulation training has similar efficacy in teaching knowledge and skill-based competencies when compared to live patient-based FAST training for surgical residents.

## METHODS

### Study Design

A pretest/intervention/posttest controlled study design was employed to compare the participants' acquisition of knowledge and skill-based competencies regarding FAST examination after training with computer-based simulated patients (SP) versus live patients (LP). All procedures were approved by our institutional review board for research involving human subjects.

General surgery residents of various training levels were recruited by availability sampling from a single residency program. Before training, all subjects completed a previously validated 71-question written pretest.[16] Content of the pretest encompassed anatomy, FAST examination technique, and interpretation (Table 1). Following pretest, all subjects underwent a 1-hour prerecorded didactic session on the physics of ultrasound, the techniques, and interpretation of FAST images. Subsequently, study participants were randomized into 1 of 2 groups: SP-based or LP-based practice groups.

The SP group underwent training using the SonoSimulator, a system developed by Pelagique (Santa Monica, CA), but did not practice on LP. Subjects used a generic ultrasound probe on a soft surface such as their own palm and attempted to acquire the intended windows by fine movements of the probe within a small area. There was no anthropomorphic mannequin torso that could be used in conjunction with this model in which displayed images changed according to probe positioning regardless of the surface the probe was placed on. As the user rotated the handheld probe, a virtual probe on a virtual torso on screen precisely mirrored the probe motion and the corresponding ultrasound images were displayed in a real-time fashion. By removing layers of skin and anatomical structures, the user could visualize the course of the ultrasound beams and better understand its trajectories. This simulator, originally