Laparoscopic Repair of Perforated Peptic Ulcers: A Low-Fidelity Simulator and Training Curriculum for Surgical Skill Development

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Introduction

• Four million Americans are affected by peptic ulcers.¹
• Perforation occurs in 2-14% of cases and is associated with a 20-30% mortality rate².
• Laparoscopic repair of perforated peptic ulcers (PPE) is associated with shorter hospital stays, less post-operative pain and inflammation, as well as earlier return to daily activities³.
• Resident training exposure to laparoscopic repair of PPE is limited, since less than 13% of cases are performed laparoscopically.
• Simulation-based surgical education has shown its benefit in the early acquisition of technical skills and higher surgical performance.
• A cost-effective, low-fidelity laparoscopic training model for the repair of PPE may be proven useful to bridge the current gap in training.

Methods

Foam and silicone models were utilized

Figure 1: Simple foam suture model

Figure 2: Silicone model with model liver

Figure 3 (a) and (b): Interior and exterior of the silicone model, designed to teach the mechanical steps of the Graham patch repair of a perforated peptic ulcer.

Methods Continued

25 trainees made three attempts on both training models and filled out a Likert scale survey, which was analyzed using the Mann-Whitney U-Test.

Training Video - Instruct Steps of Repair

Steps of Repair
1) Interrupted sutures placed across the perforation
2) Omental patch placed over the perforation
3) Omental patch secured in place

Cyclical Training: Three Attempts Per Model, With Active Coaching

5-Point Likert Scale Survey

Mann-Whitney U-Test

Figure 4: (a, c) Participants practicing the mechanical steps of the Graham patch repair (b) Simple foam suture model (d) Silicone model with omentum patch

Results

Results Continued

• Participants found both models enjoyable to use, but preferred the silicone model, reporting it to provide a better simulation of the procedure and to be more effective in the acquisition of laparoscopic skills.
• A silicone-based skill trainer and rapid training curriculum has potential merit as a method to breach the gap of training and teach the technical steps of a laparoscopic Graham patch repair.

Future Directions

A higher fidelity, 3D printed, laparoscopic simulator will be designed, and a hierarchical task analysis will be performed to formally establish a training curriculum and scoring criteria.

REALISIM: The simulator will provide both visual and tactile realism
• The simulator will contain model stomach liver, duodenum, transverse colon, and omentum.
• Model organs will emulate the physical properties of biologic tissue.

VALIDATION: The simulator will be validated by the following experiments
• Face and content validation
• Construct validation
• Concurrent validation

Acknowledgements & Citations

1. Anand, B.S. “Peptic Ulcer Disease.” Background, Anatomy, Pathophysiology, Medscape, 17 Aug. 2017

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