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Original Article

Improving students' ability to perform a standardized foetal biometry plane using ultrasound simulators

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ABSTRACT

Objective. – The objective of this study is to assess progress made in the ultrasound (US) measurement of femur length (FL) by students after one hour of training on US obstetric simulators.
Materials and methods. – Medical residents and midwives registered for the 2016 French national foetal US diploma were invited to a 1-hour US training course with simulators. The time to acquire the FL plane with changing foetal presentation was prospectively measured before and after the training. Every image was recorded, and quality criteria were assessed.
Results. – Thirty new learners trained in foetal US were evaluated. The time needed to measure the FL was significantly shorter in the post-test versus the pre-test (86s versus 125, $P = 0.015$). The quality criteria were statistically similar before and after training regarding the angle to horizontal (10.0° versus 9.6°, $P = 0.84$) and FL (31.3 mm versus 32.0 mm, $P = 0.15$).
Conclusion. – The time needed to obtain the FL plane was reduced by 30% after a 1-hour US simulation training session.

RÉSUMÉ

Objectif. – L'objectif de cette étude est d'évaluer les progrès effectués par les étudiants pour l'acquisition de la coupe de la longueur fémorale (LF), après une heure de formation sur simulateur d'échographie obstétricale.
Matériel et méthodes. – Les internes et les sages-femmes inscrits au diplôme interuniversitaire (DIU) d'échographie fœtale ont été invités à une formation d'une heure sur simulateurs. Le temps d'acquisition de la LF a été mesuré prospectivement avant et après la formation, en changeant la présentation fœtale. Chaque image a été enregistrée et les critères de qualité de la coupe analysés.
Résultats. – Trente inscrits au DIU ont été évalués. Le temps d'acquisition de la LF était significativement plus court lors du post-test (86s versus 125, $p = 0{,}015$) que lors du pré-test. Les critères de qualité étaient statistiquement similaires avant et après la formation, en particulier l'angle à l'horizontale (10,0° versus 9,6°, $p = 0{,}84$) et la LF (31,3 mm versus 32,0 mm, $p = 0{,}15$).
Conclusion. – Le temps d'obtention de la coupe du fémur a été réduit de 30 % après une heure de formation sur simulateurs.

Introduction

Ultrasound (US) becomes an essential tool for interns in obstetrics and gynaecology (OB-GYN) as soon as residency starts [1]. This examination is harmless to both mother and foetus and allows the diagnosis of many emergencies in obstetrics. However, it is highly operator-dependent [2]. The count of foetuses, foetal presentation, localization of the placenta and estimation of foetal weight are fundamental US skills that are indispensable for the management of obstetrical emergency units by residents and midwives. However, a significant majority of these providers have not been trained in obstetric US. For the estimation of foetal weight, expert US societies recommend 200 to 300 scans under supervision before practicing autonomously [3,4]. Therefore,

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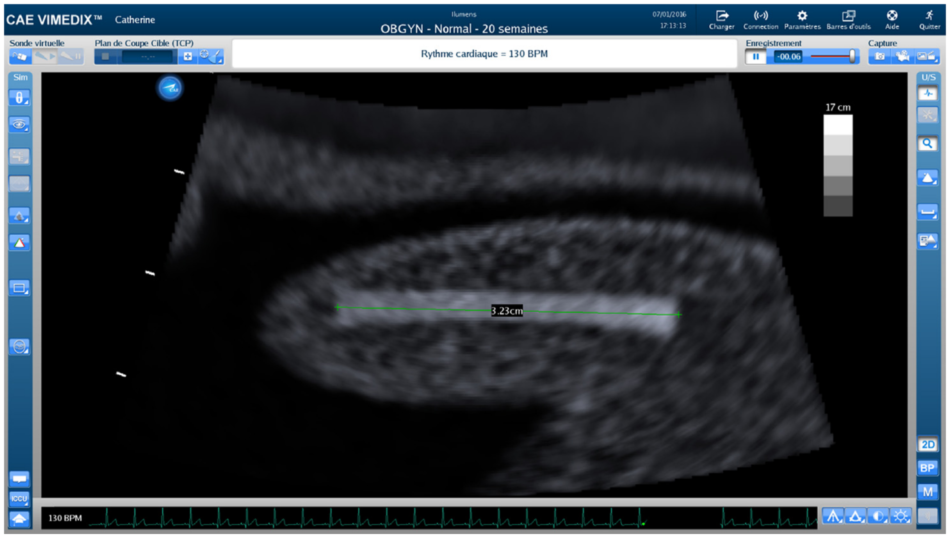

Fig. 1. Correct measurement of femur length obtained on a CAE HealthCare Vimedix™.

learning US techniques is a time-consuming process for both students and instructors.

Traditionally, interns are trained by the combination of observing seniors and practicing US on patients under supervision, mostly in obstetrical emergency units [5,6]. This method requires volunteers and depends on the availability of both instructors and equipment [7].

The use of simulation in medical schools has greatly increased during recent decades [8,9]. It represents a method to practice outside the clinical context in a stress-free environment with an available instructor [10]. Specialities that require technical skills are particularly interested in simulation [11,12]. In emergency units, for instance, residents who were trained on US simulators were as competent as those who directly practiced on actual patients [13]. The advent of new US simulators is a turning point for OB-GYN residents. They may improve beginners' skills and limit patient discomfort in the event of a prolonged and hesitant examination.

Among biometric measurements that are required for the estimation of foetal weight, femur length (FL) is particularly complicated for beginners [14]. It requires correct optimization of the picture (zoom, focus and gain) and a good three-dimensional representation. The US probe should be parallel to the femur to avoid underestimation of FL.

The objective of this study was to evaluate progress achieved by "new learners" of US obstetrics with regard to the speed of obtaining the correct FL plane after 1 hour of training on US simulators.

Materials and methods

This was a prospective single-centre study. Candidates for the 2016 French national exam for the practice of obstetrical US were asked to participate in a 1-hour training session on obstetrical US simulators. This training occurred at the simulation department of the University of Sorbonne, Paris City in January 2016. Students were recruited from different international institutions. Their theoretical background was homogenous because they were all attending the same foetal medicine lectures. Three different simulation exercises were included in the training.

The first exercise consisted of practicing the foetal biometry standardized planes on a VimedixTM US simulator (CAE Healthcare, Sarasota, USA). This device features a 20-week pregnant mannequin, a computer with keyboard, mouse and monitor and a transducer. It provides a realistic two-dimensional (2D) reconstruction of foetal anatomy. Zoom, gain and depth can be adjusted by the trainee. The system can present three-dimensional (3D) anatomical structures simultaneously next to the US images. This function was turned off for the study (Figs. 1–4).

The second exercise consisted of positioning the probe correctly on a foetal mannequin represented by a doll according to the foetal plane requested. A national instructor supervised this exercise and aimed to develop an understanding of the transducer movements necessary to obtain the transverse, sagittal or frontal views, according to foetal position.

The third exercise was performed using Hitachi MRI Fusion (Hitachi Medical systems, USA). MRI foetal images were extracted from a volume generated by a 2D reconstruction by detection of probe movement on a simulated maternal abdomen. Foetal planes were obtained through captured movement that precisely detected the movement of the probe.

Students who participated in this training were OB-GYN interns or midwives. A national instructor selected 30 students who were less experienced and who consented to participate in the study. The students were considered as beginners with ultrasound practice. They practiced ultrasound in emergency units in Obstetrics and gynecology departments. None of them was practicing in foetal medicine units. Oral and written consent were obtained.

Immediately before and after the training, the trainees were asked to acquire the standardized plane of the FL on the VimedixTM simulator (CAE Healthcare, Sarasota, USA). The operation of the simulator was orally explained to each student before the pre-test. The foetal position (cephalic, breech, transverse) was modified for each student between the pre-test and post-test.

The time needed to obtain this plane was measured prospectively from the first contact between the probe and the mannequin until the recording of the image by a senior obstetrician certified in obstetrical US and foetal medicine. The set-up of gain, image optimization and calliper positioning were performed by the student.

Images were stored and analysed according to established and validated objective quality criteria. The angle between the FL and horizontal was measured with ImageJ® software.

Data were stored in an Excel 2013 table and analysed by a t-test for matched variables using BioStatTGV®.