Evaluation of Two Flexible Colonoscopy Simulators and Transfer of Skills into Clinical Practice

Pedro Pablo Gomez, MD, Ross E. Willis, PhD, and Kent Van Sickle, MD

Department of Surgery, University of Texas Health Science Center at San Antonio, San Antonio, Texas

INTRODUCTION: Surgical residents have learned flexible endoscopy by practicing on patients in hospital settings under the strict guidance of experienced surgeons. Simulation is often used to "pretrain" novices on endoscopic skills before real clinical practice; nonetheless, the optimal method of training remains unknown. The purpose of this study was to compare endoscopic virtual reality and physical model simulators and their respective roles in transferring skills to the clinical environment.

METHODS: At the beginning of a skills development rotation, 27 surgical postgraduate year 1 residents performed a baseline screening colonoscopy on a real patient under faculty supervision. Their performances were scored using the Global Assessment of Gastrointestinal Endoscopic Skills (GAGES). Subsequently, interns completed a 3-week flexible endoscopy curriculum developed at our institution. One-third of the residents were assigned to train with the GI Mentor simulator, one-third trained with the Kyoto simulator, and one-third of the residents trained using both simulators. At the end of their rotations, each postgraduate year 1 resident performed one posttest colonoscopy on a different patient and was again scored using GAGES by an experienced faculty.

RESULTS: A statistically significant improvement in the GAGES total score ($p < 0.001$) and on each of its subcomponents ($p = 0.001$) was observed from pretest to posttest for all groups combined. Subgroup analysis indicated that trainees in the GI Mentor or both simulators conditions showed significant improvement from pretest to posttest in terms of GAGES total score ($p = 0.017$ vs 0.024, respectively). This was not observed for those exclusively using the Kyoto platform ($p = 0.072$). Nonetheless, no single training condition was shown to be a better training modality when compared to others in terms of total GAGES score or in any of its subcomponents.

CONCLUSION: Colonoscopy simulator training with the GI Mentor platform exclusively or in combination with a physical model simulator improves skill performance in real colonoscopy cases when measured with the GAGES tool. (J Surg 72:220-227. © 2014 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: flexible endoscopy, simulation, skills assessment, GAGES

COMPETENCIES: Practice-Based Learning and Improvement, Systems-Based Practice, Patient Care

INTRODUCTION

Approximately 2.8 million flexible sigmoidoscopies and 14.2 million colonoscopies were estimated to have been performed in 2002 for colorectal cancer screening.[1] Traditionally, general surgery residents have learned flexible endoscopy techniques by practicing on actual patients under the strict guidance of experienced surgeons. Currently, the required number of endoscopy cases established by the Accreditation Council for Graduate Medical Education Residency Review Committee for Surgery (RRC-S) and endorsed by the American Board of Surgery (ABS) was put into debate by a position paper issued jointly by the American Society for Gastrointestinal Endoscopy and 3 other gastrointestinal (GI) societies.[2] In response to their statement, the ABS expressed that hospital privileging for practicing endoscopists must go beyond an arbitrary number of procedures performed and should use objective criteria to evaluate technical and cognitive skills.[3] New approaches to determine competency have been postulated, given the dissimilarity in the minimal number of cases suggested by different medical societies[4] and the inadequacy of a number as a surrogate for measuring safety and proficiency during training or afterward.

Correspondence: Inquiries to Pedro Pablo Gomez, MD, University of Texas Health Science Center at San Antonio, Mail Code 7737, 7703 Floyd Curl Dr., San Antonio, TX 78229-3900; fax: (210) 567-2347; E-mail: gomezpp@uthscsa.edu, pedropablogmz@hotmail.com

  1931-7204/$30.00 http://dx.doi.org/10.1016/j.jsurg.2014.08.010

Wexner et al.,[4] in the largest prospective study devoted to investigate the effect of numbers on competence in GI endoscopy, reported that general surgeons with an experience level of at least 50 lower GI endoscopy cases were able to reach the cecum more than 90% of the time, with procedure lengths of 30 minutes or less, and with minimum morbidity and mortality. Currently, general surgery residents require a minimum of 35 upper GI endoscopies and 50 colonoscopies before graduation as their standard of training.[5] However, previously published numbers for GI fellows were set at 130 and 140 upper and lower endoscopies, respectively, to assess adequacy of skills.[6] Recently, the crucial question in defining training standards has focused on the level at which safety and basic competence is achieved. The Society of American Gastrointestinal and Endoscopic Surgeons has validated a global rating scale called Global Assessment of Gastrointestinal Endoscopic Skills (GAGES) that has been shown to be an instrument to determine endoscopic technical skills in both gastroenterologists and surgeons.[7]

The GAGES-colonoscopy (GAGES-C) tool is based on a 5-point Likert rating scale with 5 domains that include scope navigation, strategies for scope advancement, clear field, instrumentation (when performed), and overall quality. Each one of these domains is scored from 1 to 5 where 1 is given when unable to complete the task, 3 requires some assistance, and 5 reaches level of proficiency. A possible maximum score of 25 is obtained when all 5 domains are included. If instrumentation was not performed, then the maximum attainable score is 20. Vassiliou et al.[8] showed the use of this proficiency-based tool to be superior to case numbers by comparing GAGES scores among novices who performed less than 50 and 140 lower endoscopy cases based on the RRC-S and American Society for Gastrointestinal Endoscopy criteria, respectively. No statistically significant differences were found in GAGES scores among novices ($p < 0.001$). The same results were found when comparing experienced endoscopists in both groups ($p < 0.001$) taking into consideration the case-number criteria mentioned earlier. These findings suggest that the use of a proficiency measure such as GAGES may prove to be superior to case numbers as currently established.

Exposure to flexible endoscopy among surgical residents remains inconsistent and uneven nationwide. Duty-hour limitations, lack of a formal endoscopy rotation, and the recent increase in case requirements by the RRC-S are some of the challenges program directors and educators face in this new era of surgical training. Strategies such as the development of a national cognitive and technical skills curricula based on adult learning theory[9] and simulator-based training protocols have been proposed by educators to fill this training gap.[10-12] Simulation has become ubiquitous in surgical residency training programs and is often used as a method of "pretraining" residents on various surgical skills before practicing on actual patients.[13] Since the development of the first endoscopic simulator,[14] significant technological advancements have allowed a transition from physical model simulators to more complex and advanced computer-based platforms.[15-18] Despite these continuous developments, the effect of simulation training relies completely in its ability to transfer the learned skills into clinical practice. The purpose of this study was to compare 2 types of endoscopic simulators and their respective roles in transferring skills to the clinical environment.

MATERIALS AND METHODS

In our general surgery program, postgraduate year (PGY)-1 residents complete an exclusive 1-month skills development rotation in our simulation laboratory. The participants in this institutional review board–approved study were 27 endoscopic novices (i.e., PGY-1 categorical and preliminary general surgery residents). At the beginning of their skills development rotations, each resident performed a baseline colonoscopy on a patient under the guidance of experienced faculty as is the current standard learning practice. Their performance was scored using the GAGES-C[7] tool. Given that this was their first exposure to colonoscopy, we did not allow them to perform any therapeutic techniques which required instrumentation (e.g., snaring a polyp). Thus, we eliminated the instrumentation category as part of their scoring, which only allowed a maximum score of 20 rather than 25. In the case instrumentation needed to be performed, faculty took control of the case and returned the colonoscope to the PGY-1 resident once this portion of the procedure was completed. In the event that a PGY-1 resident was unable to make progress, the faculty took control of the case, advanced to a portion within the resident's ability, and returned the colonoscope to the resident. Trainees only performed colonoscopies on patients older than 18 years, scheduled to have an elective screening procedure, and with no prior history of any major intestinal or abdominal operations (e.g., colectomy, colostomy, or hysterectomy).

After the baseline assessment, each trainee completed a 3-week flexible endoscopy curriculum developed at our institution. All trainees completed 3 online modules. Module 1 described the main characteristics of the flexible endoscopic equipment, familiarizing residents with the device. Module 2 described fundamental concepts of anatomy, pathology, and procedural techniques necessary to perform endoscopy in a safe fashion. Module 3 described proper utilization of the 2 training platforms available in our simulation center. To assess understanding of these concepts, a brief quiz at the end of each module was provided to advance to the following level.

On completion of the online modules, each resident was randomly assigned to 1 of 3 training conditions based on equipment availability at our simulation center. One-third