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Interprofessional Simulation in Cardiothoracic Surgery Improves Team Confidence

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Abstract: Interest in simulation has grown substantially, as has enthusiasm for team-based approaches to surgical training. In cardiothoracic surgery, the dynamic ability of the entire team is critical to emergent events. We developed innovative, interprofessional simulation events to improve team confidence. Two separate simulations event replicating critical steps and potential crises of cardiopulmonary bypass (CPB) were attended by members of the multidisciplinary cardiothoracic team. Standard CPB equipment, echocardiography, an app to control vital signs, and typical operating room tools for cannulation were all used. Participant started at their typical roles, then rotated into unfamiliar roles for subsequent simulations. Survey and Likert scale self-assessment tools were used to determine outcomes. Statistical analysis compared results. Two separate events were attended by a total of 37 team members (17 facilitators and 20 participants). Participants rotated roles through 12 routine and high-risk scenarios for instituting and separating from CPB. Participant evaluation results were highly favorable, with requests for further similar events. Objectively, the mean score for self-assessment rose significantly comparing the pre- and post-simulation assessments. Despite a small sample size, these differences did reach statistical significance in two categories: iatrogenic dissection (p 0.008), and emergent return to CPB (p 0.016). In our experience, high-fidelity interprofessional simulation promoted team communication and confidence for key scenarios related to institution of and separation from CPB.
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Operating rooms (OR) are dynamic environments where interdisciplinary teamwork is essential, and patient safety is the primary focus (1–4). In cardiothoracic ORs hemodynamic instability and critical events can occur with little warning, especially during the transition to and from cardiopulmonary bypass (CBP). During these events, nontechnical skills like teamwork and communication are critically important (3,5). Shortcomings are commonly linked to medical errors, and lapses in patient safety can result in significant harm to the patient (2,6).

Simulation training has been used in medicine, for over 30 years (1,7). Simulation-based education exposes participants to a variety of clinical scenarios and develops knowledge, technical skills, and greater familiarity of procedures in a low-risk environment (6,8–11). Trainees and experienced practitioners alike may benefit from simulation training, and some medical specialties are requiring simulation-based training as part of their primary certification or maintenance of certification (12–14). Although the role of simulation is widely accepted in medical education, a growing body of evidence suggests that simulation should be performed from a multidisciplinary standpoint (15–17).

While the primary intent our two simulation events was to improve team dynamics, communication, and familiarity with uncommon but critical scenarios in the cardiothoracic OR, we observed that using high-fidelity interprofessional simulation improved cardiothoracic team confidence without the risk of harm to patients.

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Simulation Scenarios

Session1	Session 2
Routine Cannulation	Routine Decannulation
Arterial Air Embolus	Postoperative Hypotension
High Arterial Line Pressure	Right Ventricular Failure
Distended Left Ventricle	Blood Conservation
Poor Venous Drainage	Iatrogenic Dissection
	Emergent Return to Cardiopulmonary Bypass
	Mechanical Support

Figure 1. Listing of scenarios addressed at each simulation session.

MATERIALS AND METHODS

Our Institutional Review Board (IRB) determined this study does not constitute human subject research as defined at 45CFR46.102 and therefore, was not subject to the federal regulations.

Faculty Preparation

Faculty representation from the perfusion school as well as from the departments of cardiac surgery and anesthesiology defined 12 scenarios of importance to address (Figure 1). Objectives for each scenario were developed collaboratively. The curriculum for the first session included five topics related to institution of CPB: routine cannulation and initiation of CPB, arterial air embolus, high arterial line pressure, distended left ventricle, and poor venous drainage. The second session included the following seven topics related to separation from CPB: routine decannulation, postoperative hypotension, right ventricular failure, blood conservation, iatrogenic dissection, emergent return to CPB, and mechanical support strategies. Faculty topic assignment and distribution of objectives were distributed 2 weeks ahead of the simulation dates. Echocardiography images from prior cases were uploaded onto an iPad for visualization and illustration during the live scenarios.

Equipment/Environment

The Michael Sorrell Simulation Lab was used. This is a 7,500 square foot facility which includes a full 600 square foot OR environment including table, lights, monitors, functioning gas, air, and power on light towers, and anesthesia and gas machines. Equipment used included a standard CPB circuit, echocardiography video clips on iPad, manipulatable vital sign through the SimMon iPad application, the Chamberlain cannula table aorta (SKU #1454) with suitcase thorax (SKU #1264), and basic, routine operative equipment (Figure 2).

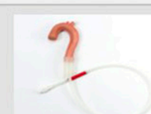
Standard Cardiopulmonary Bypass Circuit: Fully functional.	
Chamberlain Cannulatable Aorta: Can be pressurized and tolerates full CPB. Able to be cannulated multiple times.	
Suitcase thorax: Simulates an actual open chest and able to be fully prepped and draped.	
SimMon iPad App: Allows manipulation of vital signs, including arrhythmias, in real time from a remote cellular phone.	
iPad Echocardiography Video Clips: Prior operations were utilized to demonstrate intraoperative findings and correlate with vital signs and verbal cues.	

Figure 2. Images and descriptions of equipment used in simulation events.

Implementation

Each 180-minute session was divided into three parts: an orientation (10 minutes), the case scenarios with rapid cycle debriefing (20–30 minutes each), and a final debriefing with course evaluations (15 minutes).

Upon entering the OR, participants received a 10-minute orientation to ensure they understood the purpose of the simulation. The learning objectives of the simulation focused on each specific case scenario that tied together technical points, teamwork, communication, and crisis management.

The first simulation was attended by nine participants and eight faculty. The second simulation was held 4 months later and was attended by 11 participants and nine faculty. All cardiac anesthesia and cardiothoracic surgery fellows (n = 4) were required to attend both scenarios. The remainder of the participants varied between the two scenarios and were students of perfusion, general surgery residents on service, anesthesiology residents and new members of the OR team.

For the first 30 minutes of each simulation session, participants stayed in their primary roles and were taken through a scenario for routine cannulation or decannulation from CPB, including actual surgical technique with placement and removal of the cannulas as well as physically initiating or separating from CPB. After completion and debriefing the steps for routine scenarios, participants then rotated into unfamiliar roles for each subsequent scenario. For illustration: an anesthesiology fellow may cannulate the aorta for CPB while the surgical fellow runs the bypass circuit (Figures 3 and 4). Participant questions were answered in the debriefing period following each scenario.

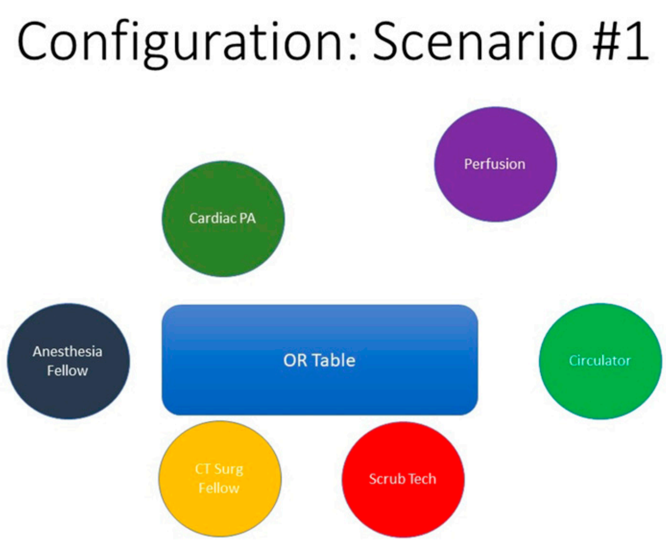


Figure 3. Initial configuration of simulation set-up with trainees and team members in their standard roles. Anesthesia fellow is at the head of the bed, and the heart–lung machine is near the perfusionist. OR, operating room; PA, physician assistant; CT Surg, cardiothoracic surgeon.

Assessment

The primary goal of this simulation was for participants to identify intraoperative events which may occur during initiation or separation from CPB and increase familiarity and confidence in responding to these events. As such our assessment of the participants was formative and supportive and was intended to help participants improve their performance in real-life scenarios. An anonymous online survey was used for participants to give feedback about the session following the first simulation event. A five-point Likert scale (which allows participants to choose from a linear set of responses) was used to determine self-assessments before and after the second event. Descriptive data was collected from the surveys and used as feedback to improve the quality and fidelity of the future events.

RESULTS

The overall perceptions of the course were highly favorable (Figure 5). A total of nine survey questions were answered anonymously by participants with response options ranging 1–5 in a standard Likert scale (1—strongly disagree to 5—strongly agree). The overall response rate was 100% (n = 9) with average rating of 4.63 indicating an overall favorable perception of the event.

For the second event, self-assessment ratings were given before and after the simulation (Figure 6). The overall response rate was again 100% (n = 11). The post-simulation ratings rose substantially for self-confidence levels in all scenarios, and despite a small sample size, reached statistical significance in two of the seven categories (iatrogenic dissection and emergency return to CPB).

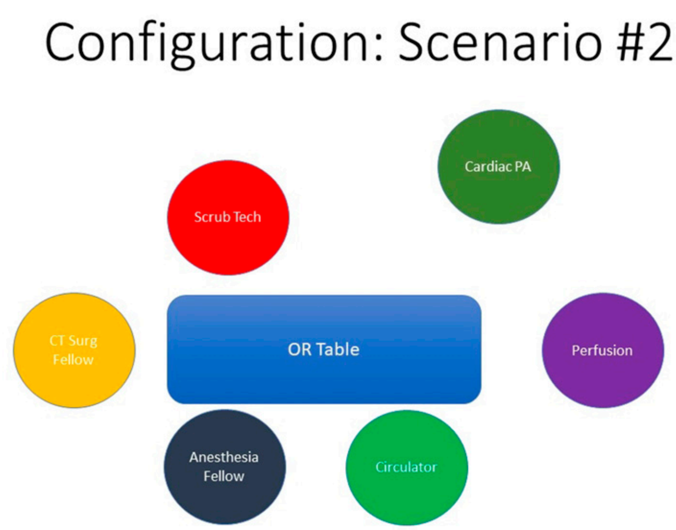


Figure 4. After the first scenario, participants rotate into non-standard roles to better understand and anticipate the needs of others during crisis. OR, operating room; PA, physician assistant; CT Surg, cardiothoracic surgeon.

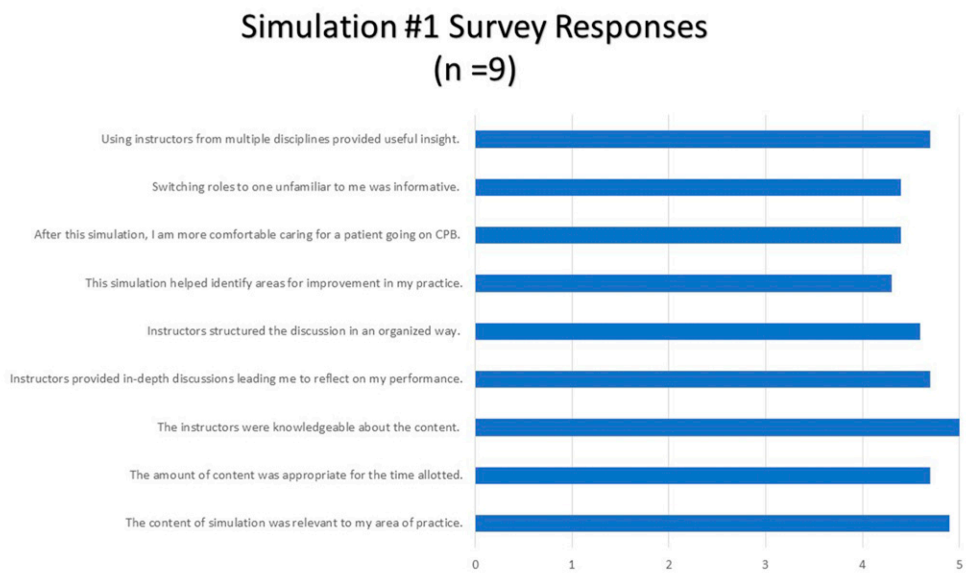


Figure 5. Responses from online survey following first simulation. CPB, cardiopulmonary bypass.

DISCUSSION

Teamwork and communication are essential for quality patient care, especially during high-risk scenarios (5,10). Multidisciplinary simulation creates an environment that replicates reality for participants and may encourage the development of nontechnical skills which must already be mastered when they are needed most (3,5,6).

The intent of our simulation session was to improve ability to manage uncommon, high-stakes scenarios encountered during initiation and decannulation from CPB, and secondarily to determine the effectiveness of these scenarios in improving self-confidence levels.

Although statistical significance was observed in only two scenarios (due in part to small sample size) we subjectively observed immediate increased learner confidence following exposure to every scenario in the second simulation and overwhelmingly positive reviews from anonymous surveys following the first simulation. Statistical significance was reached in responses to aortic dissections and emergent return to CPB (*p* .008 and .016, respectively). Iatrogenic aortic dissection occurs uncommonly (<1%) and is associated with high mortality (30%), underscoring the importance of utilizing interprofessional simulation to prepare participants outside of the OR (18). While the intent of our simulations was not to collect statistical data, the overall positive reception from our interprofessional participants combined with subjective, observational improvement in team confidence and performance following implementation led our group to share our results with others through publication.

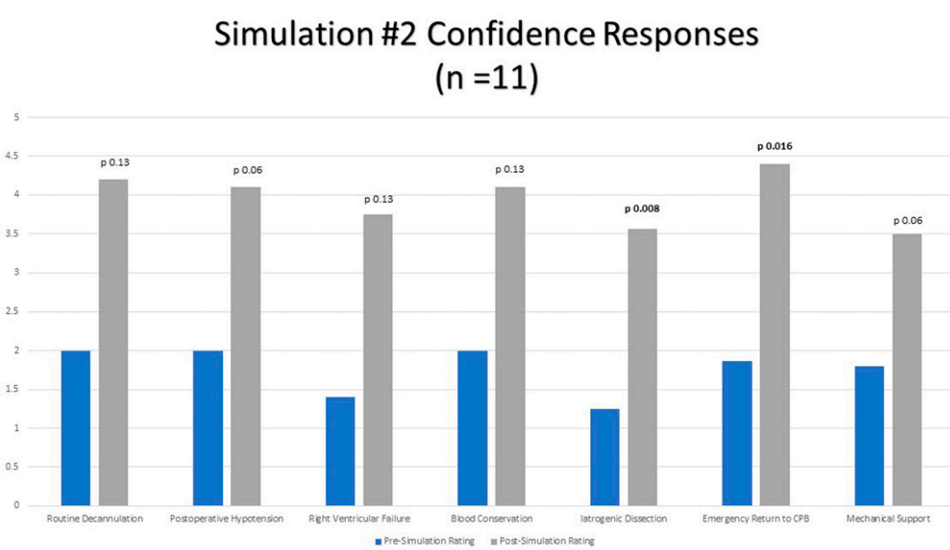


Figure 6. Likert scale comparisons following second simulation. Statistical significance was demonstrated in iatrogenic dissection and emergency return to cardiopulmonary bypass (CPB), and a positive trend was seen in all realms.

CONCLUSIONS

In our experience, high-fidelity interprofessional simulation promoted team communication and confidence for key scenarios related to institution and separation from CPB. Objectively, self-confidence ratings rose, and subjectively an appreciation of multidisciplinary perspective and team performance all improved following the simulation events.

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