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Integration and Validation of Hysteroscopy Simulation in the Surgical Training Curriculum

Mohamed Elessawy, MD, Moritz Skrzipczyk, Christel Eckmann-Scholz, PhD, Nicolai Maass, PhD, Liselotte Mettler, PhD, Veronika Guenther, MD, Marion van Mackelenbergh, PhD, Dirk O. Bauerschlag, PhD, and Ibrahim Alkatout, PhD

Department of Gynecology and Obstetrics, University Hospitals Schleswig-Holstein, Kiel, Germany

OBJECTIVE: The primary objective of our study was to test the construct validity of the HystSim hysteroscopic simulator to determine whether simulation training can improve the acquisition of hysteroscopic skills regardless of the previous levels of experience of the participants. The secondary objective was to analyze the performance of a selected task, using specially designed scoring charts to help reduce the learning curve for both novices and experienced surgeons.

DESIGN: The teaching of hysteroscopic intervention has received only scant attention, focusing mainly on the development of physical models and box simulators. This encouraged our working group to search for a suitable hysteroscopic simulator module and to test its validation. We decided to use the HystSim hysteroscopic simulator, which is one of the few such simulators that has already completed a validation process, with high ratings for both realism and training capacity. As a testing tool for our study, we selected the myoma resection task. We analyzed the results using the multimetric score system suggested by HystSim, allowing a more precise interpretation of the results.

SETTING: Between June 2014 and May 2015, our group collected data on 57 participants of minimally invasive surgical training courses at the Kiel School of Gynecological Endoscopy, Department of Gynecology and Obstetrics, University Hospitals Schleswig-Holstein, Campus Kiel.

PARTICIPANTS: The novice group consisted of 42 medical students and residents with no prior experience in hysteroscopy, whereas the expert group consisted of 15 participants with more than 2 years of experience of advanced hysteroscopy operations.

RESULTS: The overall results demonstrated that all participants attained significant improvements between their pretest and posttests, independent of their previous levels of experience ($p < 0.002$). Those in the expert group demonstrated statistically significant, superior scores in the pretest and posttests ($p = 0.001$, $p = 0.006$). Regarding visualization and ergonomics, the novices showed a better pretest value than the experts; however, the experts were able to improve significantly during the posttest. These precise findings demonstrated that the multimetric scoring system achieved several important objectives, including clinical relevance, critical relevance, and training motivation.

CONCLUSION: All participants demonstrated improvements in their hysteroscopic skills, proving an adequate construct validation of the HystSim. Using the multimetric scoring system enabled a more accurate analysis of the performance of the participants independent of their levels of experience which could be an important key for streamlining the learning curve. Future studies testing the predictive validation of the simulator and frequency of the training intervals are necessary before the introduction of the simulator into the standard surgical training curriculum.

KEY WORDS: hysteroscopy, surgical simulation, hysteroscopy simulation, residency training

COMPETENCIES: AACME, MESGE, AGE

INTRODUCTION

Hysteroscopy is a minimally invasive technique for the assessment and treatment of intrauterine pathologies.[1,2] The development of new instruments and the introduction of fellowship programs for the training of residents in

Correspondence: Inquires to Mohamed Elessawy, MD, Department of Gynecology and Obstetrics, University Hospitals Schleswig-Holstein, Campus Kiel, Arnold-Heller Strasse 3, Haus 24, 24105 Kiel, Germany; e-mail: dressawy@gmail.com

minimally invasive gynecological surgery have encouraged the usage and implementation of diagnostic and operative hysteroscopy in routine clinical practice.[3,4]

In comparison with laparoscopy, hysteroscopic skills are often assumed to be less difficult to obtain.[5] The teaching of hysteroscopic interventions has received little attention thus far, focusing mainly on the development of physical models and box simulators,[6] while the demand for well-structured hysteroscopy training is expanding rapidly.[7]

Existing training models range from cow uteri and bladders to virtual reality; however, a Dutch survey revealed that lack of simulation training during residency was the leading factor that could be enhanced for optimal acquisition of hysteroscopic skills.[7] This encouraged our working group to search for a suitable hysteroscopic simulator module and to test its validation.

With a widely accepted validation procedure yet to be established, we decided to follow the process suggested by researchers from the University of Switzerland in the evaluation of virtual reality simulators.[8] The validation process is divided into the following 3 steps: face validation, defined as the extent to which the simulation resembles real-life simulation; construct validity, a set of evaluation procedures based on quality, ability, and traits it was designed to measure; and predictive validity, the extent to which the scores are predictive of actual performance.[9]

The primary objective of our study was to test the construct validity of the HystSim to determine whether simulation training improves the acquisition of hysteroscopic skills of the candidate independent of the previous level of experience by the use of a selected training scenario, applicable to contemporary practice. The secondary objective was to analyze the performance of a selected task using the scoring charts to reduce the learning curve for both novices and experienced surgeons.

MATERIAL AND METHODS

Subjects

Between June 2014 and May 2015, our group collected data on 57 participants of minimally invasive surgical training programs at the Kiel School of Gynecological Surgery, Department of Gynecology and Obstetrics, University Hospitals Schleswig-Holstein, Campus Kiel, Germany. The participants were divided into the following 2 groups: a novice group consisting of 42 medical students and junior residents with less than 2 years of gynecological experience and no prior experience in hysteroscopy, and an expert group of 15 participants with more than 2 years of experience of advanced hysteroscopy operations on an almost daily basis (myoma and septum resections and endometrial ablations).

To mimic the actual use of the simulator in a training curriculum and to establish baseline theoretical knowledge, participants were required to watch a self-guided teaching tutorial before starting the task. The participants underwent a pretest and posttest. Each participant was allowed to practice twice before the pretest took place as the first trials were used to become accustomed to the simulator. Each participant was allowed to practice alone twice before performing a posttest. The training curriculum for the second session was identical to the first session.

Apparatus

The HystSim (hysteroscopic surgery simulator system) project was initiated in 2001 by the National Center of Competence in Research Computer-aided and Image-guided Medical Interventions of the Swiss National Science Foundation, to build the most realistic simulator possible for hysteroscopic intervention. The simulator consists of an adapted hysteroscope (10-mm resectoscope), a virtual patient robot and the simulation software. The adapted resectoscope tracked all actions and movements of the trainee and this input was used to adapt the simulation accordingly. We focused our assessment on the myoma resection task.

Multimetric Score System (MMSS)

The overall results were shown as the sum of 5 parameters; safety, fluid handling, economical usage of the hysteroscope, visualization of the cavity, and removal of the myoma. The assessment was automatically calculated using the software implanted in the HystSim and published at the end of the trial. The scoring system recorded points for the successful accomplishment of the assigned task and simultaneously subtracted points for errors. A total of 15 relevant metrics had been identified for hysteroscopy using hierarchical task decomposition. They were grouped into 4 modules (visualization, ergonomics, safety, and fluid handling) and individually weighted, building the MMSS.[10] The maximum score obtainable was 340 points. In total, 100 points were given if the pathology was completely removed. The participant could achieve 80 points each for safety and economy and 40 points each for visualization of the uterine cavity and for fluid handling. The simulation software runs on a standard laptop (Intel processor, 2 GB RAM with 8800 graphics card).

Statistics

The data were collected in a database and analyzed using all trainee data sets. The performance parameters were recorded using simulator software and output files were created using Microsoft Excel (Microsoft Corp., Redmond, WA). SPSS version 20 (IBM, Armonk, NY) was used to log and analyze the data. A t-test was used to determine the significance of the differences between 2 proportions or percentages. The