Current medical education and future possibilities for simulation-based hysterectomy model

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Abstract

Simulation is a strategy or technique for creating an experience without having to go through the actual event. Simulation provides a multidimensional safety container for learning while also opening up opportunities not available in real-world learning. Surgical education has been founded on a learning-by-doing apprenticeship approach for almost a century, with a high patient volume used to teach residents certain surgical skills step by step under various levels of supervision. This traditional paradigm is currently hampered by a number of factors: Surgical techniques have gotten increasingly difficult and specific, resulting in a decrease in the number of patients undergoing particular treatments. During the COVID-19 pandemic (Coronavirus Disease-19), there are reduction in hysterectomy surgeries. This study reviews at the impact of simulation-based hysterectomy training on the education of obstetrics and gynecology residents. The study found out that in the last ten years, simulation-based hysterectomy models, both low- and high-fidelity simulator models, from abdominal, laparoscopic, or vaginal hysterectomy simulator models, have been used in medical education to improve residents' knowledge, skills, and confidence about the instruments and procedures involved in a hysterectomy. The simulation-based hysterectomy model, when combined with a didactic lecture and real instruments for instruction, can be incorporated into the teaching curricula of Obstetrics and Gynecology residencies. In the future, we will need to develop hysterectomy simulator models and using more difficult anatomic models and simulation situations.

Keywords: Hysterectomy; Simulation training; Educational models; Medical education

1. Introduction

Simulation is a strategy or technique for creating an experience without having to go through the actual event. Simulation provides a multidimensional safety container for learning while also opening up opportunities not available in real-world learning, such as apprenticeships (So et al., 2019). Simulation can be used as an experience or an experimentation period in the experiential learning cycle, and post-simulation debriefing can be used to reflect on the experience and determine how to apply lessons gained to future clinical performance. Without threat to professional identity, simulation can provide a secure setting in which to reflect on and learn from mistakes (Rudolph et al., 2014). While healthcare simulation can be used to replace real patient contacts or other clinical settings for learning purposes, it's vital to remember that it's not the only way available, and it can be used in conjunction with other approaches to reach the education aim (So et al., 2019). Learners may not be able to grasp the dynamics of variation and adaptation to integrate or link the various components in a clinically meaningful and relevant way if they are taught in this manner. Modern educators employ a holistic approach and authentic assignments to encourage integrated learning in order to overcome compartmentalization and fragmentation issues. Although authentic assignments are available in the real clinical setting, simulation is a beneficial supplement to learning with real patients for a variety of reasons (So et al., 2019).

Surgical education has been founded on a learning-by-doing apprenticeship approach for almost a century, with a high patient volume used to teach residents certain surgical skills step by step under various levels of supervision. This traditional paradigm is currently hampered by a number of factors: Surgical techniques have gotten increasingly difficult and specific, resulting in a decrease in the number of patients undergoing particular treatments. Moral and ethical considerations became more prominent, societal acceptance of medical errors shifted, and ultimately, financial considerations, particularly operation time, complication rate, and time and costs for surgical education, became increasingly prominent in the minds of both society and surgeons (Munro, 2012). Several research have looked into the impact of repetition of certain interventions on the surgeon's learning curve, as well as the complexity and multidimensional nature of the operative learning process. Given these considerations, it was likely that a new surgical education system would be established, which would involve a repeating step-by-step schooling of difficult surgeries under more ethical, moral, and financially acceptable conditions. (Spuntrup et al., 2018).

The hysterectomy is a common gynecological procedure. Between 1981 and 1997, the incidence of hysterectomy in women over 35 years fluctuated between 628 and 937 per 100,000, according to Health Canada statistics. In 1981-1982, 462 per 100,000 women over the age of 20 had a hysterectomy, compared to 462 per 100,000 women in 1998-1999 (Lefebvre et al., 2018). Residents reported a 40% reduction in minor procedures (38.5%), a >80% reduction in benign gynecologic surgeries (50.5%), and surgical oncology procedures (50.5%) during the COVID-19 pandemic (Coronavirus Disease-19) according to a study conducted on 240 Obstetrics and Gynecology (OB/GYN) residents' at 12 Ethiopian Universities from May to June 2020 (47.2%) (Gudu et al., 2020).

This study reviews at the impact of simulation-based hysterectomy training on the education of OB/GYN residents. This study can provide new information and references for future research.

2. Simulation-based hysterectomy model for medical education

In 2005, almost 600,000 benign hysterectomies were performed in the United States alone. The abdominal method continues to be the most popular, accounting for 51.2%of all inpatient hysterectomies, followed by laparoscopic hysterectomy (31.8%), and finally vaginal hysterectomy (16.9%). Robotic assistance was used in two-fifths of laparoscopic hysterectomies, accounting for 12.6% of all benign hysterectomies conducted, vaginal (16%), laparoscopic (8%), and robotic hysterectomy (8%) (Desai and Xu, 2015).

Although residents have typically scrubbed into cases without any hands-on preparation outside of the operating room, the surgical community has agreed that task and virtual reality simulators should be utilized before trainees perform actual surgery (Malacarne et al., 2018). The use of task trainers in a virtual environment not only allows for a more relaxed assessment of surgical skills and grasp of procedure and anatomy, but it can also help evaluators provide targeted and specific feedback by providing a standardized yet individualized evaluation technique (Gala et al., 2013).

There is summary review of simulation-based hysterectomy model in the world wide in 10 years recent study (Table 1). Several research, including abdominal, laparoscopic, and vaginal hysterectomy simulator models, are shown in this table. The results of the research themselves vary, regarding the level of knowledge, skills, and self-confidence. Participants underwent an initial assessment, then performed the aforementioned hysterectomy surgery, and finally were reassessed.

Table 1. Summary review of simulation-based hysterectomy model

Author, Year	Primary country of simulation training	Period covered	Research method	No. of study participants	Simulation model	Main results and implications		
						Knowledge	Skill	Confidence
Anand et al., 2018	Boston	November 2016	Prospective cohort study	14 (6 1^{st} and 2^{nd} year groups, 8 3rd and 4^{th} year groups)	The low-fidelity VH simulator model	After the session, all residents reported improved understanding surgical anatomy of VH The 1^{st} and 2^{nd} year groups (n=6) experienced a mean improvement of 43.3% The 3^{rd} and 4^{th} year group (n=8) experienced a mean improvement of 24.4%		
Aurora et al., 2020	Columbia	April 2018 until May 2019	Prospective cohort study	68 (18 residents, 16 fellows, 15 specialists in obstetrics and gynecology, and 19 minimally invasive gynecologic surgery subspecialists)	The high-fidelity Gynesim TLH simulator model		Fellowship trained minimally invasive gynecologic surgery subspecialists achieved higher OSATS in all areas and completed all components faster. Similar performances were noted between residents, fellows, and specialists in obstetrics and gynecology in practice	
Berkowitz et al., 2018	Boston	2018	Prospective cohort study	22 (specialist obstetrics and gynecology)	The low-fidelity AH simulator model		70% of participants scored higher on the post-test	
Hong et al., 2012	Los Angeles	2010	Prospective cohort study	15 (8 2^{nd} year residents, 7 4^{th} year resident)	The low-fidelity AH simulator model			When compared to 4^{th} year residents, 2^{nd} year residents had a lower median number of hysterectomies performed as primary surgeon. In every area evaluated, both resident classes showed statistical trends or considerably increased surgical confidence.

Malacarne et al., 2018	New York	2018	Descriptive prospective study	43 (14 medical students, 15 residents, 1st and 2nd year residents, 8 3rd and 4th year residents, 14 FPMRS fellow, OB/GYN attending physicians, and FPMRS attending physicians)	The low-fidelity VH simulation task trainer model		Global rating scale and PSC scores increased as experience level became more advanced: residents scored higher than students, and attendings (combined OB/GYN and FPMRS) scored significantly higher than residents Mean time to completion was not significantly different between the individual participant groups	
Miyazaki et al., 2019	North Carolina	2019	Prospective cohort study	20 (10 resident, 10 expert)	The high-fidelity Miya model (VH simulator model)		Median time to procedure completion was significantly higher in the resident group, whereas median estimated blood loss was no different between groups. No significant differences were observed in the composite median OSATS or VSSI scores between groups. The interrater reliability indices for subscales and composite scores of the OSATS and VSSI were high	
Stickrath and Alston, 2017	Colorado	July until September 2015	Prospective cohort study	32 (9 1st year, 7 2nd year, 8 3rd year, and 8 4th year residents)	The low-fidelity AH simulator model	100% residents demonstrated improved knowledge following the session		100% rated their confidence as increased afterwards

Note:
AH: Abdominal Hysterectomy; FPMRS: Female Pelvic Medicine and Reconstructive Surgery; OB/GYN: Obstetrics and Gynecology; OSATS: Objective Structured Assessment of Technical Skill; PSC: Procedure Specific Checklist ; TLH: Total Laparoscopic Hysterectomy; VH: Vaginal Hysterectomy; VSSI: Vaginal Surgical Skills Index

2.1 Knowledge

In the learning and teaching process, various types of simulator models can be produced. For all levels of trainees, a low-fidelity simulator demonstrated an improvement in knowledge of procedural stages and instrumentation (Stickrath and Alston, 2017). The use of a simulator can result in significant improvements in residents' real and perceived surgical anatomy knowledge. Residents not only want more model-based simulation training in their hysterectomy didactic curriculum, but as shown here, such organized, model-based simulations are also important to detect and resolve specific deficiencies in resident knowledge of surgical anatomy (Anand et al., 2018).

2.2 Skill

There was an increase in the rated surgical abilities at all levels of participants in various trials, both training-based simulations utilizing low-fidelity or high-fidelity simulator models. Simulation training is an excellent tool for complex procedures with steep learning curves, as it allows for repeated practice without jeopardizing patient safety (Miyazaki et al., 2019). In OB/GYN and other surgical specialties, identifying effective educational interventions for surgical skills central to the performance of emergency care is critical, both for established surgeons with varying practice volumes and for the newer generation of learners who may not have the same volume of muscle memory to rely on in the event of emergently indicated procedures (Berkowitz et al., 2018). A resident can execute the task incorrectly in the same amount of time it takes an expert to complete it correctly, therefore efficiency does not always equate to correctness and safety; nonetheless, the mean time to completion was not significantly different (Malacarne et al., 2018).

2.3 Confidence

One of the main goals of the low-fidelity hysterectomy simulation model is to familiarize residents with the instruments and procedures involved in a hysterectomy. The low-fidelity hysterectomy simulation model and training boosts residents' confidence in surgical abilities and knowledge, especially for those with limited surgical experience (Stickrath and Alston, 2017). This is likely due to the fact that as a surgeon's skill level improves, any potential benefit received from simulation models may be lost as experienced surgeons lose the crucial clues that a real surgery setting provides (Hong et al., 2012).

3. Conclusion

In the last ten years, simulation-based hysterectomy models, both low- and high-fidelity simulator models, from abdominal, laparoscopic, or vaginal hysterectomy simulator models, have been used in medical education to improve residents' knowledge, skills, and confidence about the instruments and procedures involved in a hysterectomy. Simulator models have been demonstrated to help people with the least experience, therefore the hysterectomy simulator model would be best suited for first- or second-year residents.

We believe that this simulation-based hysterectomy model, when combined with a didactic lecture and real instruments for instruction, can be incorporated into the teaching curricula of OB/GYN residencies to aid in the acquisition of a surgical skill set, to establish competency in its trainees, and by surgical specialty organizations as a requirement for ongoing maintenance of certification, which is critical for future generations of gynecologist.

In the future, we will need to develop hysterectomy simulator models that are high-fidelity, affordable prices, and capable of performing all hysterectomy procedures completely, much like actual surgery, and that can be replaced every time a hysterectomy is performed. Using more difficult anatomic models and simulation situations, as well as refining the integration of expert demonstration and personalized coaching, and identifying regionally specialized surgical workshop programming, are all possible future possibilities.

Authors' Contributions
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Conflict of Interest
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