

Virtual Reality Robotic Surgical Simulation: An Analysis of Gynecology Trainees

Sangini S. Sheth, MD,^{*} Amanda N. Fader, MD,^{*,†} Ana I. Tergas, MD,^{*,†} Christina L. Kushnir, MD,^{*,†} and Isabel C. Green, MD^{*}

^{*}Department of Gynecology and Obstetrics, Johns Hopkins Medical Institutions, Baltimore, Maryland; and

[†]Department of Obstetrics and Gynecology, Section of Gynecologic Oncology, Greater Baltimore Medical Center, Baltimore, Maryland

STUDY OBJECTIVE: To analyze the learning curves of gynecology trainees on several virtual reality da Vinci Skills Simulator exercises.

DESIGN: Prospective cohort pilot study.

SETTING: Academic hospital-based gynecology training program.

PARTICIPANTS: Novice robotic surgeons from a gynecology training program.

METHODS: Novice robotic surgeons from an academic gynecology training program completed 10 repetitions of 4 exercises on the da Vinci Skills Simulator: matchboard, ring and rail, suture sponge, and energy switching. Performance metrics measured included time to completion, economy of instrument movement, excessive force, collisions, master workspace range, missed targets, misapplied energy, critical errors, and overall score. Statistical analyses were conducted to define the learning curve for trainees and the optimal number of repetitions for each exercise.

RESULTS: A total of 34 participants were enrolled, of which 9 were medical students, 22 were residents, and 3 were fellows. There was a significant improvement in performance between the 1st and 10th repetitions across multiple metrics for all exercises. Senior trainees performed the suture exercise significantly faster than the junior trainees during the first and last repetitions ($p = 0.004$ and $p = 0.003$, respectively). However, the performance gap between seniors and juniors narrowed significantly by

the 10th repetition. The mean number of repetitions required to achieve performance plateau ranged from 6.4 to 9.3.

CONCLUSION: Virtual reality robotic simulation improves ability through repetition at all levels of training. Further, a performance plateau may exist during a single training session. Larger studies are needed to further define the most high-yield simulator exercises, the ideal number of repetitions, and recommended intervals between training sessions to improve operative performance. (J Surg 71:125-132. © 2014 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: robotics, computer simulation, surgical procedures, minimally invasive/education, gynecologic surgery

COMPETENCIES: Practice-Based Learning and Improvement, Patient Care

INTRODUCTION

Minimally invasive surgery (MIS) approaches in gynecology are becoming more common and include vaginal, laparoscopic, and robotic surgical methods.¹⁻³ Robotic-assisted hysterectomies are one of the fastest growing and most commonly performed robotic procedures in the United States. In 2010, 110,000 robotic-assisted hysterectomies were performed.⁴ With the growing application of MIS, MIS techniques are becoming a more common part of gynecology resident surgical exposure.⁵⁻⁸ Based on national statistics, the mean number of cases of laparoscopic hysterectomy among residents grew from 23 in 2008-2009 to 34 in 2010-2011, whereas the mean number of cases of abdominal hysterectomy dropped from 74 to 65 during those years.^{9,10} Survey results published by Smith et al.¹¹ indicate that 70% of the U.S. obstetrics and gynecology

Correspondence: Inquiries to Isabel C. Green, MD, Department of Gynecology and Obstetrics, The Johns Hopkins Medical Institutions, 600 North Wolfe Street, Baltimore, MD 21287; e-mail: igreen5@jhmi.edu

Presentation information: Accepted for an oral plenary presentation at the 60th Annual Clinical Meeting of the American College of Obstetricians and Gynecologists, San Diego, CA; May 7, 2012.

Disclosure: Dr. Isabel Green received a travel honorarium from Intuitive Surgical to participate in consensus meetings for the development of a robotics curriculum in gynecology residency training programs (unrelated to this study) in 2010 and 2011.

residents had participated in a robotics procedure and 44% planned to incorporate robotic surgery into their practice; however, only 3.6% felt equipped to do so without additional training. A separate survey of obstetrics and gynecology residency program directors indicated that the most common method to assess residents' robotic surgical competency was through operating room performance, but only 28% of respondents believed their current robotic training methods were "effective" or "very effective."¹²

Studies in laparoscopic training and simulation have demonstrated that a structured curriculum can lead to improved performance and patient safety in the operating room.^{13,14} Similarly, in residency programs in which robotic surgery is a component of the resident surgical experience, a structured curriculum is likely to ensure adequate training of the resident surgeons, as well as patient safety and quality health care delivery.¹⁵ Robotic surgical education must fit a training environment constrained by restricted resident work hours, finances, and decreasing hysterectomy surgical volume.^{16,17}

The recent advent and refinement of surgical simulators, and specifically virtual reality simulators, contemporize gynecologic surgical education by serving as a sophisticated and efficacious adjunct to traditional surgical training in an increasingly challenged training environment. Although the use of laparoscopic surgical simulators in training has been validated, the incorporation of virtual reality robotic simulation into resident training is in its infancy.¹⁸⁻²⁰ The da Vinci Skills Simulator (Intuitive Surgical Inc., Sunnyvale, CA), which uses Mimic virtual reality training software (Mimic Technologies, Seattle, WA), is a surgical simulation platform for the robotic surgical system. A number of studies in the urologic literature have previously demonstrated the face, content, and construct validity of this virtual reality simulator.^{15,21,22} Given the similarities in robotic surgical principles between urology and gynecology, these validation studies are generally considered to apply to gynecologic training as well.¹⁵ Recently, Tergas et al. reported on the efficacy of both the da Vinci Skills Simulator and a standard da Vinci robotic simulation platform with regard to resident performance on a suture exercise. Additionally, the authors postulated that the da Vinci Skills Simulator would allow for greater efficiency, trainee autonomy, and improved measurement of proficiency assessments compared with a standard surgical simulator.²³

We conducted this study to further understand and describe the learning curve associated with virtual reality robotic simulation training to inform future robotic surgical curricula. The study objectives were to describe the learning curve among junior and senior level novice surgeons utilizing the da Vinci Skills Simulator with Mimic virtual reality training software (MdVT), to compare performance metrics by training level and to define a performance plateau on each of the 4 MdVT exercises.

METHODS

Participants

This was a multi-institution, institutional review board–approved study conducted at 2 affiliated academic institutions: Greater Baltimore Medical Center and Johns Hopkins Hospital, both in Baltimore, MD. Medical students and gynecology trainees (postgraduate years 1-6) who had participated in 10 or fewer robotic-assisted surgeries, and therefore considered novice robotic surgeons, were invited to attend 2 one-week robotic surgery training symposia held in 2011, which utilized the da Vinci Skills Simulator. Medical students and residents of postgraduate years 1-2 were considered to be junior level trainees whereas fellows and residents of postgraduate years 3-4 were considered as senior level trainees.

Training Platform

The da Vinci Skills Simulator is a virtual reality simulation system developed as a collaborative effort by Mimic Technologies and Intuitive Surgical, Inc. The MdVT uses Mimic's virtual reality surgical simulation platform and contains a variety of exercises specifically designed to give users the opportunity to improve their proficiency with the da Vinci surgeon console controls and basic surgical skills. Previously published da Vinci Skills Simulator validation studies have included exercises utilized in this study: matchboard, ring and rail, suture sponge, and energy switching.^{21,24,25} These exercises are organized into system training and skills training modules: EndoWrist manipulation, camera and clutching, fourth arm integration, system settings and console overview, needle control and driving, and energy and dissection. The portable case, or "backpack," which measures 57.2 cm × 60.3 cm, attaches directly on the back of the da Vinci Surgical System surgeon console, so that the console can be used for virtual reality training without the need for the patient-side cart or instruments (Fig. 1). No additional system components are required.

Training Sessions

The MdVT training session started with a brief orientation to the robotic system provided by the study team to familiarize novice surgical trainees to the robotic console and its operation. The trainees were thereafter able to proceed autonomously during the exercises.

The MdVT training symposium consisted of 4 exercises: matchboard 1 (MB), ring and rail 1 (RR), suture sponge 1 (SS), and energy switching 1 (ES) (Fig. 2). All participants were asked to complete 10 repetitions of at least 1 exercise in the available time. Participants performing fewer than 10 repetitions of an exercise were excluded from analysis of that

Download English Version:

<https://daneshyari.com/en/article/4297645>

Download Persian Version:

<https://daneshyari.com/article/4297645>

[Daneshyari.com](https://daneshyari.com)