The Role of Ultrasound Simulation in Obstetrics and Gynecology Training: A UK Trainees' Perspective

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Introduction: Ultrasonography is a core skill required by all obstetrics and gynecology trainees; however, training opportunities in clinical ultrasound are declining. Simulation ultrasound training has been proposed as a strategy to overcome this. The study aims were to determine the current availability of clinical and simulation ultrasound training in obstetrics and gynecology in the United Kingdom and to explore the trainees' perspective on the role of ultrasound simulation.
Methods: All obstetrics and gynecology trainees within the East Midlands Local Education Training Board in the United Kingdom were asked to complete an anonymous web-based survey in July 2014.
Results: Of 140 trainees, 70 (50%) responded to the survey, and 69% reported rarely having dedicated clinical ultrasound sessions. Fifty percent had failed to achieve ultrasound competencies required for their stage of training, and 83% felt that the pressures of service provision limited their exposure to clinical ultrasound. Seventy-three percent of the trainees considered ultrasound simulation to be an essential component of training, and 69% agreed that it would help improve their clinical skills. Only 50% had access to an ultrasound simulator. Seventy-seven percent of the trainees thought that it would be useful to have ultrasound simulation integrated into training.
Conclusions: Trainees are struggling to achieve minimal ultrasound competences with clinical ultrasound training alone. They believe that ultrasound simulation will shorten the learning curve and improve their clinical skills and knowledge. Despite the cost implications of simulation training, we propose that consideration is given to formal integration of ultrasound simulation into the curriculum as a possible way forward.
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Ultrasound is the primary method of imaging in obstetrics and gynecology, and it has become an essential component of clinical practice.[1] The Royal College of Obstetricians and Gynaecologists (RCOG) requires that all trainees are able to scan at a basic level.[2] It is an integral part of the RCOG training matrix,[3] and the trainees are required to achieve basic ultrasound competencies (Table 1) to advance to the next stage of training.

To be able to scan safely, the operator must acquire a specific set of practical skills and theoretical knowledge. The level of operator skill will improve with the increasing number of scans performed.[4] Training in ultrasonography is frequently provided by an experienced sonographer, adopting the "see-one, do-one, teach-one" approach. However, this approach fails to meet the demands of providing efficient training while maintaining patient safety.[5]

The current state of training in basic ultrasound for obstetrics and gynecology trainees is varied and remains a challenge.[6] The reduced working hours imposed by the European Working Time Directive[7] and the pressures of service provision both limit hands-on–training time.

Virtual-reality simulation training in ultrasound has been proposed as a useful adjunct to clinical training, to help shorten the learning curve and to help maintain skills for a prolonged period of time.[8,9] It permits the trainee to practice through repetition without compromising patient safety.

Simulation training in ultrasound is a developing technology, which may bring several benefits into teaching and training, and in the provision of objective evaluation of ultrasound competencies.[1]

Currently, simulation training is not part of the obstetrics and gynecology training curriculum in the United Kingdom. However, Tolsgaard et al[10] found that supplementing clinical training with simulation training results in substantial improvements compared with clinical training alone. This suggests that simulation should be used in conjunction with clinical training.

The aim of this study was to determine the level of existing clinical competency in ultrasonography and the current status of clinical and simulation ultrasound training, in obstetrics and gynecology in the United Kingdom. We explored the trainees' perspective on the requirement of

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TABLE 1. RCOG Basic Ultrasound Curriculum

Ultrasound Examination of Early (8- to 12-wk) Pregnancy	Fetal measurement, Lie, and Presentation	Liquor assessment (AFI and Maximum Pool Depth)	Placental Assessment
Counsel patient about procedure	Counsel patient about procedure	Counsel patient about procedure	Counsel patient about procedure
Appropriate machine setup	Appropriate probe selection and machine setup/operation	Appropriate probe selection and machine setup/operation	Appropriate probe selection and machine setup/operation
Identify bladder and right/left orientation	Confirm fetal heartbeat	Confirm fetal heartbeat	Confirm fetal heartbeat
Identify uterus	Establish lie	Assess fetal lie and presentation	Assess fetal lie and presentation
Identify gestational sac and confirm its intrauterine location	Establish presentation	Measure amniotic fluid volume: maximum vertical pool depth	Determine placental position—transabdominally
Measure gestational sac diameter	Measure BPD transabdominally	Measure amniotic fluid volume: AFI	Communicate results to patient
Measure crown-rump length	Measure FL transabdominally	Communicate results to patient	Complete a structured written ultrasound report
Confirm fetal cardiac activity	Measure HC transabdominally	Complete a structured written ultrasound report	Arrange appropriate referral follow-up
Interpret ultrasound findings in the context of the clinical setting	Measure AC transabdominally	Arrange appropriate referral follow-up	
Communicate results to patients	Communicate results and uncertainties to patients		
Complete a structured written ultrasound report	Complete a structured ultrasound report		
Arrange appropriate referral or follow-up	Discuss appropriate referral if indicated		
	Ensure images/video is recorded according to local protocol		

Adapted from http://www.rcog.org.[20]
AFI, Amniotic fluid index; BPD, Biparietal diameter; FL, Femur length; HC, head circumference; AC, Abdominal circumference.

formalized simulation training and its perceived and/or actual benefit.

METHODS

The United Kingdom is divided geographically into Local Education and Training Boards (LETB), which are responsible for the provision of postgraduate training for a particular area. The postgraduate specialty training (ST) in obstetrics and gynecology occurs for a 7-year period and is categorized into basic (ST1–2), intermediate (ST3–5), and advanced stages (ST6–7). Our cohort was composed of all trainees within the obstetrics and gynecology training program in the East Midlands LETB.

A cross sectional, web-based survey was administered to determine the current status of clinical and simulation ultrasound training. The trainees were surveyed in July 2014, which is at the end of the clinical training year. Those trainees without a UK national training number or on an out-of-program placement were excluded, leaving a total of 140 trainees. The anonymous survey was distributed via e-mail, and built-in mechanisms within the "smart survey" tool prevented double entries. Three reminder e-mails were sent biweekly, and a total of 6 weeks were allowed for completion of the survey.

Survey Development

The Midlands Research Collaborative in Obstetrics and Gynaecology group developed the survey, after an extensive literature search. The survey then underwent a 2-stage content-validity review, initially by 6 obstetrics and gynecology trainees and then by a pilot group (consisting of 5 obstetrics and gynecology trainees, 3 obstetrics and gynecology consultants, 2 lay persons, and 4 non obstetrics and gynecology health care professionals). Each item in the survey was allocated a relevance score ranging from 1 to 4 (1 being the least relevant and 4 the most relevant); items with a total relevance score of less than 3 were omitted. The survey was uploaded and formatted onto the web-based survey tool "smartsurvey.co.uk." Test-retest reliability was tested on the pilot group who completed the survey on 2 occasions, 2 weeks apart.

The final 26-point survey explored the following 4 broad categories: the trainee and their workplace, clinical training in ultrasound, simulation training in ultrasound, and the formalization of simulation training. The trainee's current level of clinical ultrasound competency was an objective measure, evidenced by the completion of objective structured assessments of technical skills (OSATS) by an ultrasound trainer, for each component of the curriculum. A 5-point Likert scale was adopted to assess the views and perceptions of the trainees on the actual and perceived benefits on the use of US simulation in clinical practice.

Data Analysis

Statistical analysis was performed using Statistical Package for Social Sciences, IL, Version 22. Descriptive statistics were generated for the responses, and for independent samples, χ^2 test was used to compare categorical and continuous variables. P values of 0.05 or less were considered to be significant.

This study was performed in accordance with the local clinical governance, audit, and service evaluation guidelines.

RESULTS

The survey was sent to 140 trainees, of which 70 trainees responded, giving an effective response rate of 50%.

The Trainee and Their Workplace

Most respondents (n = 34, 49%) were in the intermediate stage of ST, with 14 (20%) in the basic and 22 (31%) in

TABLE 2. Completion of RCOG Basic Ultrasound Modules, Across Years of Training

Basic Ultrasound Modules	Year of Training		
	ST1–2, n (%)	ST3–5, n (%)	ST6+, n (%)
Early pregnancy (8–12 wk)	0 (0)	16 (47)	22 (100)
Assessment of fetal size, liquor volume, and the placenta	1 (7)	17 (50)	19 (86)

the advanced stages. The respondents represented trainees from both large tertiary units (n = 41, 59%) and smaller district general hospitals (n = 29, 41%).

Clinical Training in Ultrasound

Basic ultrasound modules were completed by just over 50% of the respondents (early pregnancy n = 38, 54%; assessment of fetal size, liquor volume, and the placenta n = 37, 53%). Seven percent had completed the obstetric intermediate ultrasound module on the assessment of normal fetal anatomy, and 10% had completed the intermediate modules in gynecology (ultrasound assessment in gynecology n = 7, 10%; ultrasound of early pregnancy complications n = 7, 10%). Tables 2 and 3 report the completion of basic and intermediate RCOG ultrasound modules by stage of training.

Sixty-nine percent (n = 48) of trainees stated that they rarely have dedicated time in their weekly schedule for hands-on ultrasound training, with only 7% (n = 5) receiving at least once weekly–dedicated ultrasound sessions. Most hands-on ultrasound training (73%, n = 51) was opportunistic either on wards or during emergency admissions. The rest of the training occurred in the outpatient setting, spread evenly between dedicated ultrasound lists or in general obstetrics and gynecology clinics. Only 14% (n = 10) and 20% (n = 14), respectively, expressed that they were able to obtain OSATS for gynecology and obstetric ultrasound competencies. Furthermore, 69% (n = 48) of the trainees found it difficult to maintain their ultrasound skills when they rotated through different hospitals. The most common limiting factor in obtaining ultrasound training and OSATS was lack of time because of service commitment, stated by 83% (n = 58) of respondents, followed by lack of dedicated ultrasound training sessions (79%, n = 55) and lack of trainer engagement (44%, n = 31).

Simulation Training in Ultrasound

Simulation training in ultrasound was considered to be essential in current obstetrics and gynecology training by 73% (n = 51) of respondents, 69% (n = 48) agreed that it would help improve their clinical skills, and 80% (n = 56) thought that it was a useful complement to clinical training. The perceived benefits of US simulation were shared equally among trainees of varying seniority (Table 4). A formal simulation teaching program in ultrasound was available to 14% (n = 10) of trainees; however, 77% (n = 54) of trainees thought that it would be useful to have ultrasound simulation integrated into their core training.

Virtual-reality ultrasound simulators were available to 50% (n = 35) of the respondents, and they had open access to the simulator at all times. Of those who had access, trainees used the simulator in their own time in 69% (n = 24) of cases; however, 20% (n = 7) stated that they had never used it. Most trainees (51%, n = 18) used the simulator less than once a year, with 29% (n = 10) using it up to once a month.

Of those with access to the transvaginal ultrasound simulator, 46% (n = 16) thought that it had actually helped improve their clinical scanning skills, 31% (n = 11) were neutral, and a small minority disagreed (14%, n = 5). When the responses were analyzed by stage of training, it emerged that trainees in the basic and intermediate stages had found simulation training the most beneficial and that those in the advanced stage mainly felt neutral about the benefits ($\chi^2 = 6.47$, $P = 0.04$). The main reasons given for underuse of ultrasound simulation resources were lack of time (67%, n = 47), lack of formal guidance (44%, n = 31), and not being aware of the facility (41%, n = 29).

DISCUSSION

To the best of our knowledge, this is the first published UK-based survey on the provision of clinical and simulation training in ultrasound. We provide an objective measure of current clinical training opportunities and ascertain the reasons for the underuse of existing simulation resources, from the trainees' perspective.

Our study demonstrates that the traditional apprentice style of training may no longer be feasible. Most trainees do not receive regular supervised ultrasound training, and a large proportion (73%, n = 51) of the training is received on an ad hoc basis. The level of clinical exposure in ultrasound is inadequate to meet the requirements of the RCOG training matrix.[3] The RCOG training matrix requires that all trainees should have completed their basic ultrasound modules (Table 1) by the end of training year 3 (ST3).

The perceived advantage of ultrasound simulation seemed to be greater than the actual reported benefit in our cohort. Most advanced stage trainees felt neutral about the benefits; this may be representative of the fact that they have already achieved their basic ultrasound competencies and were not currently using ultrasound simulation; therefore, they were no longer able to recall the benefits/disadvantages. In addition, not all trainees had access to an ultrasound simulator at the time of the study, and consequently, they were not able to comment on the actual benefits but could remark on the potential advantages of ultrasound simulation. However, the availability of simulation resources alone is not enough, and there was underuse of available simulation resources, in part because of the lack of formal guidance. For simulation to be beneficial, it needs be used more frequently with appropriate guidance and be fully integrated into everyday learning.[11] Furthermore, the evidence supporting

TABLE 3. Completion of RCOG Intermediate Ultrasound Modules Across Years of Training

Intermediate Ultrasound Modules	Year of Training		
	ST1–2, n (%)	ST3–5, n (%)	ST6+, n (%)
Normal fetal anatomy	0 (0)	2 (6)	3 (14)
Assessment in gynecology	0 (0)	3 (9)	4 (18)
Early pregnancy complications	0 (0)	3 (9)	4 (18)

TABLE 4. Trainees' Views on Simulation Training in Ultrasound

*	Agree/Strongly Agree, n (%)				Neutral, n (%)				Disagree/Strongly Disagree, n (%)			
	ST1–2 (n = 13)	ST3–5 (n = 32)	ST6+ (n = 19)	*P* (χ^2)	ST1–2 (n = 13)	ST3–5 (n = 32)	ST6+ (n = 19)	*P* (χ^2)	ST1–2 (n = 13)	ST3–5 (n = 32)	ST6+ (n = 19)	*P* (χ^2)
Ultrasound simulation training is essential in current O&G training	10 (77)	25 (78)	16 (84)	0.84	2 (15)	3 (9)	3 (16)	0.75	1 (8)	4 (13)	0 (0)	0.27
Ultrasound simulation training will help improve my clinical skills	9 (69)	27 (84)	12 (63)	0.21	4 (31)	2 (6)	5 (26)	0.64	1 (8)	3 (9)	2 (11)	0.96
Ultrasound simulation training will help improve my clinical knowledge	11 (85)	21 (66)	11 (58)	0.27	1 (8)	4 (13)	5 (26)	0.28	1 (8)	7 (22)	3 (16)	0.51
Ultrasound simulation training is a useful complement to learning on real patients	12 (92)	27 (84)	17 (89)	0.73	1 (8)	0 (0)	2 (11)	0.19	0 (0)	5 (16)	0 (0)	0.06

*Responses from 6 participants were missing from section.
O&G, Obstetrics and Gynecology.

the benefit of simulation training has been produced in the context of a structured training program, whereby the users are provided with specific instructions on the use of the simulator, tasks to build on defined skills, and end-point assessments. Previous work exploring the benefit of unsupervised simulation training has shown that it may not be as beneficial as simulation in the context of a structured programme.[12] Our data on formalized ultrasound simulation training are comparable nationally, because only 6% of deaneries in the United Kingdom offer formalized training and in the majority (62.5%) use of simulation is unsupervised.[13]

Simulation-based ultrasound training has been shown to improve basic skills, such as adopting a systematic approach, probe orientation, and image optimization.

Within the context of obstetrics and gynecology, specifically, learner benefits have been shown in early pregnancy with ultrasound simulation,[14] and the sonotrainer ultrasound system has been employed to train ultrasound novices to achieve near-expert accuracy in first trimester and nuchal translucency measurements.[15] In addition, it has been shown to improve basic skills in transvaginal ultrasound in 3 to 4 hours,[16] whereas literature for more advanced sonography skills is limited. In view of these data, it may be argued that simulation training has a greater role to play in the earlier stages of training to allow acquisition of basic skills, which can be further developed in clinical practice. It may also serve as a method to allow trainees to maintain their basic skills as they progress through their training.

However, it is acknowledged that virtual-reality simulator training is not adequate on its own, nor is it a replacement for training on real patients.[17]

The potential to use simulation modalities to develop a more comprehensive educational strategy has previously been investigated by some medical specialties,[18] and it is already well established in other high-risk industries such as aviation. In obstetrics and gynecology, there seems to be a lack of consensus on the claimed benefits of ultrasound simulation by the RCOG ultrasound coordinators (trainers). This presents a challenge for the incorporation of formalized ultrasound simulation training into the core RCOG training curriculum because only 54% of ultrasound coordinators agree that simulation has a significant role in ultrasound training.[13] There are also the significant cost implications involved in sourcing US simulators; only 39% of the training deaneries currently have access to an ultrasound simulator.[13]

The considerable time constraints on the trainees as a result of shortened work hours and expanding service commitments is a further concern. Although the use of simulation will not fully overcome these, it does permit a learner-centred approach, allowing the trainee more control[8] and flexibility of their time and training. The trainees struggled to obtain formal assessments for ultrasound competencies (OSATS); simulators can provide objective and structured automatic feedback. This may in addition reduce the requirement for expert supervision at all times,[5] saving on human factor resources.

It is evident that trainees feel that simulation has a role to play in the delivery of ultrasound training; however, one may argue that this is only one perspective and changes to a national curriculum cannot be based solely on this. Nevertheless, it is clear that trainees are not achieving the required US competencies for their stage of training as determined by the RCOG training curriculum. Suggesting that careful thought does need to be given to re-evaluating the delivery of ultrasound training and the incorporation of simulation may provide one possible solution. It was stated by the Chief Medical Officer in his report in 2009 that "simulation training in all its forms will be a vital part of building a safer healthcare system".[19]

We acknowledge that there are some limitations to this study. One may infer from a responses rate of 50% that there was a degree of respondent bias; however, there was a good representation of trainees from both large teaching hospitals and smaller units, as well as a good mixture of trainees of varying grades. Although this study was conducted in a single LETB, given the range of respondents, we believe that our data may be extrapolated to other regions within the United Kingdom, but to obtain truly representative data, the survey would need to be rolled out nationally to all trainees. Although this is only a UK-based study, many other countries particularly in Europe also share similar concerns of lack of formalized "hands-on" practical ultrasound training.[6]

Our study demonstrates that exposure to clinical ultrasound is inadequate to meet current training requirements. Ultrasound simulation has a role to play but is underused in obstetrics and gynecological training, where available. A well-designed simulation program holds the potential to improve the use of currently available resources and may enable trainees to achieve mandatory ultrasound competencies.

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