Original Publication

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Laparoscopy Skills Simulation for the Obstetrics and Gynecology Resident

Sarah Appleton, MD*, Patricia Huguelet, MD

*Corresponding author: sarah.appleton@ucdenver.edu

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Abstract

Introduction: Operating room experience alone is insufficient for surgical training. In the current era of graduate medical education, work hour restrictions and the expectations of patients and the public limit residents' ability to participate in surgical cases. We aimed to create a laparoscopy curriculum for gynecology residents that teaches the fundamentals of laparoscopy utilizing self-learning modules complemented by skill-focused and faculty-guided laboratories to maximize learning time outside of the operating room. **Methods:** The curriculum consists of five electronic modules on the basics of laparoscopy. Residents are expected to complete these on their own. In addition, quarterly simulation labs are taught by faculty and allow residents to practice, with guidance, key skills as derived from a previously published laparoscopic surgery skills curriculum. Residents are then evaluated using an objective structured assessment of technical skill comprised of the Global Rating Scale of Operative Performance and time metrics for each skill. We also evaluate resident confidence and satisfaction. **Results:** In our initial year, residents' confidence regarding laparoscopy ability and satisfaction in training did demonstrate improvement. With concentrated practice, residents' observed skills also showed advancement. Furthermore, the implementation of the curriculum was feasible with reasonable cost and limited resident and faculty time. **Discussion:** While simulation is well accepted as a modality for teaching surgery, its implementation is often limited due to concerns for time and money. Our experience illustrates that simulation is an effective teaching tool for residents without becoming a burden on a department.

Keywords

E-learning, Laparoscopic Simulation, Gynecology Simulation, Gynecology Residents, Fundamentals of Laparoscopic Surgery, E-modules

Appendices

- A. Patient Positioning to Avoid Injury Module folder
- B. Laparoscopic Tools Module folder
- C. Prevention of Laparoscopic Entry Injuries Module folder
- D. Distention for Laparoscopy Module folder
- E. Basic Principles of Electrosurgery Module folder
- F. Laboratory Station Tasks .docx
- G. Evaluation Tools.doc

All appendices are peer reviewed as integral parts of the Original Publication.

Educational Objectives

By the end of the laparoscopic training program, participants will be able to:

1. Position a patient properly and safely for gynecologic laparoscopy.
2. Utilize laparoscopic trocars and uterine manipulators appropriately.
3. Describe various methods of laparoscopic entry and select an appropriate entry method to avoid patient injury.
4. Describe and implement safe laparoscopic distention.
5. Explain and apply basic principles of electrosurgery during laparoscopic procedures.
6. Demonstrate improvement in performance and time of selected skills on a laparoscopic trainer, achieving established benchmarks.

Introduction

The purpose of this curriculum is to teach and assess basic knowledge and technical skills in laparoscopy to obstetrics and gynecology (OB/GYN) residents. In developing this curriculum, we considered Knowles' principles on adult learning theory, which delineate that adults learn best when they (1) take responsibility for their own learning, (2) are placed in the program commensurate with their learning skill, (3) are able to progress at their own pace, (4) are provided immediate feedback, (5) receive contextual learning, (6) are taught according to their own learning style, and (7) do not have to repeat what they already know.¹ These

elements are emphasized in laboratory-based surgical simulation training, thus allowing for its success as a teaching modality for OB/GYN residents. As a result of simulation, improvements in technical skills in both laboratory settings and operating rooms have been demonstrated.²⁻⁷ However, integrating such a simulation curriculum into a residency training program is fraught with difficulties, which may explain why we did not find any existing gynecological laparoscopy training tools within MedEdPORTAL. We also investigated the well-established Fundamentals of Laparoscopic Surgery program by Peters et al.,⁸ which has been implemented across the United States and internationally. Despite their popularity, full-scale curricula such as this one face barriers commonly cited in simulation literature, including resident and faculty time constraints, faculty interests, faculty expertise, simulation equipment, funding for simulation equipment, and animal laboratory administrative issues.⁹⁻¹¹ Therefore, we modified the practice program specifically for gynecologic trainees.

During the initial design and implementation of the simulation training program at our home institution, we discovered that adding an online module component to our laparoscopy simulation curriculum helped to overcome some common barriers, most notably, faculty and resident time constraints, as well as inability to access certain equipment. While the online modules served only as preparatory material to the lab tasks, we made them available continuously for those learners who may not have performed well during the lab session.

Lab session performance measures were created based on the work by Reznick, Regehr, MacRae, Martin, and McCulloch, who described how task-specific checklists and the Global Rating Scale of Operative Performance make for an effective structured assessment of residents' surgical skills.¹² This assessment model, collectively known as the objective structured assessment of technical skills, can be used to evaluate and teach both basic and complex skills. Since checklists as originally described were not applicable, we created our own, but we still used the Global Rating Scale of Operative Performance. Through these adaptations, we have developed a laparoscopic training program for OB/GYN residents that utilizes an acceptable amount of faculty time commitment, resident time commitment, and financial support.

Methods

The laparoscopy curriculum is designed for all levels of residents and comprises two components: (1) online self-study modules to address the fundamentals of laparoscopy and (2) hands-on laboratories to focus on specific skills. The online portion is designed to introduce components of laparoscopy as applied in the operating room. All five modules (Appendices A-E) described in Table 1 are housed online with all other resident curricula and should be completed as self-study throughout the year. Each module contains a pre- and posttest to allow the learner to evaluate knowledge gained.

Table 1. Self-Study Modules

Module	Purpose	Viewing Time
Patient Positioning to Avoid Injury (Appendix A)	Reviews safe and proper positioning of the patient to avoid nerve injury.	5 min. 22 sec.
Laparoscopic Tools: Trocars and Uterine Manipulators (Appendix B)	Introduces types of instruments and the reasons each should be used.	7 min. 16 sec.
Prevention of Laparoscopic Entry Injuries (Appendix C)	Reviews key steps and techniques used to avoid injuries with entry in laparoscopy.	7 min. 4 sec.
Distention for Laparoscopy (Appendix D)	Reviews distention methods and troubleshooting for distending the abdomen.	5 min. 43 sec.
Basic Principles of Electrosurgery (Appendix E)	Introduces electrosurgery, its uses and risks, and the equipment needed.	13 min. 50 sec.

The second portion of the curriculum is designed to complement the modules and involves a series of faculty-guided laboratories to teach laparoscopic procedural skills and allow for supervised practice. Each of the four laboratory sessions covers all four of the following skills:

- Sleeve transfer.
- Shape cutting.
- Extracorporeal knot tying.
- Vaginal cuff suturing.

The sessions were held quarterly to allow residents on different rotations an opportunity to participate at least once. Appendix F provides specific details regarding the four skills, equipment needs, and cost. Lab equipment (e.g., box trainers, Penrose drains, peg board, and vaginal cuff models) was purchased with the support of a small internal departmental grant. Additional equipment (e.g., laparoscopic scissors and needle drivers, knot pusher, sutures) was borrowed from the operating room or labor and delivery ward, and we collected expired materials from our clinical setting to help supply all of the labs. Material acquisition can easily be adapted based on the resources of other institutions. We utilized \$8,245 for our initial costs and estimate \$2,155 will be needed to support disposable supplies each year, for a total estimated cost of \$10,200 for the first year. Given depreciation, the anticipated yearly cost of this program will be approximately \$3,000.

We arranged for laparoscopy labs to be conducted in available conference rooms or clinical exam rooms. When available, we recommend securing one large conference room to allow for a more cohesive and efficient session. Resident and faculty participation tends to be much higher when the labs are held in close proximity to other resident and faculty clinical activities. For example, hosting these sessions during faculty administrative time minimizes conflicts with other clinical or research obligations.

In addition to the two curriculum facilitators, each lab session requires three to four faculty members. We recruited faculty on a voluntary basis for each lab, highlighting the fact that the lab did not require preparation but, rather, simply providing the residents with guidance during each skill. In order to ensure that sessions have adequate faculty supervision throughout the year, resolicitation of the faculty is necessary every few months.

Prior to the lab, each station was set up with all materials and a laminated card describing the skill and the time goal for the faculty member to easily reference. A quick orientation to the four skills was presented to both residents and faculty at the start of each lab, and then they were given the remainder of the lab to practice any of the four skills. Total time allotted for each session was 2.5 hours. Faculty were instructed to work with the resident on each skill as they would in the operating room (i.e., give suggestions for conservation of movement, instrument use, and handling of tissue). Starting times were collected at the beginning of the year, and final times were collected in the second half of the year to measure improvement. All residents were given the opportunity, and encouraged, to practice between labs on a trainer always available to them.

To assess each resident's performance during each lab, we had the faculty complete the Global Rating Scale of Operative Performance¹² (Appendix G) and record the time to skill completion. The goal is to be able to measure residents' progress throughout their residency training. It is expected that residents will improve their times for each skill with each subsequent laboratory. The goal times for residents to reach for sleeve transfer (48 seconds), shape cutting (98 seconds), and extracorporeal knot tying (136 seconds) before graduation from the program are designated based on the standards used in the work by Ritter and Scott.¹³ The vaginal cuff goal suturing time (300 seconds) was designated based on expert opinion of our gynecologic surgeons. In addition to faculty evaluations, we also disseminated a pre-/posttest to measure the impact of the curriculum on the residents' confidence. This survey was given to the residents before the first lab and immediately following the fourth lab and asked the residents to rate the following on a 10-point Likert scale (0 = *not confident*, 10 = *very confident*):

- How confident are you regarding your knowledge of laparoscopy?
- How confident are you in performing minor laparoscopic procedures?
- How confident are you in performing major laparoscopic procedures?
- How satisfied are you with your laparoscopic training thus far?

Lastly, as much of the learning in this simulation is self-guided, it is recommended that debriefing with participants occur at the end of each quarterly laboratory session. This can be facilitated by the same faculty who have led the lab session and should take approximately 5 minutes per resident. Each resident should be asked to reflect and set goals before the next session using the following prompts:

- For which skills have you met the goal?
- Where have you improved?
- What skills do you intended to practice before the next lab?
- How and when will that practice occur?

Results

In the first year the curriculum was implemented, 11 faculty members participated in addition to the two faculty organizers who attended all of the labs. The range of faculty participation ranged from 2 hours (one lab) to 9 hours (four labs), with a mean of 4.1 hours (two labs) per participating faculty member during the academic year. All of the faculty instructors were full-time gynecology surgeons.

All of our OB/GYN residents ($N = 37$) were eligible to participate in the simulation labs. At the completion of the first year, 12 residents completed all five self-study modules with their pre- and posttests. An additional 14 residents had started the curriculum as measured by at least one completed module. A total of 27 residents (73%) participated in at least one laparoscopy lab. Of those, eight participated in two labs, and two participated in three or more labs. As a point of comparison, the resident participation rate was greater than the resident attendance at didactic education sessions during that year, which averaged 47%.

Our first assessments did demonstrate an overall increase in confidence in laparoscopy knowledge and performing both minor and major laparoscopy procedures, as well as an increase in satisfaction with laparoscopy training (Table 2). Prelaboratory confidence scores in all categories were higher overall in senior-level residents than in junior-level residents (Table 2). However, satisfaction scores regarding training did not vary significantly among classes.

Table 2. Resident Laparoscopy Self-Assessment Mean Scores per Postgraduate Year and Overall^a

Item	PGY1 ($n = 7$)		PGY2 ($n = 8$)		PGY3 ($n = 6$)		PGY4 ($n = 6$)		Total ($N = 27$) ^b	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
How confident are you regarding your knowledge of laparoscopy?	3.4	6	4.8	6	6.0	6.3	6.5	7.0	5.2	6.3
How confident are you in performing minor laparoscopic procedures?	3.0	5.6	5.9	7.0	7.3	7.3	8.9	9.5	6.3	7.3
How confident are you in performing major laparoscopic procedures?	1.1	2.0	1.6	5.0	4.4	4.7	5.5	7.0	3.3	4.8
How satisfied are you with your laparoscopic training thus far?	4.6	6.5	6	6.9	7.3	7.9	7.5	8.5	6.5	7.5

^aLikert scale: 0 = *not confident*, 10 = *very confident*.

^bAll p values < .05.

The Global Rating Scale of Operative Performance data were limited due to the minimal postlab scores obtained as few residents repeated the lab in 1 year. The skill times are represented in Table 3. Overall, no resident achieved the goal times, but all did improve their times with practice over the year. The experience of training in the operating room is also demonstrated with the globally better times for senior-level residents than junior-level residents.

Table 3. Mean Initial and Final Times (in Seconds) per Skill by Resident Level

Skill	PGY1 (n = 7)		PGY2 (n = 8)		PGY3 (n = 6)		PGY4 (n = 6)	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Post and sleeve	88	79	90	49	82	56	76	54
Shape cutting	503	355	433	400	493	299	311	190
Extracorporeal knot	267	246	264	242	248	213	239	193
Vaginal cuff suturing	650	541	558	528	514	435	520	397

Discussion

We found that it is feasible to develop and implement a laparoscopic curriculum, and we were able to overcome many of the commonly cited problems, including faculty time, resident time, and resources. In the current state of medical practice, it is difficult for teaching faculty to give up clinical time for dedicated resident teaching. Because our program involves self-study and does not rely on the same faculty at every training session, we were able to engage a larger faculty group, with minimal time commitment from any single individual. Lastly, our labs were created on a limited budget and therefore will be sustainable with minimal cost each year.

In reflecting on our laparoscopic training program, we recognize that there are limitations. The first of these is resident self-study and practice. To overcome our initially identified obstacle of resident availability, we created a protected educational time to allow the residents to participate in the hands-on training sessions. We also created the online modules to allow residents to review on their own time. As we piloted the program, the completion rate of the modules by the residents was low and required multiple reminders from the program coordinators to complete. Furthermore, we encouraged residents to practice between labs and provided a trainer and supplies in their call room. Initially, it was underutilized, but with time, it has become more familiar to residents to practice on their downtime. We did try incentives—ranging from prizes to pride to money—but none seemed effective in changing the residents' behavior. Ultimately, encouraging senior residents to teach junior residents in preparation for cases or when they had available time seemed to be the best motivating technique.

Having laboratory sessions only quarterly limits the one-on-one faculty-to-resident instruction time. As a result, residents may practice skills incorrectly or not get feedback in a timely fashion. We aim to create videos of each skill as performed by faculty laparoscopists for the residents to watch as they practice. The additional online modules would include procedure-specific presentations such as salpingectomy for ectopic pregnancy or laparoscopic hysterectomy.

In order to increase resident achievement of the target task times, we are developing a video library of the procedural skills taught during the laboratory sessions for residents to watch prior to the lab and while they are practicing on their own. We continue to work on improving access to equipment for resident self-study between lab sessions.

As new residents attend the labs, we plan to collect data using the Global Rating Scale and procedure times before and after each lab session to be better able to assess the impact of the training session. In doing so, we hope to decrease the bias impact of any interval cases the resident may do between labs. The new data collection procedure will also allow us to monitor each resident's progress throughout his or her training. Furthermore, we plan to reassess the needs of the residents regarding procedural skill training by querying current residents, recently graduated residents, and faculty. As with any simulation program, the question still remains whether a yearlong curriculum leads to improved resident performance in the operating room. In moving forward, we aim to continue to evaluate this type of curriculum and its impact.

Sarah Appleton, MD: Assistant Professor, Department of Obstetrics and Gynecology, University of Colorado School of Medicine

Patricia Huguelet, MD: Assistant Professor, Department of Obstetrics and Gynecology, University of Colorado School of Medicine

Disclosures

None to report.

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Ethical Approval

Reported as not applicable.

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