Original Article

A Randomized Multicenter Study Assessing the Educational Impact of a Computerized Interactive Hysterectomy Trainer on Gynecology Residents

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ABSTRACT   **Study Objective:** To assess the improvement of cognitive surgical knowledge of laparoscopic hysterectomy in postgraduate year (PGY) 1 and 2 gynecology residents who used an interactive computer-based Laparoscopic Hysterectomy Trainer (Red Llama, Inc., Seattle, WA).
Design: A multicenter, randomized, controlled study (Canadian Task Force classification I).
Setting: Five departments of obstetrics and gynecology: Keck School of Medicine of the University of Southern California, Los Angeles, CA; University of California, Los Angeles, Los Angeles, CA; University of Washington, Seattle, WA; University of British Columbia, Vancouver, British Columbia, Canada; and University of Toronto, Toronto, Ontario, Canada.
Participants: Gynecology residents, fellows, faculty, and minimally invasive surgeons.
Interventions: The use of an interactive computer-based Laparoscopic Hysterectomy Trainer.
Measurements and Main Results: In phase 1 of this 3-phase multicenter study, 2 hysterectomy knowledge assessment tests (A and B) were developed using a modified Delphi technique. Phase 2 administered these 2 online tests to PGY 3 and 4 gynecology residents, gynecology surgical fellows, faculty, and minimally invasive surgeons (n = 60). In phase 3, PGY 1 and 2 gynecology residents (n = 128) were recruited, and 101 chose to participate, were pretested (test A), and then randomized to the control or intervention group. Both groups continued site-specific training while the intervention group additionally used the Laparoscopic Hysterectomy Trainer. Participant residents were subsequently posttested (test B). Phase 2 results showed no differences between cognitive tests A and B when assessed for equivalence, internal consistency, and reliability. Construct validity was shown for both tests (p < .001). In phase 3, the pretest mean score for the control group was 242 (standard deviation [SD] = 56.5), and for the intervention group it was 217 (SD = 57.6) (nonsignificant difference, p = .089). The t test comparing the posttest control group (mean = 297, SD = 53.6) and the posttest intervention group (mean = 343, SD = 50.9) yielded a significant difference (p < .001, 95% confidence interval, 48.4–108.8). Posttest scores for the intervention group were significantly better than for the control group (p < .001).
Conclusion: Using the Laparoscopic Hysterectomy Trainer significantly increased knowledge of the hysterectomy procedure in PGY 1 and 2 gynecology residents. Journal of Minimally Invasive Gynecology (2018) ■■, ■■–■■ © 2018 AAGL. All rights reserved.

Keywords: Cognitive; Laparoscopy; Pelvic anatomy; Surgery; Simulation

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Over the past 3 decades, multiple factors have contributed to suboptimal surgical training of obstetrics and gynecology (Ob-Gyn) residents. Among the primary challenges of assuring surgically competent residents is the use of new technology and innovative surgical techniques. These have resulted in a reduction in the number of abdominal and vaginal hysterectomies a resident performs per year [1,2]. Other factors affecting surgical training are the reduced time available for attending teaching [3], reduction and restrictions in resident duty hours [4], impact of electronic medical records [5], inadequate teaching and understanding of anatomy [6], and financial impact of teaching in the operating room [7]. Evidence for the inadequacies of recent graduates is found in a recent survey of 130 Ob-Gyn fellowship directors who reported only 20% of first-year fellows were able to independently perform a vaginal hysterectomy, and 46% were able to independently perform an abdominal hysterectomy [8]. Similarly, only 28% of graduating residents felt prepared to independently perform a vaginal hysterectomy, 58% an abdominal hysterectomy, and 22% a laparoscopic hysterectomy [9].

Surgical training requires substantial cognitive skill training because evidence suggests that 75% of the performance of surgical procedures relies on cognitive skills, whereas only 25% relates to technical aspects of performing surgery [10]. Innovative educational tools are currently required to help pretrain residents before going to the operating room. These tools enable residents to be safer and more prepared learners, thus optimizing their operating room experience [11,12].

Mastering technical skills alone is insufficient for achieving competency in both cognitive and technical skills required to perform surgical procedures [13]. Adding cognitive material to technical skills courses significantly improves resident performance of salpingectomy and episiotomy over and above traditional training alone [14,15].

An interactive, computer-based Simpraxis Laparoscopic Hysterectomy Trainer (Red Llama, Inc., Seattle, WA) was developed to provide novice gynecologic surgeons an opportunity to master the cognitive material needed to perform a laparoscopic hysterectomy before actual operating room experience. Using a 3-phase multicenter, randomized, controlled study design, we tested the hypothesis that the use of the Laparoscopic Hysterectomy Trainer would significantly improve cognitive surgical knowledge in postgraduate year (PGY) 1 and 2 Ob-Gyn residents beyond their current site-specific resident education program.

Materials and Methods

Study Design

Five accredited departments of obstetrics and gynecology participated in the 3-phase study: (1) Keck School of Medicine of the University of Southern California, Los Angeles, CA; (2) David Geffen School of Medicine at the University of California, Los Angeles, Los Angeles, CA; (3) University of Washington School of Medicine, Seattle, WA; (4) University of British Columbia School of Medicine, Vancouver, British Columbia, Canada; and (5) University of Toronto School of Medicine, Toronto, Ontario, Canada. It was assumed that the PGY 1 and PGY 2 training at each participating site was comparable and complied with the required guidelines of the Accreditation Council for Resident Education and/or the Fellows of the Royal College of Surgeons of Canada. The University of Southern California Institutional Review Board approval was obtained (University of Southern California Institutional Review Board #HS-13-00826, January 20, 2014.) Subsequently, institutional review board approval was obtained at each participating site.

Phase 1

A modified Delphi approach [16] was used to create 2 tests to assess cognitive knowledge of the performance of a laparoscopic hysterectomy, querying knowledge of pelvic anatomy, instrumentation, procedure steps, decision making, and pre- and postoperative concerns. The Delphi panel used videoconferencing and electronic mail for correspondence among 7 academically recognized minimally invasive surgeons. This panel formulated a comprehensive group of questions probing the test takers' knowledge of the basic information required for the performance of a multitude of gynecologic surgeries while concentrating on the cognitive aspects of the performance of a laparoscopic hysterectomy (Appendixes 1 and 2). Varied question types were used including multiple-choice, multiple response, matching, fill in the blank, and interactive identification of anatomic structures from an image or high-definition video. During the formulation of the questions, it was understood that PGY 1 and 2 Ob-Gyn residents were not yet at the level of performing a laparoscopic hysterectomy, but the information presented in the trainer was materially applicable to many gynecologic surgeries, such as various adnexal surgeries, cesarean section, retroperitoneal dissection, and abdominal hysterectomy, that PGY 1 and 2 Ob-Gyn trainees do perform during their first 2 years in training.

For a pilot study, the test was administered online to 25 experienced gynecologic surgeon volunteers who were board-certified generalists in Ob-Gyn attending the 2013 American Association of Gynecologic Laparoscopists Global Congress on Minimally Invasive Gynecology and who had performed at least 100 hysterectomies of any type. Evaluation of the results enabled the Delphi expert panel members to create 2 equivalent 50-question knowledge tests for use in phase 2 and phase 3.

Phase 2

The 2 final cognitive tests (designated A and B for this phase) were administered online using a crossover design to a group of "skilled gynecologic surgeons" consisting of gynecologic surgery fellows, general gynecologists, minimally invasive surgery faculty, and a group of PGY 3 and 4 Ob-Gyn residents (n = 60). The PGY 3 and 4 residents'