

Technology-Enhanced Simulation Improves Trainee Readiness Transitioning to Cardiothoracic Training

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OBJECTIVE: Transitioning from medical school and general surgery training to cardiothoracic (CT) surgical training poses unique challenges for trainees and patient care. We hypothesized that participation in technology-enhanced simulation modules that provided early exposure to urgent/emergent CT patient problems would improve cognitive skills and readiness to manage common urgencies/emergencies.

DESIGN: Traditional and integrated cardiothoracic residents at our institution participated in a technology-enhanced simulation curriculum. The course comprised of didactics, hands-on simulation, virtual models, and mock oral examinations. Residents also were given a validated pretest and post-test to evaluate knowledge retention and integration. Resident performance was graded using a previously validated objective structured clinical examination. Resident perception of course usefulness and relevance was determined through the completion of a perception survey.

SETTING: This study occurred at the University of Pittsburgh School of Medicine with the Department of Cardiothoracic Surgery. The facility used was the Peter Winter Institute for Simulation, Education and Research.

PARTICIPANTS: From 2013 to 2015, 25 traditional and integrated cardiothoracic residents participated in these training modules who have completed all portions of the simulation were used for analysis.

RESULTS: For our participants, knowledge base significantly increased by 7.9% (pretest = 76.0% vs. post-test = 83.9%, $p < 0.01$). According to trained-rater evaluation,

93.6% of responses to the 11 objective structured clinical examination competencies were deemed adequate. Post-course perception survey demonstrated 92% of participants scoring the sessions as important or very important toward development and confidence in managing the cardiothoracic scenarios. These findings were present despite historical assumption that these learners were prepared for complex patient care.

CONCLUSIONS: After completing a technology-enhanced course combining didactics, simulation, and real-time assessment, residents demonstrated objective improvements in cognitive skills and readiness in managing CT patients. Resident postcourse feedback indicated enhanced confidence, suggesting increased preparedness transitioning to CT surgery. This has strong implications for improved patient safety during these potentially labile transition periods. (J Surg Ed ■■■■■. ©2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEYWORDS: surgical education, cardiothoracic training, cardiothoracic emergencies, resident assessment, objective structured clinical examinations

COMPETENCIES: Medical/Surgical Knowledge, Communication, Patient Care, System-Based Practice, Practice Based Learning and Improvement

INTRODUCTION

Easing the transition to a cardiothoracic residency and establishing optimal patient care and safety has been at the forefront of resident education.¹ Recently, based on our efforts and others, the American College of Surgeons has committed to developing a program that seeks to standardize the transition from medical school to surgical training to enhance patient safety.² Furthermore, the Consortium of

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American College of Surgeons Accredited Education Institutes (ACS-AEIs) was created to promote patient safety through advance technologies, simulation, and innovative education and training.¹ Therefore, many surgical subspecialties are developing simulation-based training curriculums as part of their residency training to improve clinical and operative skill.⁴⁻⁶ In CT surgery, residents have an opportunity to travel and enroll in an annual operative simulation “boot camp” that is sponsored by the TSDA.⁷ Using deliberate practice, residents were trained and evaluated on various tasks of cardiothoracic modules such as cardiopulmonary bypass, coronary artery bypass grafting, aortic valve replacement and others.⁷ These modules predominantly address surgical skills and allows the resident to use these skills in a safe setting. Though there is this focus on surgical simulation, technology only recently has gained traction in surgical subspecialties regarding the management of patients in a postoperative setting especially in cardiothoracic surgery.⁸

Groups have previously demonstrated the effect of simulation in the transition of general surgery trainees.¹ First-year surgical residents enrolled in a course that incorporated didactics and simulation. The surgical trainees demonstrated improvement on pretest and post-test examinations, indicating retention and gain of knowledge. Learner feedback also indicated improved comfort and readiness for tackling acute surgical problems tested during this course.¹ This was further studied in expanded form in a prospective manner to the degree that the effect was seen in performance on the wards.⁹

A cardiothoracic (CT) surgical patient can present with a wide range of preoperative and postoperative complications, with various levels of illness. These issues present with a relatively high index of acuity such that trainees find these circumstances the most difficult to triage.¹⁰ Furthermore, they are often anxiety-provoking such that performance can be effected significantly.¹¹ These complex patients present with life-threatening and broad-range problems that need timely, safe and effective management. General surgery residents interested in cardiothoracic training have a diverse range of exposure to cardiothoracic surgery rotations. According to the Accreditation Council of Graduate Medical Education, general surgery residents are required to have only 5 thoracotomy cases to graduate. They are not required to rotate through a cardiac surgery rotation.¹² Moreover, in 2007, a new training paradigm was implemented, creating a more targeted approach to cardiothoracic training. The integrated 6-year cardiothoracic residency training program (I-6) accepts applicants directly out of medical school without any general surgery training. There are currently 26 participating programs, with 32 residency positions. Furthermore, some programs have implemented a 4 + 3 program for general surgery residents, in which the resident completes 4 years of general surgery with 3 years of cardiothoracic training. The management of cardiothoracic

emergencies and problems are not routinely taught in medical school. As a result the vast backgrounds of new I-6 and traditional cardiothoracic residents, it is imperative that trainees understand the nuances for recognizing the early signs of an acute cardiopulmonary urgency at the start of their residency. Furthermore, our technology-based simulation curriculum allows trainees to use their knowledge and skillset in a safe environment, without the potential of harming patients.

In the present study, we implemented a technology-enhanced surgical simulation curriculum for both traditional and integrated cardiothoracic surgery residents at the University of Pittsburgh Medical Center that was founded and adapted from previous experiences.^{1,3,9,11} We hypothesized that participation in an intensive simulation program that provided early exposure to a CT-focused curriculum would improve cognitive skills and resident readiness to manage common CT patient urgencies and emergencies. This intensive program requires hands-on participation, protected time for residents, time commitment to education by faculty, and a dedicated center (Peter M. Winter Institute for Simulation Education and Research—WISER Center) with staff who are trained experts in simulation education.

MATERIALS AND METHODS

Participants

From 2013 to 2015, 31 trainees participated in this course. Three learners did not take either the precourse or postcourse examination due to scheduling conflicts, medical leave, or patient care emergencies, and therefore, they were excluded from the analysis. Two surgical fellows seeking further training in adult cardiac, transplantation, and minimally invasive thoracic surgery at the institution who participated in this study were also excluded from analysis due to their potential increased experience with cardiothoracic patients. Lastly, one medical student rotating with the cardiothoracic surgery department participated in this course. This participant was also excluded. If the resident has taken this course multiple times over the years, then the first score was used for analysis. As a result of the variability in the response rate and participation, we did not have the statistical power to make any assessments on one trainee from year to year and therefore this was not a focus of this study. Ultimately, 16 traditional and 9 integrated cardiothoracic surgery residents at the University of Pittsburgh Medical Center participated in a technology-enhanced simulation curriculum incorporating knowledge-based, experiential and practical clinical scenarios.

Curriculum

The clinical scenarios simulate components of surgical procedures and on-call cardiothoracic surgical urgencies

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