

Impact of Simulation-Based Training on Radiology Trainee Education in Ultrasound-Guided Breast Biopsies

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Abstract

Purpose: The aim of this study is to determine the impact of a simulation-based ultrasound-guided (USG) breast biopsy training session on radiology trainee procedural knowledge, comfort levels, and overall procedural confidence and anxiety.

Methods: Twenty-one diagnostic radiology residents from a single academic institution were recruited to participate in an USG breast biopsy training session. The residents filled out a questionnaire before and after the training session. Ten multiple-choice questions tested general knowledge in diagnostic breast ultrasound and USG breast biopsy concepts. Subjective comfort levels with ultrasound machine and biopsy device functionality, patient positioning, proper biopsy technique, image documentation, needle safety and overall procedural confidence and anxiety levels were reported on a 5-point Likert scale before and after training.

Results: Participants demonstrated significant improvement in number of correctly answered general knowledge questions after training ($P < .0001$). Significant improvement was seen in resident comfort level in ultrasound machine functionality, patient positioning, biopsy device functionality, biopsy technique, image documentation, as well as overall confidence level (all $P < .05$). Participants indicated a slight but not significant reduction in anxiety levels ($P = .27$).

Conclusions: A simulation-based USG breast biopsy training session may improve radiology trainee procedural knowledge, comfort levels, and overall procedural confidence.

Key Words: Medical education, simulation-based training, ultrasound, breast, biopsy

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INTRODUCTION

Ensuring trainees receive adequate training to acquire procedural skill proficiency and competency is challenging and requires progressive teaching techniques. The traditional Halstedian apprenticeship model has been the mainstay of procedural skill training for medical residents for over a century [1]. This model places the patient at the center of the trainee learning experience with gradual, progressive skill mastery through residency under the direct supervision of the attending physician [2,3]. This

time-honored training method has propagated the “see one, do one, teach one” philosophy that persists in procedural training today. Although this methodology has benefits such as direct hands-on experience and working under real-world pressures, modifications are needed to optimize patient safety and reduce medical errors, which are principal priorities in modern health care delivery.

Simulation-based training is a method that provides hands-on experience in a safe, controlled environment. For this reason, it has become a central component of modern medical education, adopted early on in the surgery, cardiology, and anesthesiology fields. When integrated successfully into a training curriculum, simulation-based training can supplement and enhance the traditional apprenticeship model by reducing training variability and offering a more standardized educational approach for trainees. This interactive learning style allows the trainee to perform patient-related tasks and

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procedures in a risk-free environment that mimics real-world clinical scenarios while gaining the needed procedural knowledge, skill proficiency, and self-confidence before treating actual patients [4]. Simulation scenarios can be tailored to each learner's knowledge level and gives the instructor an opportunity to assess performance, identify areas of strength or weakness, and refine skills in a controlled environment.

Because of the success of simulation-based training in other medical specialties, radiology residency programs are increasingly implementing this teaching method into trainee curricula. Prior studies have shown that procedural skill training in radiology improves knowledge, technical skills, and confidence levels of trainees, which suggests that integration of simulation-based training in radiology residency curricula holds promise [5-7]. Although building technical skill is imperative to the successful execution of interventional procedures, assessing psychological factors influencing the trainee procedural experience like confidence and anxiety is also a valuable and often overlooked component of trainee education. We propose that simulation-based training in procedural subspecialties of radiology, specifically breast imaging, may be of value because of challenges posed by the unique clinical environment. Patient apprehension regarding the risks associated with a biopsy, a potential new breast cancer diagnosis, and absence of routine procedural sedation make this a suboptimal environment for procedural training and may heighten both trainee and patient anxiety. Given these challenges, we sought to find an alternative method to establish trainee foundational knowledge, develop procedural skills, and improve trainee confidence and anxiety before actual performance of procedures on patients.

The purpose of this study is to determine the impact of a simulation-based ultrasound-guided (USG) breast biopsy training session on resident procedural knowledge, comfort levels with technical components, and overall procedural confidence and anxiety. Furthermore, we aim to evaluate the influence of the training session on resident confidence and anxiety in the clinical setting and explore trainee attitudes toward simulation-based training in radiology education.

MATERIALS AND METHODS

Subjects

After obtaining approval from our institutional review board, 21 diagnostic radiology residents from a single academic institution were recruited to participate in an

USG breast biopsy training session from December 2016 to June 2017. Informed consent was obtained from each trainee and participation in the study was optional. Participants included seven first-year residents, seven second-year residents, and seven fourth-year residents. The current resident rotation cycle at our institution does not include a breast imaging rotation in the third year of radiology residency. The first- and second-year residents had prior diagnostic ultrasound experience, but the majority had no experience performing USG procedures. All of the fourth-year residents had prior experience performing USG procedures, having completed 4 months of interventional radiology rotations and 2 months of breast imaging rotations.

Training Session

The residents participated in an hour-long simulation-based training session led by a single fellowship-trained breast radiologist. A turkey breast phantom with olives inserted to mimic masses was used for demonstration purposes and biopsy practice (Fig. 1a and b). Although there are synthetic breast phantoms available on the market, turkey breast phantoms are inexpensive and easy to prepare and resemble the form and texture of a human breast in the supine position [5]. As an introduction, the staff radiologist demonstrated the basic controls and functions of the ultrasound machine, image optimization techniques, and appropriate labeling and documentation of biopsy images in accordance with ACR Practice Parameters for the Performance of Ultrasound-Guided Percutaneous Breast Interventional Procedures [8]. The session also covered needle safety, patient positioning for biopsy, and proper USG breast biopsy technique. After a brief didactic session and demonstration by the staff radiologist, residents had the opportunity to familiarize themselves with the functions of the ultrasound machine and practice USG biopsies on the turkey breast phantom. The residents performed a minimum of three practice biopsies during the training session. Participants also had the opportunity to ask questions and were given real-time feedback from the staff radiologist throughout the training session.

Data Acquisition

Before the training session, each trainee completed an anonymous, 10-question, multiple-choice questionnaire that tested knowledge of general ultrasound and breast biopsy concepts. Specifically, sonographic breast anatomy, basic ultrasound physics, as well as appropriate biopsy

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