Simulation Improves Nontechnical Skills Performance of Residents During the Perioperative and Intraoperative Phases of Surgery

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OBJECTIVE: Failures in nontechnical skills (NTS) rather than technical expertise are frequently at the root of medical errors in the operating room (OR). NTS are the cognitive (decision making and situation awareness) and interpersonal (communication and teamwork) skills that are recognized but are not formally addressed in surgical training.
The purpose of the study was to examine the effect of simulation-based training (SBT) on NTS performance of surgical residents during simulated laparoscopic cholecystectomy (LC).

SETTING: The study was performed in a simulated OR at the Center for Medical Education and Innovation at Riverside Methodist Hospital, Columbus, OH. The simulated OR was arranged with standard equipment for LC, a high-fidelity patient simulator, and a real OR team.

DESIGN: General surgical residents completed 2 identical SBT sessions. For each session, residents were briefed on the LC case, completed the case in the simulated OR, and debriefed their videotaped simulation performance with a content expert. The video recordings were reviewed and the residents' NTS were scored using a perioperative time-out checklist and an intraoperative checklist for LC by 4 raters who were blinded to both the residents' postgraduate year level and the order of the videotaped simulation sessions.

RESULTS: Residents showed a significant improvement in completeness of the perioperative time-out checklist from session 1 (mean score = 1.27 ± 1.00) to session 2 (mean score = 5.00 ± 1.28), $p < 0.001$. Residents' scores on the intraoperative checklist also improved from session 1 to session 2, $p < 0.05$. Overall, residents felt that the simulation was a valuable teaching and training tool and recommend that it be incorporated into residency training.

CONCLUSION: SBT appears to be an effective technique for improving NTS of surgical residents during the perioperative and intraoperative phases of surgery. As surgical proficiency is 75% nontechnical and 25% technical, it could be reasonably argued that improved NTS of surgeons could improve surgical outcomes. (J Surg Ed 72:957-963.

KEY WORDS: simulation, nontechnical skills, time-out, surgical education, residency training

COMPETENCIES: Patient Care, Medical Knowledge, Interpersonal and Communication Skills, Practice-Based Learning and Improvement, Systems-Based Practice

INTRODUCTION

Simulation of surgical procedures offers a safe environment for trainees to practice and refine their surgical skills without risk of harm to real patients.[1] This technique has been used in high-risk industries such as aviation and the military for decades, and more recently, it has been adopted by surgery to augment conventional surgical training. Research demonstrates that technical skills gained during simulation-based training (SBT) transfer to the operating room (OR), thus resulting in reduced procedural time[2,3] and intraoperative errors.[2-5]

It is estimated that surgical proficiency is approximately 75% nontechnical and 25% technical.[6] Although technical skills contribute less to surgical performance, it has been the main focus of simulation research and curriculum design.[7]

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There is a lack of research assessing the role of SBT in the nontechnical aspects of patient care. Nontechnical skills (NTS) are the cognitive (e.g., decision making and situation awareness) and interpersonal (e.g., communication and teamwork) skills that underpin technical proficiency. Analyses of adverse events during surgery reveal that the underlying causes often originate from failures in NTS rather than technical expertise.[8-10] Furthermore, these failures equally occur during the preoperative (38%), intraoperative (30%), and postoperative (32%) phases of surgery.[11] Given this evidence, it could be reasonably argued that improved NTS of surgical care providers would result in improved surgical outcomes.

The purpose of the study was to examine the effects of SBT on the NTS of surgical residents during the perioperative and intraoperative phases of simulated laparoscopic cholecystectomy (LC). NTS performance during the perioperative phase of LC was assessed with a perioperative time-out checklist (PTC) comprising standard items from the World Health Organization Surgical Safety Checklist[12] and items from our institution's time-out checklist. It was hypothesized that SBT would help improve NTS performance of surgical residents during the perioperative phase, as evidenced by residents' improved performance on the PTC.

NTS performance during the intraoperative phase was assessed with an intraoperative checklist (IC) for LC. The IC was specifically developed for this study and consists of items aligned with the 6 core competencies endorsed by the Accreditation Council for Graduate Medical Education (ACGME).[13] Although observational studies have attempted to measure ACGME core competencies in the OR,[14,15] few studies have examined the effect of SBT on these competencies. It was hypothesized that SBT would help improve NTS performance of surgical residents during the intraoperative phase, as evidenced by residents' improved scores on the IC.

METHODS

Setting

The study was conducted at the Center for Medical Education and Innovation at Riverside Methodist Hospital in Columbus, OH, after it was approved by the Institutional Review Board. The study was performed in a simulated OR that was arranged with standard setup for LC. Specifically, the simulated OR consisted of a high-fidelity patient simulator (Medical Education Technologies, Inc., Sarasota, FL); real OR equipment (an anesthesia machine, cardiopulmonary monitors, laparoscopic video equipment, OR drapes, and OR instruments); and a real OR team comprising a board-certified anesthesiologist, a scrub technician, and a circulating nurse. The patient simulator was controlled from the central control room by a team of simulationists.

Participants

All general surgical residents ($n = 13$; postgraduate year [PGY]–1-5) at Riverside Methodist Hospital were invited to participate in the study. Participation in the study was completely voluntary, and residents provided informed consent to participate. To avoid potential coercion by the investigative team, the consenting process was performed by staff from the OhioHealth Research Institute.

Performance metrics

A PTC (Appendix A) was used to assess residents' NTS performance during the perioperative phase. The PTC consists of 8 safety items: 6 items from the World Health Organization Surgical Safety Checklist[12] (i.e., patient's name, patient's age, surgery to be performed, position of the patient (where applicable), whether prophylactic antibiotics was administered during the previous 60 minutes before skin incision, and whether the OR team is ready to begin the operation) and 2 items from the Riverside Methodist Hospital's surgical time-out checklist (i.e., β-blocker administration and verification of compression devices). Each PTC item was scored on a scale of 0 to 2: in which 2 points were awarded for an accurately completed item, 1 point for an incomplete item, and no points for an omitted item.

An IC was used to assess residents' NTS performance during the intraoperative phase. The IC consists of 33 items that are aligned with the ACGME 6 core competencies. Each item is rated on a 5-point Likert scale, with 1 = failed to perform, 3 = performed adequately, and 5 = performed exceptionally. Responses to each ACGME competency across 4 simulated complications were summed, and the minimum and the maximum scores for each competency are listed as follows:

Patient care: minimum = 9; maximum = 45
Medical knowledge: minimum = 4; maximum = 20
Interpersonal and communication skills: minimum = 14; maximum = 70
Professionalism: minimum = 5; maximum = 25
Practice-based learning: minimum = 4; maximum = 20
Systems-based practice: minimum = 6; maximum = 30

Study design

Each resident completed 2 identical simulation sessions over the course of the study period. Each session consisted of 3 parts: brief (~1 min), simulated case (10-20 min), and debrief (15-30 min).