Needs Analysis for the Development of a Virtual Laparoscopic Hiatal Hernia Simulator

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Introduction

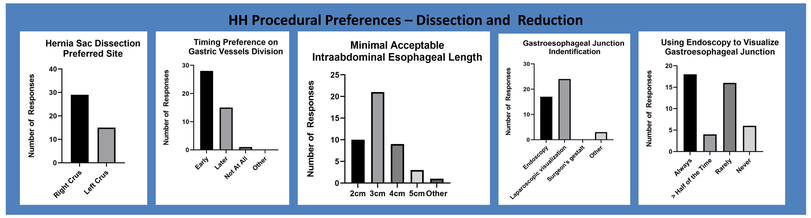
- Minimally invasive approach has become the standard for repairing hiatal hernias (HH).
- It is a difficult procedure to master, and it is associated with higher recurrence rate in patients with larger hernias (types 3 and 4).
- Low-volume foregut centers have been associated with worse postoperative outcomes.
- Currently training in this procedure is based on case volumes and unless you are in one of the high-volume centers, trainees typically don't get enough case volumes to master this procedure.
- To address this gap, we are developing a virtual laparoscopic hiatal hernia simulator with funding from the National Institute of Health (NIH).
- The objective of this work is to develop a structured needs analysis to identify current laparoscopic HH repair practices and define important features for development of our virtual simulator.

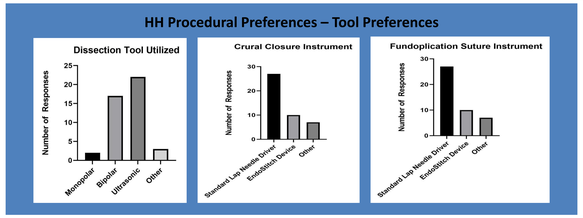
Methods and Procedures

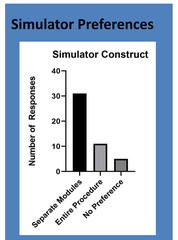
- A 48-item survey was created in REDCap to assess demographics, prior experience, procedure specific training, and preferences regarding technical details and distributed to practicing foregut expert surgeons in North America (n = 250) via the SAGES Foregut Task Force with approval from the UTSW IRB.
- The responses were grouped into three categories based on the clinical experience (**G1**: < 5 years, **G2**: 5-15 years, and **G3**: >15 years).
- Descriptive statistics including percentages, mean, standard deviation, and median (when appropriate) were calculated.
- For analyzing consensus on select responses as well as the ratings of the importance of the various HH procedural steps and preference on the simulator, a non-parametric Kruskal-Wallis test was used. The ratings among the three groups are in agreement when there is no observed significant difference (null hypothesis, $p > 0.05$). Dunn's test with Benjamini-Hochberg correction was used for post hoc testing of responses that had disagreement

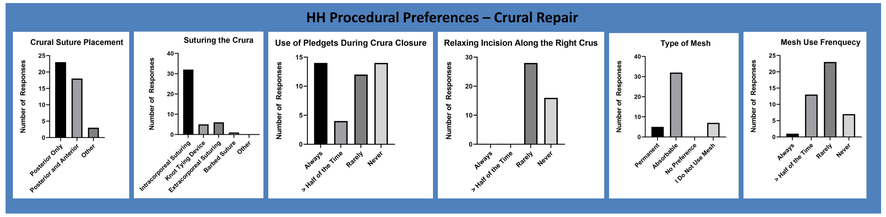
Results

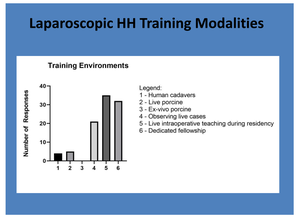
- We received a total of **n = 51** responses (response rate 20%) of which **n = 44** completed all parts (86.3%).
- The distribution based on experience was **G1: n = 10 (22.7%)**, **G2: n =13 (29.5%)** and **G3: n =21 (47.7%)**.
- Practice background: **Minimally Invasive Surgeons (MIS): n = 31 (70.4%)**, **General surgeons: n = 8 (18.2%)** and **Bariatric surgeons: n = 5 (11.4%)**.
- Number of HH repairs performed per month: **</= 2 (n = 12)**, **3-5 (n = 17)**, **6-10 (n = 6)** and **> 10 (n = 9)**.

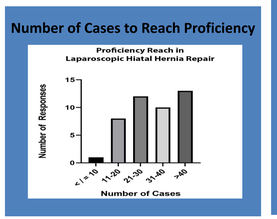












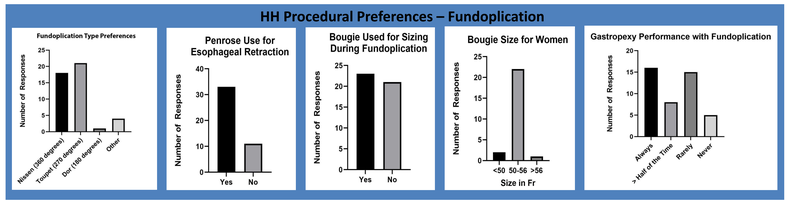


Table 1: Weighted Averages of Responses for the Importance of Various HH Steps

Question	Group 1	Group 2	Group 3	K-W test p-value*
Penrose placement for esophageal retraction	3.1	2.8	3.2	0.793
Carrying the mediastinal dissection to the inferior pulmonary vein	3.4	3.6	3.7	0.586
Measuring intraabdominal esophageal length using ruler/grasper	3.9	3.5	3.2	0.477
Bougie placement	2.4	3.1	2.8	0.452
Endoscopy	4	4.1	2.9	0.032
Division of short gastric vessels	3.8	4.3	4.2	0.345
Identification of gastroesophageal junction (GEJ)	4.8	4.6	4.5	0.585
Shoe-shine maneuver	4.3	4.2	4.3	0.805
Gastropexy	2.7	3.2	2.6	0.29

Table 2: Weighted Averages of Responses for the Importance of Various HH Virtual Reality Simulator Features

Question	Group 1	Group 2	Group 3	K-W Test p-value*
Having a laparoscopic assistant in the simulator	3	2.8	2.5	0.532
Modeling aorta with blood flow to simulate perforation injury during crural closure	2.8	2.4	2.5	0.457
Modeling a shorter esophagus in the simulator	4.2	3.7	3.3	0.101
Modeling intraabdominal adhesions in the simulator	2.9	2.9	2.1	0.114
Modeling a prominent fat pad in the simulator	4	3.1	3.5	0.136
Simulating the dissection of lesser omentum to access the right crus	4.3	3.6	3.9	0.196
A realistic interface with force feedback (haptics) for the simulator	3.7	3.8	3.6	0.774

$P < 0.05$ denotes disagreement

Conclusions

- Based on the survey, current training in laparoscopic HH repair is limited and strongly indicate a gap and the importance of developing a virtual reality simulator.
- Our survey confirmed consensus for procedure performance from dissection, crural repair, and fundoplication as well as relative importance of procedural steps that will facilitate performance assessment.
- Most of the respondents preferred separate modules for hernia sac dissection, crural closure, and fundoplication in the VR simulator.
- For anatomical modeling, based on the response to our survey, we will simulate a Type III HH.

Acknowledgments

- The authors gratefully acknowledge the support of this work through NIH/NIBIB grant #R01EB025247.
- We thank the SAGES Foregut Taskforce for help in distributing the survey.

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