

Crisis Management Simulation: The Value of Interdisciplinary Debriefing

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Abstract

Objective: Simulation offers an important avenue for surgical and anesthesia training. This is especially important for crisis management scenarios where individuals need to act quickly and efficiently for optimal patient care. Practice based performance can be measured and real time feedback provided during debriefing scenarios.

Methods: In this paper, we highlight a dual anesthesia and otolaryngology cavernous carotid injury scenario. The trials were run three different times with inter-trial debriefing.

Results: The focused debriefing improved resident performance in terms of blood loss on subsequent trials. Furthermore, the learners provided important feedback regarding the utility of training and how it improved their ability to handle crisis management scenarios in the future. **Conclusion:** Debriefing for crisis management in a simulation trial improves performance and trainee confidence. Follow up studies will evaluate real world effectiveness over a longer follow up period.

Keywords: Debriefing; Crisis Management; Simulation; Improved Performance

Introduction

Simulation training allows physicians to practice complex procedures in a low-risk, controllable, and replicable environment while under direct supervision [1]. Such simulations may be plastic models, virtual reality simulators, or human cadavers, and are associated with improved educational outcomes in healthcare professionals [2]. An additional element may be added to these simulations in the form of a debriefing, which may be defined as

a “facilitator-led participant discussion of events, reflection, and assimilation of activities into their cognitions” [3]. These debriefings have been associated with improved learning outcomes after simulation in comparison to a simulation without a subsequent debriefing [4].

One such healthcare educational simulation centered upon neurosurgical residents managing a cavernous carotid injury dur-

ing an endoscopic endonasal procedure [5]. This simulation used cadaveric heads with artificial blood to simulate the cavernous carotid bleed, and assessed learners ability to obtain vascular control over three trials, with different physiological parameters. Furthermore, the simulation included a supervising instructor to provide relevant guidance. The learners' performance improved over the course of the trials, and they reported the simulation as valuable and that they would like more similar opportunities [5]. However, this simulation did not include a debriefing experience; therefore, we looked at expanding the simulation by adding a debriefing experience after the simulation and assessing debriefing's effects on outcomes and performance.

This study had six otolaryngology and six anesthesia residents working together with the goal to manage a simulated cavernous carotid injury during an endoscopic endonasal procedure. Learners were assessed on their anatomic knowledge, simulated blood loss, situational awareness, decision making, leadership, communications, and teamwork. Specific focus was placed on debriefing after each simulation to assess the effect of debriefing on improvement of procedural and non-procedural skills. The role of debriefing in this study may be applied to any analysis of learning outcomes after simulation-based training.

Methods

Study design

This study was approved by the Oregon Health and Science University Institutional Review Board. Otolaryngology (ENT) residents ($n = 6$, 3 in the third year of training and 3 in the fifth year of training) and anesthesiology residents ($n = 6$, all in their third year of training) worked collaboratively during this simulation to manage intraoperative cavernous carotid injuries. Three different clinical scenarios of increasing severity and complexity were managed by teams consisting of one ENT resident and one anesthesiology resident.

The cavernous carotid injury simulation was set up as previously described [5,6]. Briefly, the internal carotid artery was cannulated. This cannula was connected to a perfusion pump (Belmont Fluid Management System 2000, Billerica, Massachusetts, USA). This pump allows the examiner to model a variety of clinical scenarios by modulating the blood pressure and pulsatile flow rate. An A-line was connected via an adaptor that facilitated real-time MAP readings. The ENT residents used an endonasal endoscopic approach to repair the injured cavernous carotid artery using a muscle graft.

The anesthesia setup included a cart with drug trays, anesthesia machine, anesthesia vital sign monitor, endotracheal intubation set up and standard IV equipment.

Clinical scenarios

The three clinical scenarios used in this study were described in a prior study [5,6]. Briefly, Scenario 1 involved a healthy patient, Scenario 2 was a patient with coronary artery disease, and Scenario 3 included a patient with chronic steroid use. In Scenario 1 and Scenario 2, residents were given 7 minutes to control the bleeding. In Scenario 3, residents were allotted only 4 minutes to manage the carotid injury. After each scenario, a 10-minute debriefing session was conducted. 5 minutes were allotted for specialty-specific debriefing and another 5 minutes were allotted for interprofessional debriefing with both ENT and anesthesiology.

Resident performance

The amount of blood loss per team per scenario was recorded by an independent faculty member. Additionally, each resident was evaluated by an independent faculty member in the following categories: decision-making ability, situational awareness, communication and teamwork, and leadership. Residents were scored after each scenario on a scale of 1 to 4. 1 indicates a poor performance that potentially endangers patient safety, 2 indicates a marginal performance in which considerable improvement is needed, 3 indicates a satisfactory performance with room for improvement, and 4 indicates consistently high-quality performance that can be used as a positive example for others.

Resident evaluation of simulation

All residents completed a pre-simulation survey asking about previous experience using cavernous carotid injury simulators, confidence in managing crises, and ability to work with other specialties. ENT residents were also asked about their endoscopy skills.

After completion of the simulation, residents were asked to provide feedback on the debriefing sessions and usefulness of the simulation. Residents were asked to score each statement on the post-simulation survey from 1 (strongly disagree) to 7 (strongly agree).

Statistical analysis

Blood loss is reported as the mean of all groups \pm SEM for each scenario. Performance scores and resident feedback are reported

as mean scores. Differences between groups were detected using the student's t-test and $p < 0.05$ was used as the threshold for statistical significance.

Results

Pre-simulation survey

None of the ENT residents had performed this cavernous carotid injury simulation before. All ENT residents strongly agreed or agreed that simulation is a valuable training experience, feel comfortable with endoscopy, and can work with residents from

other specialties. 50% had concerns about managing carotid arteries during endoscopic surgeries and Crisis Resource Management (CRM) (Figure 1A).

Among anesthesiology residents, none had performed this simulation in the past. As in the ENT cohort, 100% of anesthesiology residents strongly agreed or agreed that simulation is a valuable training experience. 84% felt comfortable working with other specialties and 50% expressed some level of familiarity with CRM (Figure 1B).

Figure 1: Pre-simulation survey. A) Otolaryngology (ENT) residents (n = 6). B) Anesthesia residents (n = 6).

Blood loss

Average blood loss per resident group declined with each subsequent scenario (1100 mL \pm 146 for Scenario 1, 717 mL \pm 90 for Scenario 2, and 475 mL \pm 91 for Scenario 3) (Figure 2). When comparing the two 7-minute scenarios, resident groups significantly reduced the amount of blood loss in Scenario 2 compared to Scenario 1 (717 mL \pm 90 vs. 1100 mL \pm 146; n = 6 each; $p = 0.0495$) (Figure 2).

Resident decision-making abilities and situational awareness

In the domain of decision making, the average performance score by scenario increased for both ENT (2.4 vs. 2.8 vs. 3.0) and anesthesiology (2.6 vs. 2.8 vs. 3.3) (Figure 3A). Similarly, residents developed more situational awareness with each subsequent scenario (ENT: 2.5 vs. 2.8 vs. 3.1; anesthesiology: 2.3 vs. 2.4 vs. 3.4) (Figure 3B).

Communication, teamwork, and leadership

Both ENT and anesthesiology residents improved their communication and teamwork skills after each scenario (ENT: 2.4 vs. 2.8 vs. 3.1; anesthesiology: 2.4 vs. 2.8 vs. 3.6) (Figure 4A). Anesthesiology residents also continued to increase their leadership abilities (2.6 vs. 2.9 vs. 3.4) (Figure 4B), ENT residents, however, had a decline in their leadership performance despite initially improving (2.6 vs. 2.9 vs. 2.7) (Figure 4B).

Figure 2: Average blood loss by scenario.

Scoring scale:

- Poor - Performance endangered or potentially endangered patient safety, serious remediation is required
- Marginal - Performance indicated cause for concern, considerable improvement is needed
- Acceptable - Performance was of satisfactory standard but could be improved
- Good - Performance was of a consistently high standard, enhancing patient safety; it could be used as a positive example for others.

Figure 3: Average performance scores for decision-making abilities and situational awareness of ENT residents (n = 6) and anesthesiology residents (n = 6).

Figure 4: Average performance scores for communication/teamwork and leadership skills of ENT residents (n = 6) and anesthesiology residents (n = 6).

Resident feedback on simulation

Resident feedback regarding the simulation was overall positive. Most residents strongly agreed that the simulation will help them prevent errors in the future and increased their ability to manage future similar clinical scenarios (Figure 5). Furthermore, residents did not find debriefing to be particularly stressful and felt as though the faculty facilitators were effective in leading the debriefing sessions (Figure 5). Most agreed that they would return back to the simulation center for future training experiences (Figure 5).

Debriefing feedback

Overall, most residents found the debriefing sessions to be

helpful. 67% of ENT residents (n = 4) and 50% of anesthesiology residents (n = 3) explicitly reported that the debriefing sessions were valuable. Interestingly, since the ENT cohort included a mix of junior (PGY3) and senior (PGY5) residents, we were able to assess the importance of the debriefing sessions by current level of training. 100% of the PGY3 ENT residents (n = 3) found the debriefing sessions to be helpful while only 33.3% of PGY5 ENT residents (n = 1) noted that they benefited from the debriefing sessions (Figure 6). Several residents commented that having debriefing sessions between each scenario allowed them to identify areas of improvement and to enhance their performance in subsequent scenarios.

Figure 5: Resident feedback on model simulation.

Figure 6: Debriefing feedback for ENT residents (n = 6, 3 PGY3 and 3 PGY5) and Anesthesiology residents (n = 6, all PGY3).

Figure 7: Debriefing feedback comparison from ENT residents.

Discussion

Simulation training provides a unique experience that allows residents an opportunity to formulate effective methods/algorithms in assessing and responding to intraoperative vascular emergency situations [5-7]. These events can be catastrophic and encompass several key obstacles for surgeons intraoperatively including sudden mental stress, lack of adequate contingency planning, impaired operative visualization due to active bleeding, lack of operative experience responding to such emergencies, and an inherent unpredictable nature of such events. Because these events can be rare, they may never be experienced by residents during their formal training and many must instead face them during practice. Improper technique coupled with a high stress environment can often result in unnecessary technical errors that can result in substantial patient morbidity and mortality. These factors are further convoluted due to the need for cooperative action by multiple specialty professionals, working in conjunction, in order to properly respond to such situations. As a result, interprofessional team-based simulation training for such events has been emphasized in recent years as a potential avenue to bolster resident training across different specialties in order to prepare them for such events [5,7].

In this simulation of endonasal cavernous carotid artery injury, ENT and anesthesia residents worked in conjunction to address and navigate a difficult clinical scenario in order to ensure favorable patient outcomes. Overall, the residents improved significantly with each subsequent scenario in terms of the objective measure parameter of blood loss. Residents also scored more favorably with each subsequent scenario in the qualitative domains of teamwork and communication. Their competency as assessed by faculty also improved significantly in terms of situational awareness and deci-

sion-making abilities. A key element that likely contributed to the improvement was the incorporation of interprofessional debriefing following each simulation.

Interprofessional simulation provides an environment where multiple professionals of varying specialties can work together and reflect on their clinical practice without any risk to patients [5,7]. This also allows for an enriching education environment with an array of perspectives from the vantage point of supporting teams and collaborating professionals [5,7,8]. Although effective on their own, such simulations are particularly effective when used in conjunction with debriefing sessions [8]. Debriefing allows for deep reflection of thought process, clinical judgment, and actions undertaken during the simulation. This is at the heart of the “experimental learning theory” [3,8,9] where a participant faces a concrete experience through simulation and then develops abstract concepts and generalizations to guide future events through observation and reflection upon that experience [8]. Through this, participants get an opportunity to share their own knowledge, receive feedback on their thought process, and simultaneously attain new skills while being exposed to new thought processes. This results in a robust learning experience that provides the learner with long lasting experiential learning that can be applied during practice. The use of debriefing in simulations has been associated with improved clinical performance and competency as well as longer knowledge retention when compared to simulations without debriefing sessions [9].

Two forms of debriefing have been defined in the literature as effective modalities of reflection [7-10]. Instructor led debriefing sessions, where a specialty specific instructor leads a session following simulation, and team-based debriefing, where interprofessional participants reflect collectively upon the simulation. In our study both debriefing modalities were employed with equal time allotted for each debriefing type following every simulation scenario.

The team-based sessions directed ENT and anesthesia residents to discuss communication skills and reflect on their teamwork ability. As noted in figure 4 there was steady increase in resident scoring on communication and teamwork skills graded by faculty assessment for every subsequent scenario. The specialty specific instructor led debriefing focused on providing technical feedback on decision making and leadership skills displayed by the residents. Although the residents improved steadily in terms of situ-

ational awareness and decision-making scores as assessed by the faculty, it was interesting that only the anesthesia residents had continuous improvement in terms of leadership whereas ENT residents did not (Figure 3). This may be the result of different instructor debriefing style for each specialty; however, it is more likely a function of the composition of ENT residents which were split between PGY5 and PGY3 residents. Anesthesia residents on the other hand only had PGY3 residents. Upper-level residents may have less to gain in terms of debriefing particularly in the area of leadership when compared to their junior resident counterparts and thus the results reflect less appreciable change. This is evident when comparing the self-reported feedback on the debriefing sessions where nearly all the ENT PGY3 residents reported it was helpful, whereas only 33.3% of PGY5 residents reported that the debriefing was helpful (Figure 6). This may also reflect that senior residents have had more experience developing leadership skills through their training than junior residents. The disparity between the ENT and anesthesia leadership improvement scores may be more a reflection that the Senior ENT residents did not have as much room for needed improvement in this area as compared to the more junior ENT and anesthesia residents. Whereas in the categories of decision making, situational awareness, teamwork and communication both groups of residents improved appreciably regardless of seniority.

Future studies of interprofessional simulation debriefing should further investigate its effectiveness across different residency training cohorts by comparing the effects on separate specialties by PGY year. A limitation of this study was the lack of cohesiveness among the ENT resident PGY years when compared to the anesthesia residents. This makes it difficult to delineate whether the observed improvements were specialty specific or indeed a reflection of a seniority experiential disparity. Furthermore, it would have been interesting to see how a control group without debriefing incorporated would have performed on post scenario assessments with each subsequent scenario.

Conclusion

Interprofessional simulation provides a unique experience for residents by allowing them to develop skills in dealing with emergency situations, especially those of vascular intraoperative complications. These skills can be highly improved through effective use of debriefing methods which can result in improved teamwork, communication, awareness, and overall competency across mul-

multiple specialties and experience levels. Debriefing may therefore be more effective in aiding junior residents than senior residents particularly in areas of leadership.

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