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Original Article

Development and Validation of Simulation Training for Vaginal Hysterectomy

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ABSTRACT **Study Objective:** To develop and validate an educational intervention based on vaginal hysterectomy (VH) simulation.
Design: Prospective cohort study (Canadian Task Force classification II-2).
Setting: Surgical skills simulation center.
Patients: Thirty residents in Obstetrics and Gynecology (11 PGY-2, 11 PGY-3, and 8 PGY-4).
Intervention: VH educational intervention that included a lecture, a video, and surgical skill simulation using a new inexpensive model.
Measurements and Main Results: The primary outcome was written test scores before and after the educational intervention, and the secondary outcome was self-rated confidence in performing VH. Baseline written scores were similar for all 3 training levels; however, baseline confidence scores were higher for PGY-3 and PGY-4 residents than for PGY-2 residents ($p < .01$). After the workshop, written test scores improved significantly for all trainees (median [range] improvement, 4 [3.5–5.0] points; $p < .01$). Mean (SD) improvement in confidence scores for PGY-4, PGY-3, and PGY-2 residents was 0 (0.5), 0.5 (0.8), and 1 (1.3), respectively, with improvement in confidence scores reaching significance only for PGY-2 residents ($p < .02$). All trainees expressed high satisfaction with the workshop.
Conclusion: An educational intervention based on VH simulation is feasible and improves knowledge and confidence in junior residents with limited exposure to VH. Journal of Minimally Invasive Gynecology (2014) 21, 74–82 Published by Elsevier Inc. on behalf of AAGL.

Keywords: Education; Model; Resident; Simulation; Vaginal hysterectomy

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Vaginal hysterectomy (VH) is the preferred approach to hysterectomy because it is associated with less morbidity, quicker recovery, and lower cost when compared with abdominal hysterectomy [1]. A recent position statement of the American College of Obstetricians and Gynecologists on VH states that "If most women undergoing hysterectomy

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for benign conditions each year chose a vaginal or laparoscopic procedure, rather than abdominal or robotic hysterectomy, performed by skilled and experienced surgeons, pain and recovery times would be reduced while providing dramatic savings to our health care system" [2]. With the introduction of other minimally invasive treatments, however, the number of VH procedures available worldwide for training residents is declining [3,4]. In a recent survey of fourth-year residents in Obstetrics and Gynecology from 41 states, 68% reported performing <20 VH procedures at 3 months before graduation [3]. Not surprising, graduating residents express lack of confidence in performing VH [5,6]. In a survey of resident hysterectomy training trends after the introduction of robotic hysterectomy, only 38.1% of program directors and 27.8% of residents reported graduating residents as being completely prepared to perform VH [6].

Because surgical cases available for residency training are declining, educational interventions that can be used for teaching and assessing surgical skills in VH are urgently needed. There has also been a gradual transition from surgical experience–based to competency-based assessments for certification in performing surgical procedures [7]. A PubMed search of articles from 1966 to 2012 using the terms "Education," "Resident training," "Vaginal hysterectomy," "Vaginal model," and "Vaginal simulator" identified only 1 article on development of a vaginal hysterectomy simulator [8]; however, validity or efficacy of the model was not evaluated. Only 5.6% of graduating residents ever report participating in a skills workshop for VH [6]. An inexpensive educational intervention that could teach VH skills to Obstetrics and Gynecology residents would be immensely useful for training and certification.

Education interventions that have been shown to improve resident knowledge and surgical skills include lectures, videos, and simulation. Clear advantages of one type of intervention over another have not been established [9–13]. Surgical simulation has been used to standardize training and improve residents' skill for performing other complex procedures such as laparoscopic cholecystectomy [9–18]. Simulation has been considered an optimal method for teaching adults because it enables the learner to gain and retain technical proficiency through task-based learning within a professional context and provides a supportive, motivational, and learner-centered milieu conducive to learning [19,20]. An effective simulation program includes not only the simulation model but also a multiple-component intervention including procedure-specific didactic instruction, and should include a way to measure acquisition of technical skills and proficiency [21–23]. The objective of the present study was to develop and validate an educational intervention to teach VH. Our hypothesis was that an educational intervention based on simulation would improve specific procedure-related knowledge and confidence in performing VH.

Material and Methods

After obtaining institutional review board approval, we developed an educational intervention that included a VH simulation model, a lecture, and a video. A VH model insert consisted of the uterus, fallopian tubes, ovaries, urinary bladder, and attached ligaments (Figs. 1 and 2 and Video 1). A detailed list of materials is given in Appendix A. The uterus was made from a balloon filled with caulk. Ovaries were constructed from pieces of foam cut to 2 × 3 cm. The uterus and ovaries were placed inside a surgical glove, the ovaries in 2 of the glove fingers and the uterus in the hand portion of the glove and fixed with super glue. The thumb and 2 fingers of the glove were positioned to become the uterosacral ligaments, and the extra glove finger was fixed to the uterus with super glue. An additional water-filled balloon was fixed to the wrist portion of the glove to represent the urinary bladder. Fallopian tubes and uterine arteries made of string were fixed to the uterus. The infundibulopelvic ligaments were recreated by placing a suture through the fingertips containing the ovaries and attaching this suture to the pelvic side wall. MediChoice stockinette material (Owens & Minor, Inc., Mechanicsville, VA) was used to fashion the vagina, which was attached to the cervix and the pelvis. The uterosacral ligaments were then attached to removable screws (#8 × $^{3}/_{4}$ -inch zinc-plated pan-head Phillips drive sheet metal screws) placed in appropriate positions along the sacrum of the model. Removable screws were used as a cost-saving measure enabling new model inserts to be placed in the same pelvis after completion of one simulation and preserving the pelvis for other simulation sessions. These attachments allowed the VH model insert to be suspended in a birthing simulator pelvis (PROMPT; Laerdal Medical Corp., Wappingers Falls, NY) (Figs. 3–5), which is used to teach obstetric maneuvers at the Penn Clinical Simulation Center. The VH model insert cost approximately $10 per model and required <30 minutes to assemble.

The model was evaluated by 6 attending physicians in Obstetrics and Gynecology (n = 3) and Female Pelvic Medicine and Reconstructive Surgery (n = 3). All 6 faculty members were able to identify all key anatomic structures. We evaluated the construct validity of the vaginal hysterectomy model in three phases: validation of the VH model only (phases 1 and 2) and validation of a complete educational intervention that included a lecture, video, and simulation using the VH model (phase 3).

Phase 1: Validation of Model Anatomy

In phase 1, we evaluated the anatomic fidelity of the model (content validity). Forty-four Obstetrics and Gynecology residents and medical students were enrolled. Our hypothesis was that PGY-3 and PGY-4 trainees would identify anatomic structures on the model more accurately than would PGY-1 and PGY-2 trainees and medical students. Medical students were involved only in validation of model