VALIDATION OF THE VIRTUAL LAPAROSCOPIC HIATAL HERNIA SIMULATOR (VLAHHS) FOR OBJECTIVE PERFORMANCE ASSESSMENT OF A SIMULATED LAPAROSCOPIC CRURAL REPAIR

Sofia Garces-Palacios, MD; Bryanna Stukes, MD; Mark Ellis MS; Apoorva Pise MS; Doga Demirel, PhD; Alexis Desir, MD; Daniel J Scott, MD; Carla Holcomb, MD; Ganesh Sankaranarayanan, PhD

Background

Laparoscopic repair of a hiatal hernia (HH) requires knowledge of complex anatomy and advanced skills.

Fellowship training and significant case volumes are often required to achieve proficiency.

Despite the increased adoption of surgical simulation, validated tools for training and assessing advanced laparoscopic procedures remain limited.

To address this gap, The Virtual Laparoscopic Hiatal Hernia Simulator (VLaHHS) was developed to provide a safe, objective platform for training and assessment of a laparoscopic crural repair.

Objective

This study aim to evaluate the discriminant validity of VLaHHS by assessing its ability to distinguish performance across two levels of surgical expertise.

The University of Oklahoma

UT Southwestern Medical Center

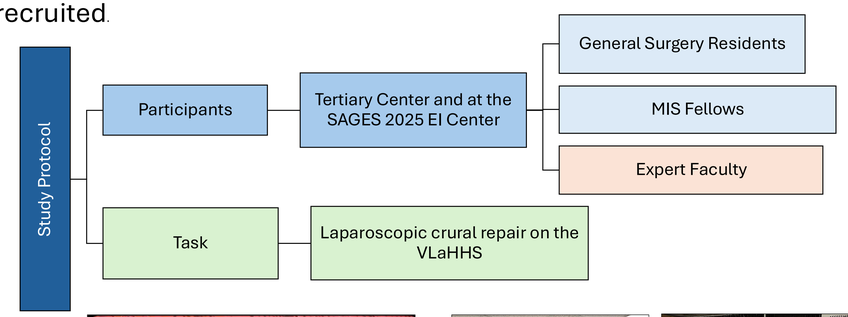
The University of Utah

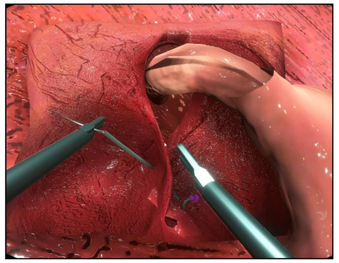
Artificial Intelligence and Medical Simulation (AIMS) Lab

This study was funded by the NIH R01 Grant # EB025247

Methods

In this IRB-approved study, general surgery residents, fellows, and attendings from a tertiary academic center and at the 2025 SAGES Education and Innovation Center were recruited.





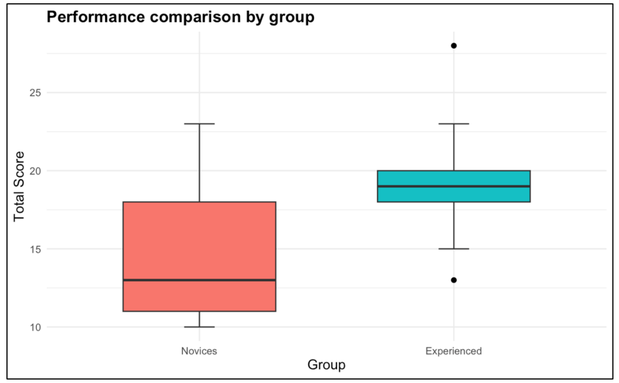
Crural repair task on the VLaHHS

Participants performing the crural repair task on the VLaHHS. Right (UTSW) - Left (SAGES E&I Center)

Participants were stratified into two groups: novices (PGY 1–2) and experienced (PGY 3–5 residents, fellows, and attendings). All participants performed a simulated crural repair task on the VLaHHS. The simulator automatically recorded objective performance metrics including overall performance scores and task completion time. Data were tested for normality (Shapiro–Wilk test showed non-normality for several measures); between-group comparisons were conducted using Wilcoxon rank-sum tests.

Results

46 subjects participated: novices = 17 (PGY1 = 9, PGY2 = 8); experienced = 29 (PGY3 = 6, PGY4 = 4, PGY5 = 2, Fellow = 5, Faculty = 12). The experienced group achieved significantly higher total scores compared with novices (13 vs 19, W = 119, p = 0.003) (Figure 1). Significant differences were also observed in smooth tool handling (W = 188, p = 0.03) and correctly performed slipknots (W = 174, p = 0.002). Completion time was shorter in the experienced group (12.57 vs 8.17 minutes) but this difference did not reach statistical significance (W = 282, p = 0.43).



Conclusion

The VLaHHS effectively distinguished between novice and experienced surgeons on key performance metrics, demonstrating discriminant validity. These findings further support its potential role as an objective assessment platform and its integration into advanced laparoscopic training curricula to enhance skill acquisition in hiatal hernia repair.