The Emotional and Cognitive Impact of Unexpected Simulated Patient Death

A Randomized Controlled Trial

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Background: Observational studies suggest that emotions experienced during simulation training may affect cognitive load and learning outcomes. The objective of this study was to manipulate emotions during simulation training and assess the impact on cognitive load and learning.

Methods: In this prospective randomized trial, 116 final-year medical students received training in a simulated scenario of a 70-year-old woman presenting with reduced consciousness due to aminosalicylic acid ingestion. Training groups were randomly allocated to one of two endings for the scenario: The patient was transferred to another service, or she experienced a cardiorespiratory arrest and died. Participants rated their emotions and cognitive load after training. Three months later, we evaluated their performance on a simulation Objective Structured Clinical Examination station of a 60-year-old man presenting with reduced consciousness due to ethylene glycol ingestion.

Results: Emotions tended to be more negative for students in training groups where the simulated patient died. These students also reported a higher cognitive load (mean $\pm$ SD, 7.63 ± 0.97 vs 7.25 ± 0.84; $P = .03$; $d = 0.42$) and were less likely to be rated as competent to diagnose and manage a patient with reduced consciousness due to toxin ingestion (OR, 0.37; 95% CI, 0.14-0.95; $P = 0.04$) 3 months later.

Conclusions: Students exposed to unexpected simulated patient death reported increased cognitive load and had poorer learning outcomes. Educators need to expose learners to negative experiences; therefore, further studies are needed on how best to use negative emotional experiences during simulation training.   *CHEST 2014; 145(5):958–963*

Abbreviations: MPL = minimum pass level; OSCE = Objective Structured Clinical Examination

Training medical students and residents on high-fidelity simulators is an effective complement to their clinical training.[1,2] The simulation environment may be more learner centered than the clinical environment because students can practice in a setting where errors do not have clinical consequences and in which they can have direct supervision with immediate feedback.[3-5] They can also encounter abnormal clinical findings that are not readily available on clinical rotations and can train on these whenever and as often as they like. Despite its pedagogic appeal, however, in practice, a learning gap is associated with simulation training whereby up to 25% of students fail to improve their performance after training.[6,7] Several possible explanations account for failure to improve following simulation training, including inappropriate content, ineffective delivery, and cognitive overload due to the highly interactive nature of the simulation learning environment.[8,9]

Cognitive load theory provides a convenient framework for exploring the relationship between the design of simulation training sessions and learning outcomes.[9] This theory is based on the assumption that working memory has limited capacity and that learning is

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impaired when aspects of instructional design overload this capacity.[9-11] Cognitive load comprises three components. Intrinsic load reflects both the inherent difficulty of a given task and the learner's prior experience with this task. Extraneous load, a superfluous

load that is potentially detrimental to learning, is imposed on learners by their interaction with the instructional material (including teachers). Germane load refers to the amount of working memory dedicated to learning the new task. According to cognitive load theory, these components are additive, and learning is reduced when the total cognitive load exceeds the capacity of working memory. Thus, the optimal instructional design is one that avoids cognitive overload, minimizes extraneous load, and maximizes germane load.[9,11]

Thus far, exploration of variables that influence cognitive load during simulation training and of the effect of cognitive load on learning outcomes has been limited. We reported that emotions experienced during simulation training are associated with subjective cognitive load ratings and that learning outcomes are poorer for students with higher cognitive load.[12] Although these findings are consistent with the psychology literature on the effects of emotion on performance, the observational design of our previous study only allows us to generate a hypothesis on the relationship among emotions, cognitive load, and learning outcomes.[13-16] To test this hypothesis, we need to manipulate the emotions of learners during simulation training and then study the impact of this manipulation on cognitive load and learning outcomes.

Perhaps the simplest and most realistic way to influence emotions during a learning experience is to provide feedback to learners on their performance. The perception of failure predictably results in negative emotions, although the relationship between failure and subsequent performance is less predictable.[17-20] During simulation training, the use of definitive outcomes, such as patient death or survival, provides learners with unambiguous feedback on performance. The utility of exposing learners to patient death during simulation training is, however, a highly contentious issue.[21] Three learning scenarios in which simulated patients are allowed to die partly explain this discord. The first is expected death where both teachers and students know in advance that the simulated patient will die during the learning experience and that dealing with death is one of the stated learning objectives. In this setting, it seems intuitive that patient death would enhance learning. The second scenario is where teachers but not students know that the patient will die (unexpected death), and the third is where death is conditional on learner performance, in which case neither teachers nor students can predict death in advance (death resulting from action or inaction). There is uncertainty regarding the effect of unexpected death on learning outcomes because of a lack of empirical data and because strong arguments can be made for and against exposure to patient death. For example, advocates of learner exposure to patient death draw from literature suggesting that errors during learning result in better long-term performance,[22] whereas opponents counter with data suggesting that the emotional impact of patient death may result in cognitive overload and reduced learning.[12,20,23]

Given the equipoise regarding the utility of unexpected patient death, we chose this exposure to manipulate the emotions of learners during simulation training and to then study the impact of emotion on cognitive load and learning outcomes. The setting for the study was a simulation training session for which the learning objectives were diagnosis and management of a patient with an altered level of consciousness due to toxin ingestion. We randomly allocated participants to simulation training scenarios that ended with survival or unexpected death of the simulated patient and assessed the impact of patient death on emotions and cognitive load during the training session. To assess the impact on learning outcomes, we evaluated performance on diagnosis and management in a similar simulation scenario of altered level of consciousness due to toxin ingestion 3 months later. We predicted that the unexpected death of a simulated patient would result in a negative emotional response, increased cognitive load, and poorer learning outcomes from the simulation training session.

Materials and Methods

Participants

Participants were 116 final-year medical students at the University of Calgary (graduating class of 2011). We have a 3-year undergraduate curriculum of which the first 2 years comprise integrated systems courses and the final year is a clinical clerkship. This study took place during a simulation training session that was part of the clinical skills in clerkship curriculum, which runs throughout the clerkship year. The Conjoint Health Research Ethics Board at the University of Calgary approved the study (ethics ID# E-22899), and we obtained written informed consent from all participants prior to entry into the study. During the consent process, we told the participants that the goal was to study the impact of emotions