

ACS 2024 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

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Challenges in Surgical Education

Efficacy and Transferability of Midlevel Fidelity Surgical Simulators: Development of Custom Simulators of Anomalous Variation of Hepatobiliary Anatomy for Cholecystectomy

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Background: Surgical simulators are highly utilized training tools in surgery residency programs; however, they vary in degree of fidelity. Recently, research on low-fidelity simulators, those that are static with less realistic anatomy and developed at low cost, were evaluated during the COVID19 pandemic. However, mid-fidelity simulators offer more realistic anatomy, may be physiologically or clinically functional, and can be developed at low to moderate cost. Mid-fidelity simulators have been found to yield improved resident self-confidence, improved competency and proficiency while performing surgical procedures.

Current Challenges: Many surgical simulators, regardless of fidelity level, are most often developed based on normal anatomy. Although valuable, these types of simulators do not offer residents opportunities to engage with aberrant anatomy or other complications in a safe and controlled environment prior to operating on a real patient.

Need of Innovation: To prepare residents to make sound surgical decisions and hone operative skill when encountering certain complications with or without anomalous anatomy, we have developed custom cholecystectomy simulators based on common variations of the hepatic ducts and cystohepatic junctions in relationship to the cystic artery and its branches. The hepatobiliary tree is 3D printed using flexible 50A photopolymer resin. This model is incorporated with a silicone liver mold, synthetic adhesions, synthetic hepatic artery, and other supportive tissues. The simulator can be used for laparoscopic or open cholecystectomy. For the laparoscopic approach the model is placed inside a laparoscopic training box. For the open procedure model, the housing containing the extrahepatic biliary model and accessory structures are placed in a functional abdomen model complete with all layers of the abdominal wall to gain access to the peritoneal cavity. Survey feedback from residents is compared to feedback on procedural performance from attending surgeons via SIMPL app data using cross tabulations. Feedback on simulator utility was appreciated.