Debriefing decreases mental workload in surgical crisis: A randomized controlled trial

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Background. *Mental workload is the amount of mental effort involved in performing a particular task. Crisis situations may increase mental workload, which can subsequently negatively impact operative performance and patient safety. This study aims to measure the impact of learning through debriefing and a systematic approach to crisis on trainees' mental workload in a simulated surgical crisis.*
Methods. *Twenty junior surgical residents participated in a high-fidelity, simulated, postoperative crisis in a surgical ward environment (pretest). Participants were randomized to either an instructor-led debriefing, including performance feedback (intervention;* $n = 10$*) or no debriefing (control;* $n = 10$*). Subjects then immediately managed a second simulated crisis (post-test). Mental workload was assessed in real time during the scenarios using a previously validated, wireless, vibrotactile device. Mental workload was represented by subject response times to the vibrations, which were recorded and analyzed using the Mann-Whitney* U *test.*
Results. *Participants in the debriefing arm had a significantly reduced median response time in milliseconds (post-test minus pretest −695, quartile range −2,136 to −297) compared to participants in the control arm (42, −1,191 to 763), (between-arm difference* $P = .049$*).*
Conclusion. *Debriefing after simulated surgical crisis situations may improve performance by decreasing trainee's mental workload during a subsequent simulated surgical crisis. (Surgery 2016;■:■-■.)*

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SURGICAL CRISES are high-stake situations. To be competent, surgeons are required to make quick and effective clinical decisions, while concurrently directing their attention toward patient safety and providing optimal patient care. Situational awareness, communication, leadership, resource management, teamwork, and decision-making, termed together as "nontechnical skills" (NTS), are necessary components of delivering safe and high-quality clinical care.[1-4] Both technical and NTS are of crucial importance to ensure successful clinical outcomes when managing surgical crises like postoperative complications.[5,6] Effective crisis management requires a certain level of mental effort to concurrently manage all tasks simultaneously while maintaining good situational awareness and teamwork.

Mental workload can be defined as the "amount of mental effort" involved in performing a particular task.[7] Human information processing models have proven particularly useful for understanding mental workload. The availability of internal mental resources is of critical importance to power information processing subsystems and is linked to the level of mental effort required to have effective task performance.[8,9] Mental demand is assumed to be higher for difficult tasks than for easy ones,[10] making it crucial to maximize available internal mental resources in situations where difficult, yet quick decisions are required (ie, surgical crises).

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When sufficient resources are unavailable, as in situations where task demands are high, the natural course of information processing becomes disrupted and errors may occur.[10,11] During surgical crises, factors such as an increased workload,[12] interruptions,[13] level of provider experience[14] and stress[15] have been shown to influence the mental workload of surgeons. This can subsequently impact clinical decision-making and performance, ultimately contributing to workplace errors.[16,17] Resource theories propose that less mental effort is required for well-learned tasks[18,19] and imply that education might be one avenue to help make mental resources more accessible.

Previous research on surgical training suggests that the use of virtual reality simulators can lead to improved education and operating room performance.[20] Debriefing is a reflective process, which is a vital component of any simulation training and is critical to the learning process.[21,22] The "gold standard" is the instructor-led debriefing, in which an expert facilitator guides the subject to reflect on their previous performance and actions and actively allows them to change or grow their understanding.[21,23,24] Debriefing may also include expert advice or a review of systematic approaches to clinical issues.[24]

Although debriefing improves subsequent performance when compared to no debriefing at all, the exact mechanism and cognitive processes by which this occurs remains unclear.[25] More specifically, the immediate impact of instructor-led debriefing, as it relates to mental workload theory, has not been explored. Therefore, this study sought to explore the impact of debriefing on mental workload as it relates to postoperative surgical crisis simulated scenarios. We hypothesized that instructor-led debriefing would decrease mental workload during a subsequent, simulated surgical crisis.

METHODS

Subjects. After Research Ethics Board approval (St Michael's Hospital, University of Toronto, Ontario, Canada—REB#09-269), 20 junior general surgery residents (postgraduate years 1 and 2) were recruited through the Department of Surgery medical education offices. Informed consent was obtained and all subjects were asked to maintain confidentiality regarding the study details to prevent the performance bias of future subjects.

Study design. This study was a prospective, randomized controlled trial (Fig 1). Subjects were randomized to either the intervention group

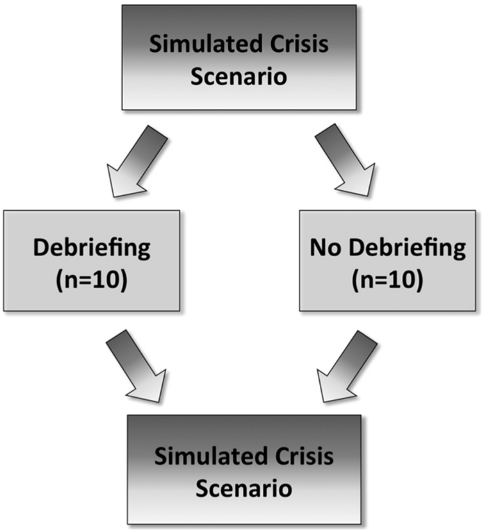

Fig 1. Study design.

(debriefing) or the control group (no debriefing). Subjects were assigned to the 2 groups with a randomly permuted block design using 1:1 allocation. Random numbers were computer-generated (http://www.random.org) and allocations were concealed using consecutively numbered, sealed, opaque envelopes.

All subjects participated in 2 high-fidelity, postoperative crisis scenarios. Immediately after the first scenario (pretest), subjects in the intervention group participated in an individual, 15-minute debriefing led by an instructor with respect to the performance during the session. The instructor had expertise in general surgery, crisis management, and simulation-based education. Subjects were asked to reflect on their performance, and the instructor provided feedback using a debriefing with good judgment technique to guide the subjects' reflection. The feedback only targeted issues related to patient management and did not address NTS performance.

The instructor also presented the subjects with a systematic approach to future crisis scenarios. Immediately after their first simulation session (pretest), the control group did not receive any feedback and was instructed to wait in a quiet room for approximately 15 minutes. After 15 minutes of debriefing (intervention group) or waiting (control group), both groups underwent a second simulation scenario (post-test) of similar level of difficulty. To control for any sequencing effect, the order of the 2 scenarios was randomized and equally distributed between the 2 groups.