Mobile in Situ Simulation as a Tool for Evaluation and Improvement of Trauma Treatment in the Emergency Department

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BACKGROUND: Medical simulation is an increasingly recognized tool for teaching, coaching, training, and examining practitioners in the medical field. For many years, simulation has been used to improve trauma care and teamwork. Despite technological advances in trauma simulators, including better means of mobilization and control, most reported simulation-based trauma training has been conducted inside simulation centers, and the practice of mobile simulation in hospitals' trauma rooms has not been investigated fully.

METHODS: The emergency department personnel from a second-level trauma center in Israel were evaluated. Divided into randomly formed trauma teams, they were reviewed twice using in situ mobile simulation training at the hospital's trauma bay. In all, 4 simulations were held before and 4 simulations were held after a structured learning intervention. The intervention included a 1-day simulation-based training conducted at the Israel Center for Medical Simulation (MSR), which included video-based debriefing facilitated by the hospital's 4 trauma team leaders who completed a 2-day simulation-based instructors' course before the start of the study. The instructors were also trained on performance rating and thus were responsible for the assessment of their respective teams in real time as well as through reviewing of the recorded videos; thus enabling a comparison of the performances in the mobile simulation exercise before and after the educational intervention.

RESULTS: The internal reliability of the experts' evaluation calculated in the Cronbach α model was found to be 0.786. Statistically significant improvement was observed in 4 of 10 parameters, among which were teamwork (29.64%) and communication (24.48%) ($p = 0.00005$).

CONCLUSION: The mobile in situ simulation-based training demonstrated efficacy both as an assessment tool for trauma teams' function and an educational intervention when coupled with in vitro simulation-based training, resulting in a significant improvement of the teams' function in various aspects of treatment. (J Surg Ed 73:121-128. © 2015 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: in situ simulation, mobile simulation, high-fidelity patient simulators

COMPETENCIES: Professionalism, Interpersonal and Communication Skills, Practice-Based Learning and Improvement

BACKGROUND

Trauma is the primary cause of death and the principal preventable cause of death in the first 4 decades of life.[1] The initial treatment of trauma victims demands knowledge and expertise.[2] Therefore, there is great importance for the preparation and training of caregivers attending trauma victims in hospitals. The variability of injuries and presentations demands a more proactive approach to training rather than depending only on the random bedside teaching opportunities. Currently, there are several methods for training in trauma care. These include the Advanced Trauma Life Support (ATLS) course, the Definitive Surgical Trauma Care course, video debriefing of trauma bay resuscitation, lectures, morbidity and mortality discussions, and simulation-based training.

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The American College of Surgeons (ACS) has created the ATLS course for doctors to teach the primary evaluation and treatment of trauma patients. The course is the instructional basis for teaching trauma management intended for physicians from surgical disciplines in the United States and around the world. In the current form, this course includes lectures, interactive case discussions, and a laboratory training session for teaching invasive surgical procedures.[3,4] Although the course is planned to instruct a single surgeon, the management of trauma cases is the product of teamwork comprising members from several medical disciplines.[5-7]

The instruction of teamwork in trauma scenarios by reviewing video recordings of live events taking place in real trauma bays was proven to be reliable and efficient in improving the level of proficiency of trauma teams when compared with reviewing of detailed written recordings of trauma documentations.[8,9] It was confirmed that video recording permitted the identification of many faults in the treatment, including errors leading to death.[10]

In recent years, there has been a significant progress in the field of trauma instruction via high-tech medical simulators.[11-13] This milieu has evolved not only because of technological improvements but also because of increasing awareness for patient safety and the need to decrease the amount of human errors in medicine.[14] The main use of high-fidelity simulators has been directed to improve medical skills.[15-18] This technology has enabled to evaluate the effect of the ATLS course on trainees. Simulation-based training showed superiority of treatment provided by the course graduates in comparison with physicians who did not enroll in the course.[19]

High-fidelity patient simulators have existed for more than 2 decades and were designed initially to train anesthesiologists.[20,21] Nevertheless, there are still a few technological gaps in creating a comprehensive trauma simulation. Although these simulators normally include a human-scale body with anatomic and dynamic airways, they can train very few, if any, surgical capabilities. Furthermore, there is still much doubt concerning the ability of this tool to create a true change in trauma management capabilities, and there is still much to inquire.[22]

The hypothesis of this research is that mobile in situ simulation is a powerful tool to evaluate and to train trauma teams. We concluded that a 1-day instructional intervention using this tool can improve the trauma management capabilities of the trainees both subjectively according to self-assessment questionnaires and objectively according to raters' assessment.

METHODS

Participants

Hospital staff formed 4 randomly assembled trauma teams in a second-level trauma center in Israel. Each team consisted of a team leader who is a board-certified general surgeon, an anesthesiologist, 1 to 2 physicians (mostly residents in general surgery or orthopedics), and 3 to 4 emergency department nurses, all together a team of 7 to 8 professionals. A total of 60 staff members were recruited to participate in the simulation-based educational program. They were all briefed by the chief of the trauma service in the medical center in a meeting that was held before the start of the study to explain the objectives, requirements, and steps of the program. Finally, all the participants signed a consent form (Sheba Medical Center institutional review board approval number 8205-10-SMC, October 26, 2010) permitting the exercises to be filmed by camera and used for research purposes.

Research Design

First, a pretest drill was conducted in September 2011, followed by an in vitro simulation-based educational intervention 2 months later at the Israel Center of Medical Simulation (MSR).[23] Finally, 3 months later, a posttest in situ drill was held. The 4 randomly formed teams of 7 to 8 persons were reviewed at each point. A total of 32 team members participated in the pretest ($n = 32$) and 31 participated in the posttest ($n = 31$). There is no distinct correlation between the 2 groups. To conduct an instructive intervention and calibrated assessment, the chief of the trauma unit along with a team of 2 physicians and 2 nurses from the emergency department were qualified in a 2-day instructor's course that focused on debriefing skills as well as on the evaluation metrics of trauma management and teamwork.

Intervention

The simulation-based intervention included a 1-day course at MSR, which was designed based on conclusions from the pretest exercises. The course comprised skill stations: airway management, chest trauma management, hemorrhage control and shock management, and short focused simulations of a multitrauma patient. Trained instructors via real-time video-based debriefing tutored all stations and simulations. All 60 participants went through the intervention during a 1-day training course at MSR.

Equipment

The mobile high-fidelity patient simulator used for this study was the SimMan 3G by Laerdal, Stavanger, Norway.[24] In an attempt to ameliorate the Human Patient Simulator (HPS) performances and to create livelier scenarios, several innovations were added to the simulator by MSR. Firstly, a vigorous bleeding machine, comprising a 6-L fluid tank, filled with bright red–colored fluid, simulating blood, connected to a high-pressure air balloon. This system was connected using cables to external wounds on the