Simulator Based Obstetric Ultrasound Training: A Prospective, Randomized Single-Blinded Study

Hadar Rosen, MD;[1] Rory Windrim, MD, FRCSC;[1] Yee Man Lee;[1] Lara Gotha, MD, MSc;[1] Vsevolod Perelman, MD;[2] Stefania Ronzoni, MD, PhD[1]

[1]Maternal Fetal Medicine Unit, Department of Obstetrics and Gynaecology, Mount Sinai Hospital, University of Toronto, Toronto, ON

[2]Department of Emergency Medicine, Mount Sinai Hospital, University of Toronto, Toronto, ON

Abstract

Objective: To compare the use of simulator-based and patient-based obstetric ultrasound training.

Methods: This was a prospective, randomized, single-blinded trial. Eighteen consenting obstetric trainees with minimal previous ultrasound exposure were recruited. Enrolled patients were also fully consenting. Mid-trimester fetal brain anatomy in the standard planes (i.e., biparietal diameter and head circumference, cavum septum pellucidum, posterior fossa, and lateral ventricle) was chosen as a surrogate for all fetal anatomy ultrasound training. Trainees were randomized into two groups according to training method: simulator group (n = 9) or patient group (n = 9). All participating trainees went through the following sequence: a didactic session regarding the required planes; a "real" patient 15-minute pretest; a 45-minute training session with a dedicated ultrasound educator, using either a simulator or a "real" patient (according to the randomized group assignment); and a 15-minute post-test to obtain and label the standard four planes on a "real" patient. All images were stored and then scored by two blinded Maternal Fetal Medicine staff, according to 3 set criteria: image quality, landmarks, and measurements. Each criterion was scored 0 to 15 for a total score of 0 to 60.

Results: Pretest competence was similar between the two groups. For each of the two groups there was a significant score improvement following training: real patient (mean score pretest 13.3 vs. post-test 24.6; $P < 0.04$) and simulator group (mean score pretest 15.9 vs. post-test 28.9; $P < 0.05$). All trainees demonstrated significant overall score improvements (mean score pretest 14.6 vs. post-test 26.6; $P < 0.04$) regardless of training method. Trainees were further divided by their initial level of confidence (pretest score $\leq$5: very unconfident; pretest $>$5: unconfident). The improvement was similar for both groups, but "very unconfident" trainees' performance improved more in the simulator group (mean pretest vs. post-test score 3.5 to 35) compared with the patient group (mean pretest vs. post-test score 2.3 to 25.6)

Conclusion: Simulator-based obstetric ultrasound training performed as well as real patient training and was found to be especially beneficial for beginner trainees. Simulator-based ultrasound training has a high rate of acceptance by trainees, does not require investment of patient or clinic resources, and warrants consideration as an educational tool for the safe and effective teaching of obstetric ultrasound.

Key Words: Simulation, obstetric ultrasound, education, randomized study

Corresponding Author: Dr. Hadar Rosen, Mount Sinai Hospital, Toronto, ON. rosenhadar@gmail.com

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Résumé

Objectif : Comparer le recours à un simulateur et à une vraie patiente dans la formation à l'échographie obstétricale.

Méthodologie : Un essai prospectif et randomisé à simple insu a été mené auprès de 18 apprentis obstétriciens consentants qui avaient peu d'expérience avec l'échographie. Les patientes de l'étude ont aussi donné leur plein consentement. La formation à l'échographie a été évaluée par exploration anatomique du cerveau fœtal au deuxième trimestre, selon les observations habituelles (diamètre bipariétal et circonférence de la tête, *cavum septi pellucidi*, fosse postérieure, ventricules latéraux). Les participants ont été placés aléatoirement dans deux groupes, qui allaient recevoir une formation différente : sur un simulateur (n = 9) ou sur de vraies patientes (n = 9). Ils ont ensuite, dans l'ordre : participé à une séance didactique sur les plans demandés; réalisé un pré-test de 15 minutes sur une patiente; suivi une formation de 45 minutes, sur un simulateur ou une vraie patiente (selon leur groupe), donnée par un spécialiste de l'échographie; et réalisé un post-test de 15 minutes sur une vraie patiente pour obtenir des images des quatre observations habituelles, qu'ils ont ensuite catégorisées. Toutes les images ont été enregistrées, puis notées à l'insu par deux prestataires de soins médicaux fœto-maternels, selon trois critères prédéfinis : la qualité de l'image, les points de repère anatomiques et les mesures obtenues. Chaque observation s'est vu attribuer une note de 0 à 15, pour un score total allant de 0 à 60.

Résultats : Le niveau de compétence pré-test était similaire entre les deux groupes. Après la formation, le score total a significativement augmenté et pour le groupe formé sur une vraie patiente (score moyen pré-test : 13,3; post-test : 24,6; $P < 0,04$) et pour le groupe formé sur un simulateur (score moyen pré-test : 15,9; post-test : 28,9; $P < 0,05$). De plus, tous les participants ont significativement amélioré leur score total (score moyen pré-test : 14,6; post-test : 26,6; $P < 0,04$), peu importe le type de formation reçue. Les participants ont ensuite été classés en sous-groupes, selon leur

niveau de confiance initial (score pré-test ≤5 : très peu confiant; score pré-test >5 : peu confiant). Si le niveau d'amélioration des deux sous-groupes était similaire, les participants jugés « très peu confiants » du groupe formé sur un simulateur (score pré-test moyen : 3,5; post-test : 35) ont toutefois connu une plus grande amélioration que ceux du groupe formé sur une vraie patiente (score pré-test moyen : 2,3; post-test : 25,6).

Conclusion : La formation à l'échographie obstétricale sur un simulateur a été aussi efficace que la formation sur une vraie patiente. En outre, elle s'est révélée particulièrement efficace chez les débutants. Cette technique a un taux d'acceptation élevé chez les apprenants, ne nécessite pas le recours à une patiente ou à des ressources cliniques, et finalement mérite d'être considérée comme un outil d'enseignement de l'échographie obstétricale à la fois sécuritaire et efficace.

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INTRODUCTION

Ultrasound assessment is an integral part of contemporary obstetric practice. Ideally, obstetric trainees would graduate with the obstetric ultrasound skills appropriate to the accepted standards in their jurisdiction. However, obstetric ultrasound training faces several challenges.[1,2] These challenges include limited time during otherwise busy training programs[3] and a lack of consistency in training standards across programs and countries.[4] Moreover, many programs teach ultrasound during clinical care of pregnant women who may have been formally requested to act as training subjects. Typically, this training occurs during women's routine clinic visits and may cause patient discomfort associated with prolonged scanning and delays in patient flow. From the trainees' perspective, "real patient" training may provoke anxiety and stress due to the gap between lack of expertise and the patient's expectations for a professional study.[3] These challenges may be off-set by the advantages of simulation-based training: a flexible independent schedule, student-centred learning processes, and elimination of the pressure of a real patient encounter. In light of these challenges, the simulation-based training approach has been proposed as a valid method of introducing ultrasound skills into medical training programs.[5,6]

Before the introduction of simulator training as an educational tool for obstetric ultrasound training, validation of its utility is required. The aim of this study was to prospectively assess the use of simulator-based obstetric ultrasound training compared with the standard patient-based training method.

METHODS

The study was conducted at the Mount Sinai Hospital at the University of Toronto from November 2014 to November 2015. Institutional research ethics approval was obtained (MSH REB number 14-0139-E). Consents were obtained from all trainees and all patients participating in the study. Obstetrics and gynecology Post-Graduate Year (PGY-1) and Post-Graduate Year (PGY2) residents prior to their basic ultrasound rotation and international obstetrics and gynaecology fellows with self-attested minimal to absent previous exposure to obstetric ultrasound scanning were enrolled. Trainees were randomly assigned into 2 groups according to the expected training method, using a computerized random number randomization process. Trainees were assigned to either a simulator or patient training method. In this study, we used basic head and brain imaging as a surrogate for all fetal anatomy ultrasound training. The study utilized a pretest and post-test design, as shown in Figure 1.

Step 1: Preparation

All participants underwent a comprehensive pretest training session composed of a didactic classroom teaching with a PowerPoint presentation lasting 45 minutes, with time for questions and answers. This presentation included an introduction to basic ultrasound technology and detailed the specifics of mid-trimester fetal head anatomy. The four image planes to be acquired in the study were in accordance with International Society of Ultrasound in Obstetrics and Gynecology guidelines:[7] (1) head measurements—biparietal diameter and head circumference, (2) cavum septum pellucidum, (3) posterior horn of the lateral ventricle, and (4) posterior fossa.

Trainees were then asked to fill a pretest confidence survey answering six questions on a scale from 1 to 5, where 1 is not confident and 5 is very confident.

Step 2: Pretest

All trainees from both groups were assigned a real patient and were required to scan and produce the four standard images as previously detailed in 15 minutes.

Step 3: Training

Trainees received a 45-minute hands-on training session according to their group allocation either with a real patient or with the simulator (Figure 2). All training sessions were provided by the same ultrasound educator (Y.M.L.).

The simulator used in the study was the high-fidelity obstetric ultrasound simulator Vimedix Ob/Gyn (CAE