Novel low-cost laparoscopic cholecystectomy simulation for third year medical students

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Introduction

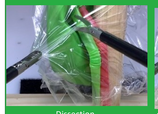
Simulation in medical education has been established for enhancing student skills and learning.[1] More specifically, simulations in surgery have been utilized to train residents in both hands-on laparoscopic and VR modalities for cholecystectomy. The results of the cholecystectomy simulation training(s) enhanced clinical learning, faster procedure completion time, and fewer adverse events.[2,3] Similarly, The University of Ottawa implemented a multifaceted program for medical students that included simulation workshops and educational information regarding the surgical field. The study resulted in decreased anxiety and increased confidence in medical students.[4] One barrier to training third year medical students is cost; many simulators cost several hundred dollars per use.[5] Therefore, we propose a low-cost hands-on laparoscopic cholecystectomy simulation to increase operating room comfort and enhance knowledge of essential anatomy in third year medical students.

Methodology

Class of 2024 Marshall University Joan C. Edwards School of Medicine (JCESOM) surgery clerkship students from rotations 2 through 6 (n=46) completed an IRB-approved questionnaire regarding comfort level in OR, simulation satisfaction, anatomical and medical learning objectives. Mean values were determined with Graph Pad Prism 9 software (La Jolla, California). Statistical inference was conducted using an unpaired t-test, $p<0.05$ was considered to be statistically significant.

Gallbladder model

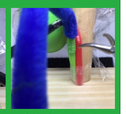
A store-bought green 12-in balloon was used as a gallbladder model. Two 6.5 cm straws with corrugation were inserted into the balloon body. A red straw was used to represent the cystic artery and a green straw was used to represent the cystic duct. The structures were secured with a conventional office stapler. The gallbladder model was secured to a ring stand. Cling wrap was used to simulate the fibrous tissue layer. The assembled gallbladder model was then placed in the laparoscopic simulator and a pipe cleaner was used to represent the intraoperative cholangiogram catheter (IOC).



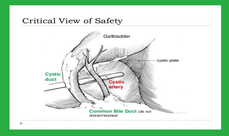
Dissection



Isolate structures and obtain critical view of safety



IOC catheter insertion



Strasberg SM, Hertl M, Soper NJ. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. J Am Coll Surg. 1995 Jan;180(1):101-25. PMID: 8000648.

Figures and Tables

Figure 1. Simulation improved OR comfort levels in students without prior surgical experience

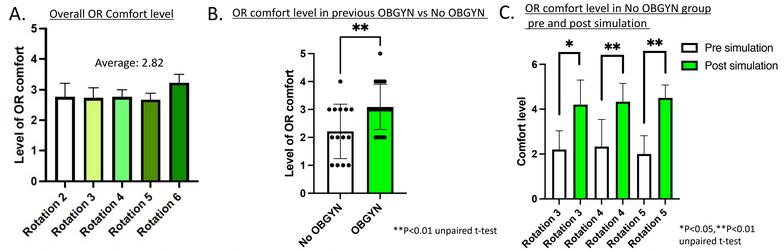


Figure 2. Simulation associated with high levels of student satisfaction across five rotations

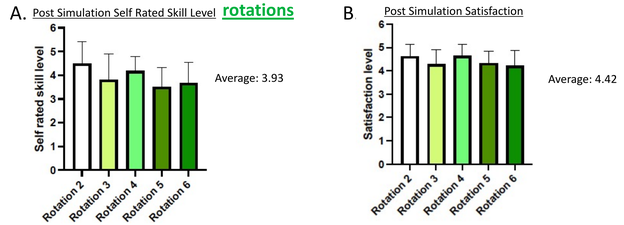


Figure 3. Simulation significantly enhanced learning of both anatomical concepts and medical knowledge

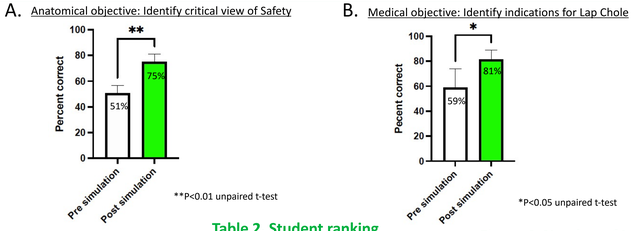


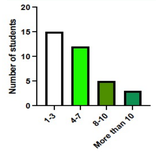
Table 1. Model cost analysis

Model	Cost per use (total for 50 students)
Novel Lap chole	$2.50 ($125)
Conventional model[5]	$50 ($2,500)

Table 2. Student ranking of learning resources

Learning resource	Average rank (out of 5)
Assisting in OR	1.71
Simulation experience	2.83
Interacting with Residents/attendings	3.29
Watching videos of procedures	3.54
Practice questions	3.58

Figure 4. Number of Lap Chole Scrub-ins Rotations 2-5



Results

- Overall comfort levels ranged from 2.75 to 3.2 with an average of 2.82. Interestingly, students who had not yet completed the OBGYN rotation reported significantly lower OR comfort levels. Additionally, this set of students showed significant increases in their OR comfort post simulation.
- Students consistently rated the simulation high with an average satisfaction of 4.42.
- There was a statistically significant increase in identification both the medical indications for Lap Chole and the critical view of safety in post-simulation survey.
- **The simulation experience was the second highest rated learning material only second to directly assisting in the OR**.

Conclusions, limitations, and future directions

- Using low-cost cholecystectomy simulation is an effective teaching modality for third year medical students in clerkships.
- Implement model with surgery residents measure technical ability and advanced skills
  - Stone expression from cystic duct
  - Gallbladder rupture with simulated stones
- Develop model for additional anatomic accuracy as pictured below:



References

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