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S001

Potential clinical utility of real-time tissue perfusion quantification using laparoscopic laser speckle contrast imaging (LSCI) and differential responses to arterial versus venous occlusion in porcine intestine model

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Introduction: Precise and accurate intraoperative assessment of tissue perfusion at intestinal anastomoses is a critical determinant of optimal outcome. Laser Speckle Contrast Imaging (LSCI) is a new emerging technology that allows for the visualization of tissue perfusion in a dye free, repeatable manner. LSCI detects and displays real-time tissue perfusion/blood flow in a colormap with spatiotemporal precision and accuracy. We report a novel quantification function of LSCI correlating with tissue perfusion colormap.

Methods: ActivSightTM is an FDA-cleared device that displays both ICG and LSCI in minimally invasive surgery. Novel perfusion quantification algorithms measuring relative perfusion units (RPU) using reference areas of normally perfused and ischemic tissue were tested in a porcine intestine model: (1) selective devascularization of small bowel to create a continuous gradient of perfused-watershed-ischemia; and (2) controlled occlusions of aortic inflow/portal vein outflow clamping with arterial pressure monitoring in left iliac artery. RPUs were measured in three regions – perfused, watershed and ischemic segments. Positive and negative controls were mesenteric blood vessels and the avascular mesentery. Statistical analysis was performed by ANOVA and student's t-test.

Results: Mean RPU measurements over the three bowel segments were able to clearly distinguish between the perfused (100% ± 10%), watershed (58% ± 8%) and ischemic (0% ± 8%) regions of small bowel ($p < 0.0001$)(Figure 1). Measurements in mesenteric blood vessels and avascular mesentery were not statistically different from perfused and ischemic segments respectively. With aortic occlusion, perfused bowel demonstrated strong linear correlation ($r^2 = 0.95$) between RPU and mean arterial pressure (MAP), as did watershed bowel ($r^2 = 0.56$) above threshold MAP (37 mmHg). With portal vein occlusion, both perfused/watershed segments demonstrated strong positive nonlinear correlation between RPU and MAP (Spearman correlation coefficient 0.81/0.68, respectively). Intestinal RPU and perfusion colormap were highly sensitive to relatively small changes in MAP caused by venous occlusion (Perfused/Watershed = Mean RPU 100% ± 10%/58% ± 8% at MAP 50 mmHg vs. 30% ± 4%/15% ± 7% at MAP 48, $p < 0.00001$).

Conclusion: This novel RPU metric, manifested through LSCI colormaps, acts as a measure of tissue perfusion and could distinctly detect perfused, watershed and ischemic regions in porcine intestine. RPU's were sensitive to real time perfusion changes at tissue level with manipulation of arterial inflow and venous outflow. Perfusion changes resulting from arterial obstruction elicited linear RPU responses while venous outflow obstruction induced non-linear RPU and colormap changes. Intestinal tissue perfusion measurements appeared to be more sensitive to venous outflow obstruction and may serve as a new real-time, dye-free tool for intestinal anastomotic assessment.

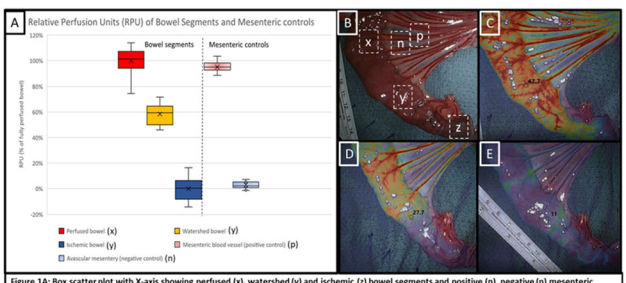

Figure 1A: Box scatter plot with X-axis showing perfused (x), watershed (y) and ischemic (z) bowel segments and positive (p), negative (n) mesenteric controls; Y-axis showing LSCI-measured RPU (normalized as % of fully perfused bowel) of perfused (100%±10%), watershed (58%±8%), and ischemic (0%±8%) bowel segments and positive (95%±5%), negative (3%±3%) mesenteric controls. Mean RPU of all three bowel segments were significantly different ($p<0.0001$), Mean RPU of perfused and ischemic bowel segments were not statistically different from positive ($p=0.85$) and negative ($p = .76$) mesenteric controls, respectively.
Figure 1B: RGB image of porcine small bowel model that was selectively devascularized to create bowel perfusion gradient with perfused (x), watershed (y) and ischemic (z) bowel segments. Mesenteric blood vessels (p) and avascular mesentery (n) were used as positive and negative controls, respectively.
Figure 1C,D,E: LSCI perfusion overlay images of different experimental groups - no occlusion (C), arterial (proximal aorta) occlusion (D) and venous (portal vein) occlusion (E). Note corresponding dramatic colormap and RPU changes in response to portal outflow obstruction in comparison to aortic occlusion.

S002

Tissue oximetry as a potential alternative to indocyanine green (ICG) perfusion assessment in colorectal anastomotic cases

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Introduction: Anastomotic margin tissue perfusion is recognized as critical to successful colo-rectal anastomosis creation. Near infrared fluorescence (NIR) imaging with indocyanine green (ICG) is the most common modality used by surgeons as an adjunct to clinical assessment in confirming adequacy of tissue perfusion. Tissue oxygenation as a surrogate for tissue perfusion has been described in a variety of surgical specialties but its use in colo-rectal surgery has been limited. Here we report our experience using a handheld tissue-oxygen (TO) meter, IntraOx (Vioptix Inc, Newark, CA USA), for evaluation of colo-rectal tissue bed oxygen saturation (StO2) and compared its utility with NIR-ICG in identifying the viability of colonic tissue prior to anastomosis in a range of colo-rectal procedures.

Methods and Procedures: This was an IRB approved multicenter trial consisting of 100 patients undergoing elective colon resections. After specimen mobilization a clinical margin was chosen based on oncologic, anatomic and clinical assessment as per the clinicians' standard technique. The IntraOx device was then used to take a baseline reading of colonic tissue oxygenation on a normal segment of perfused colon. Following this, measurements were taken circumferentially at 5 cm intervals along the bowel proximally and distally to the clinical margin. An StO2 margin was then determined based on the point at which the StO2 dropped off by ≥ 10 percentage points. This was then compared to the NIR-ICG margin using the Spy-Phi system (Stryker, Kalamazoo, MI).

Results: StO2 was found to have a sensitivity and specificity of 94.8% and 93.1% respectively and a PPV and NPV of 93.5% and 94.5% respectively when compared to NIR-ICG. At 4-week follow-up, no significant complications or leaks were reported.

Conclusion: The IntraOx handheld device was found to be similar to NIR-ICG in identifying a well perfused margin of colonic tissue while having the added benefits of high portability and reduced costs. Further studies looking at the effect of the IntraOx on preventing colonic anastomotic complications such as leak and stricture are warranted.

S003

A pressure platform can accurately identify attending surgeon intraoperative fatigue. Preliminary results of a pressure platform analysis

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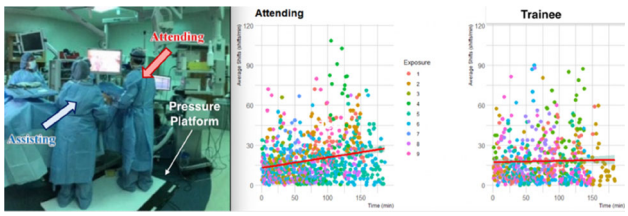
Background: Work-related musculoskeletal fatigue and injuries accumulate over time and are increasingly being recognized to affect surgeons' performance. Objective measurement of ergonomic risk may help minimize long term injuries. The purpose of this study was to assess whether a pressure measurement system can accurately detect intraoperative surgeons' fatigue.
Methods: Ergonomic data of 5 different surgeons and surgical trainees were recorded. Participants stood on a pressure measurement system (25.6inx51.2in) during the operation that enabled the assessment of surgeons' body-weight shifts, defined as shifting over 30% of body weight from one leg to the other (Figure). All participants self-reported their lower-body musculoskeletal discomfort using a body-part discomfort survey (3-point Likert) pre- and post-operatively. Fatigue was defined as a 1-point increase after the operation. T-test, chi-square, and Pearson correlation analyses were undertaken.
Results: Data from 9 procedures were collected from 3 different attendings and 2 residents/fellows (Table). Average operative time was 137 ± 39.6 min. Attendings reported higher lower extremity fatigue postoperatively compared to the trainees (50% vs 29%, $p < 0.001$). Participants had an average of 19 body-weight shifts per minute; attendings had many more body-weight shifts that increased as the case progressed ($r^2 = 0.227$, $p < 0.001$)(Figure), while trainees, who were mainly assisting in the cases, had fewer shifts and reported less fatigue.
Conclusions: Higher intraoperative fatigue is associated with more body-weight shifts of attendings but not of trainees. A pressure platform can accurately identify attending surgeon intraoperative fatigue.



	Attendings (3)	Trainees (2)	p-value
Age, mean (SD)	45.2 (0.8)	30 (3)	0.0025
Female sex, %	33.3%	100%	0.182
Weight (pounds), mean (SD)	183 (54)	181 (29.7)	0.966
Height (cm), mean (SD)	174.3 (14.5)	167.6 (7.2)	0.599

SD, standard deviation.

S004

Outcomes following antegrade balloon sphincteroplasty as an adjunct to laparoscopic common bile duct exploration

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Background: Management of choledocholithiasis is often a two-step process with laparoscopic cholecystectomy and either pre- or post-operative endoscopic retrograde cholangiopancreatography (ERCP). Laparoscopic common bile duct exploration (LCBDE) at the time of cholecystectomy can safely and definitively manage common duct stones under one anesthetic. Despite the proven efficacy and safety profiles of LCBDE and its associated decrease in hospital costs and length of stay (LOS), ERCP continues to be predominantly utilized. A significant barrier to LCBDE adoption is the associated learning curve. As such, simplifying the intervention may drive adoption. We refined a previously described technique utilizing over-the-wire balloon catheters to dilate the Sphincter of Oddi to facilitate stone passage into the duodenum. To determine the efficacy during the initial adoption phase on an emergency general surgery service, we reviewed our experience with LCBDE antegrade balloon sphincteroplasty.
Methods: We retrospectively reviewed the records of patients who underwent LCBDE with antegrade balloon sphincteroplasty on the emergency general surgery service at a single tertiary care center over a 16 month period. Age, sex, BMI, pre-operative diagnosis, imaging studies, laboratory results, fluoroscopy time, operative time and outcomes were reviewed.
Results: The balloon sphincteroplasty technique was utilized during LCBDE in 15 patients ages 19–88 over the 16 month period. Operative indications included cholecystitis ($n = 8$), gallstone pancreatitis ($n = 2$), cholelithiasis ($n = 3$), and primary choledocholithiasis ($n = 2$). 93% of the common bile ducts were successfully cleared without the need for a postoperative ERCP. Average fluoroscopy time was 296 ± 81 s. The average operative time was 159 ± 36 min. There were no intra- or postoperative complications. The average length of stay was 1.9 days.
Conclusion: Antegrade balloon sphincteroplasty is a simple and safe adjunct to LCBDE. With further experience and widespread adoption, LCBDE with balloon sphincteroplasty could provide definitive choledocholithiasis management for patients and decrease length of stay and cost for patients.

S005

Autonomous robotic vs manual suturing: an experimental quality assessment and comparison

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Introduction and Objective: Limitations in tool motion and visualization contribute to inconsistent outcomes in difficult surgical tasks such as laparoscopic anastomosis. We aim to standardize these procedures via supervised autonomy with the Smart Tissue Anastomosis Robot (STAR). Previously, STAR demonstrated superior suture consistency and accuracy in open surgeries. Here we extend these results to comparison of STAR to human surgeons in laparoscopic anastomosis tasks.

Methods: STAR consists of a KUKA LBR Med lightweight robot with a motorized commercial suture tool. Two laparoscopic near infrared and structured light cameras reconstruct 3D point clouds of the surgical field for tissue tracking and surgical planning. We considered two laparoscopic suturing tasks for comparison tests: i) end-to-end anastomosis using synthetic small bowel (STAR: $n = 196$ sutures, LAP: $n = 202$ sutures), and ii) vaginal cuff closure on synthetic vaginal tissue (STAR: $n = 69$ sutures, LAP: $n = 53$ sutures). For the robotic (experimental) trials, STAR generates laparoscopic suture plans based on tissue size, geometry, and spacing to minimize variance between consecutive sutures. For the human (control) trials, surgeons completed suturing tasks within a laparoscopic trainer. A simulator induced soft tissue motion from breathing artifacts in all trials. Results for each task are combined within their respective study arm prior to comparison. Differences between robotic and manual suture spacing consistency, bite depth consistency, and time per stitch were examined. Consistency metrics are normalized and reported as the coefficient of variance (CoV). $p < 0.05$ is considered significant for all tests.

Results: There was no significant difference between STAR (4.20 ± 2.24 mm) and manual (3.77 ± 3.24 mm) laparoscopic anastomosis ($p = 0.091$), however, STAR's suture spacing was more consistent as measured by the normalized CoV (STAR = 53.27%, manual = 86.21%, $p < 0.001$). Bite depth: STAR (3.94 ± 1.95 mm) was significantly greater than manual (2.63 ± 2.11 mm) ($p < 0.001$), however STAR's bite depth was more consistent as measured by the CoV (STAR = 49.64%, manual = 80.04%, $p < 0.001$). Time per stitch: There was no significant difference between STAR (86.58 ± 41.48 s) and manual (84.63 ± 103.00 s) ($p = 0.83$).

Conclusions: STAR is a promising solution for achieving consistent anastomosis outcomes in spatially constrained laparoscopic surgeries. Using accurate 3D imaging systems, near infrared tracking algorithms, and optimized suture plans, STAR demonstrated better consistency in suture metrics as compared to manual laparoscopic technique. Suturing speed can be further improved by adding tactile sensing and removing velocity limits. Future work will consider tests on porcine models in preclinical scenarios.

S030

Serbian national training programme for minimally invasive colorectal surgery "LapSerb: outcomes from 1465 laparoscopic colorectal resections

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Introduction: Serbian National Training Programme for minimally invasive colorectal surgery (LapSerb) was introduced to implement laparoscopic colorectal surgery across the country. The programme aims to train established colorectal surgeons in advanced laparoscopic surgery without compromising patient safety. For this purpose, highly trained laparoscopic colorectal surgeons form United Kingdom were involved through workshops and live operating with trainee surgeon from Serbia. The training involved colorectal workshops and live operating with trainee surgeon. Also, The competencies were assessed through Global Assessments Scores (GAS) forms, MCQs and review of unedited videos by the trainers. The aim of this study is to report the outcomes of laparoscopic colorectal resection perfomed by LapSerb certified surgeons.

Methods: LapSerb, prospectively maintained multicentred database was screened and analysed for laparoscopic colorectal resections from January 2020 to February 2021. Data were collected under five categories; Abdominoperineal rection (APR), anterior resection (AR), Right and left sided colectomies (RC, LC) and other colectomies (OC). Data included patient demographics, indications, perioperative data and 30-day outcomes.

Results: A Total of 1465 laparoscopic colectomies by 24 certified surgeons were included in the final analysis. Mean patients' age was 67 ($\pm$ 11) years old, 60%(876) were male and 58%(848) were ASA grade II. AR was the most common procedure with 699(48%) cases, followed by RC and LC with 24.5%(357) and 21%(303) cases respectively. 4.5%(66) were APR and 2%(31) were others. 4.8%(70) required conversion to open surgery, Stoma formation was done in 25.7%(375) of patients. 30 days readmission and reoperation were done in 2.3%(34) and 4.7%(69) of the patients and overall reoperation related to anastomotic problems was 2%(28). 1210(83.2%) resections were malignant with majority due to adenocarcinoma (1197,82.2%). R0 resection was achieved in 97.8%(1171) in all adenocarcinoma cases with T3 tumour being the most common (63.8%). 16.8% of cases were benign with main pathology of polyp unsuitable for endoscopic resection in 74.3%. Overall mortality in all cases was 1.1%.

Conclusion: LapSerb programme has successfully and safely established laparoscopic colorectal surgery across the country with comparable and acceptable Clinical outcomes. Further application of LapSerb program will ensure standardized laparoscopic practice between different regions in the country with more validation of the program through the newly introduced national database.

S031

Feasibility of targeted lymphadenectomy using indocyanine-green immunofluorescence lymphatic mapping for colon cancer

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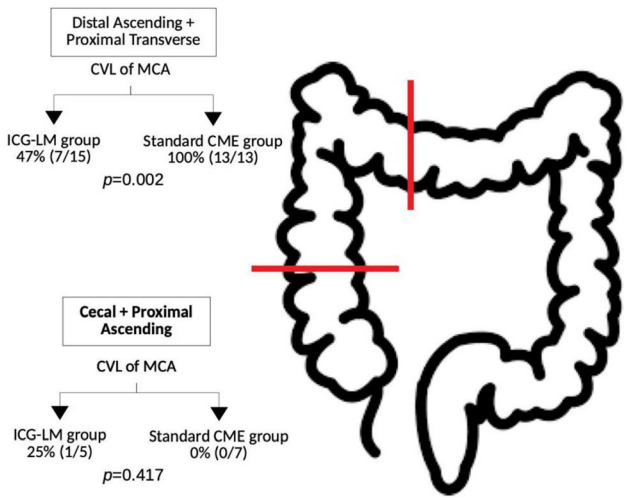
Introduction: Higher nodal harvest is associated with better oncologic outcomes for colon cancer, but lymphatic drainage of the colon is variable. Intraoperative identification of the lymphatic drainage patterns using indocyanine-green(ICG) immunofluorescence may allow tailored lymphadenectomy during complete mesocolic excision(CME). The aim of this study was to determine the feasibility of ICG immunofluorescence for lymphatic mapping(ICG-LM) and its effect on nodal status in right-sided colon cancer.

Methods: A prospective cohort study was performed at a single university-affiliated colorectal specialist referral site from 06/2018–06/2021. Patients with biopsy-proven adenocarcinoma and bulky right-sided tumours were approached for participation. From 06/2018–03/2020, participants underwent ICG-LM, which involved peritumoral injection of ICG at the beginning of the operation and immunofluorescence imaging of the lymphatic drainage basins 20 min post-injection. CME with central vascular ligation(CVL) was performed based on identified drainage basins in the ICG-LM group. In the standard CME group, CVL of the ileocolic pedicle was done for cecal/proximal ascending lesions, and CVL of the ileocolic and middle colic pedicles for distal ascending/proximal lesions. The main outcomes were feasibility(did ICG drain into lymphatic system) and nodal status.

Results: A total of 40 patients were included in this study (ICG-LM n = 20, standard CME n = 20). There were no differences in age, gender, comorbidities, tumour location, resected bowel length, procedure length, and intraoperative or postoperative complications between the two groups. Figure 1 shows the differences in CVL between the two groups. The incidence of nodal involvement was 30% in both groups (p = 1.00). The total lymph node harvest was higher in the ICG-LM group. The number of positive nodes, D3 nodes, and proportion with positive D3 nodes were similar.

Conclusions: Lymphatic mapping using ICG immunofluorescence for colon cancer is feasible and may increase the total nodal harvest, but did not affect the proportion with node-positive disease. Any potential oncologic benefit would have to derive from a higher lymph node harvest.

Mean(SD)	ICG-LM (n = 20)	Standard CME (n = 20)	p
Resected bowel length,cm	22.5(11.3)	22.5(13.6)	1.00
Procedure length,min	176(70)	156(40)	0.282
Total lymph nodes	30.2(9.5)	24.1(5.7)	0.019
Number of + nodes	1.9(3.9)	1(1.7)	0.380
D3 nodes	3.9(2.2)	3.5(2.1)	0.560
% with + D3 nodes	20%	10%	0.661



S032

Is laparoscopic surgery safe in elderly patients with diverticulitis? A national database study

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Introduction: Laparoscopic surgery for diverticulitis has been favored in the elective setting and is increasingly used in urgent/emergent cases as well. However, there are no large studies examining the use of laparoscopy among elderly patients with diverticulitis. The objective of this study is to compare the short-term outcomes of laparoscopic versus open surgery for diverticulitis among elderly patients in both elective and non-elective settings.

Methods and Procedures: The ACS-NSQIP database was used to identify elderly (age 65 years and older) patients who underwent surgery for a diagnosis of acute diverticulitis from 2015–2019. Patients were divided into elective and non-elective groups. In each group, in order to account for differences in preoperative characteristics and to minimize selection bias, patients who underwent laparoscopic surgery were matched 1:1 with those who underwent open approach using Coarsened Exact Matching. In each group, 30-day outcomes were compared between laparoscopic and open approaches.

Results: Of 15,316 patients identified in the aggregate cohort, the mean age was 72.7 ± 6.1, 10,598 (69.2%) were female, 9284 (60.6%) were done electively, and 7794 (50.9%) underwent laparoscopic surgery. In the elective group, a total of 3348 patients were matched. In this elective matched cohort, laparoscopic surgery was associated with lower morbidity (OR:0.47; 95%CI:0.38–0.58), fewer surgical site infections (SSI) (OR:0.43; 95%CI:0.33–0.57), less post-operative sepsis (OR:0.62; 95%CI:0.40–0.97), fewer 30-day readmissions (OR:0.54; 95%CI:0.41–0.71), and shorter length of stay (LOS) (mean difference:1.7d; 95%CI:1.5–1.9). In the non-elective group, a total of 1000 patients were matched. Similarly, laparoscopic surgery in this non-elective matched cohort was associated with decreased morbidity (OR:0.76; 95%CI:0.58–0.98), fewer SSIs (OR:0.66; 95%CI:0.44–0.98), less post-operative septic shock (OR:0.59; 95%CI:0.34–0.99), and shorter LOS (mean difference:1.2d; 95%CI:0.43–2.1). There was no difference in mortality in either group.

30-Day outcomes of laparoscopic vs. open surgery for acute diverticulitis in elderly patients (matched cohorts).

	Elective (N=3348)			Non-elective (N=1000)		
Outcome	Laparoscopic	Open	p-value	Laparoscopic	Open	p-value
Morbidity	9.2%	17.7%	<0.001	29.8%	36.0%	0.037
SSI	4.8%	10.6%	<0.001	9.2%	13.4%	0.036
Post-op sepsis	1.9%	3.0%	0.035	14.4%	14.2%	0.928
Post-op septic shock	0.5%	1.0%	0.115	4.6%	7.6%	0.047
Readmission	7.2%	12.4%	<0.001	14.9%	14.4%	0.865
LOS (days)	4.4±3.3	6.1±4.0	<0.001	10.8±6.3	12.0±6.7	0.003

Conclusions: Compared to the open approach, laparoscopic surgery for acute diverticulitis among elderly patients is associated with less morbidity, fewer SSIs, less post-operative septic shock and shorter LOS in both elective and non-elective settings. Laparoscopic surgery, when possible, should be considered as the preferred approach in elderly patients with acute diverticulitis.

S033

Classification and delineation of rectal tumours through artificial intelligence metabolic characterisation

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Introduction: Prompt and accurate classification of rectal tumour pathology, benign versus malignant, remains a challenge. Current real-time assessment methods such as narrow band imaging and confocal microscopy at endoscopy are inconsistent and colonoscopic biopsy is often inaccurate in lesions > 3 cm and may induce fibrosis and epithelial displacement (which has implications for further treatment options such as Transanal Minimally Invasive Surgery or Transanal Endoscopic Microsurgery). Imaging modalities such as computed tomography or magnetic resonance imaging are not useful in real-time and provide no information on tissue biology. Polyp characterization using artificial intelligence and dynamic fluorescence perfusion, detailing the impedance to flow as a core cancer characteristic, may provide a solution to these issues.

Methods: Biophysics perfusion parameters were studied prospectively in 20 patients to develop algorithmic capability of in situ digital classification of benign versus malignant disease through inflow phase analysis of indocyanine green (ICG) with multispectral endoscopy. Time-fluorescence plots for all rectal lesions, as well as regions of healthy control tissue, were extracted for algorithmic analysis. Algorithms were validated in 40 additional patients enabling optimization of real-time classifying parameters with indicative boundary delineation of smaller lesions deemed suitable for local resection by heatmapping. Microscopic confirmation of intra-tumoural ICG localization over time was performed in a subgroup using fresh frozen tissue sections with Hoescht nuclear staining. In vitro studies of both HT29 cell lines and spheroids determining intracellular ICG distribution was also performed.

Results: Rectal tumor characterization was highly sensitive (> 90%) by dynamic modelling in the 60-patient cohort. Simplified perfusion parameters (relating to fluorescence inflow and decay) equaled more complex detailing accuracy (modelled on extensive biophysical properties of perfusion through tissues) with less computational effort. Determinant boundary delineation by such metabolic characterization enabled delineation protocol development in ten selected patients. On microscopic examination, ICG signal was significantly greater intra-tumourally than compared to adjacent benign tissue($p < 0.05$). ICG predominantly distributed microscopically within tumor stroma in the early phases (15 min after systemic administration) but was also shown to transfer intracellularly in vitro within similar timeframes.

Conclusion: Metabolic hallmarks of cancer can be used to classify rectal tumours with high accuracy, explainability and interpretability. Confident labelling of rectal lesions at the time of first clinical encounter would permit the expedition of appropriate definitive care, including local excision. Furthermore, boundary delineation to ensure marginal clearance is feasible. International, multicentred clinical trials(including randomization) to confirm generalizability and clinical usefulness are now planned.

S042

The rising tide of revisional surgery: tracking changes in index cases among bariatric accredited fellowships

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Introduction: Over the last three decades, the field of bariatric surgery has seen peaks and troughs in the types of weight loss procedures performed. Our primary aim was to evaluate the metabolic and bariatric case volumes amongst fellows enrolled in Fellowship Council (FC) bariatric fellowships. Our secondary aim was to assess trends for fellowship programs performing revisional surgery.

Methods: We reviewed de-identified FC case logs for all bariatric accredited programs from 2010 through 2019 academic year. Only clinically active fellows who performed at least 100 procedures were included. The number of primary sleeve gastrectomy, gastric band, gastric bypass, biliopancreatic diversion and major revisional bariatric surgeries (defined as a revision with creation of a new anastomosis) were graphed for each academic year (Figure 1). The fellows were stratified into quartiles based on the number of revisional operations performed per year and graphed over ten years (Figure 2). Volumes of primary gastric bypass, major revisions, and total anastomotic cases were compared over time using ANOVA with $p < 0.05$ considered significant.

Results: Our study included 822 fellows. Sleeve gastrectomy had a significant surge in fellowship training in 2010 and began to plateau in 2015. It continues to be the most common procedure among bariatric surgeries performed by fellows. The number of primary (non-revisional) Roux-en-Y gastric bypasses performed by fellows showed a non-significant decrease from 84 to 75 cases/fellow from 2010 to 2019. This decrease was offset by a significant increase in major revisional surgeries over the 10 years from 8 to 19 revisional cases/fellow. As a result, the number of anastomotic cases did not change significantly over time. Interestingly, as revisional volume has grown, the gap between quartiles of fellowship programs has widened with the 95th percentile growing at a much faster rate than lower quartiles.

Conclusions: Procedures performed in the last decade during fellowship training in bariatric programs follow similar trends to bariatric MBSAqip data. Sleeve gastrectomy is the most commonly performed surgery although primary gastric bypass remains a close second. The number of major revisional cases has more than doubled over this time period, with the most robust growth isolated to a small number of programs. As revisional surgery continues to increase, applicants interested in a comprehensive bariatric practice should seek out training programs that offer strong revisional experience.

Figure 1

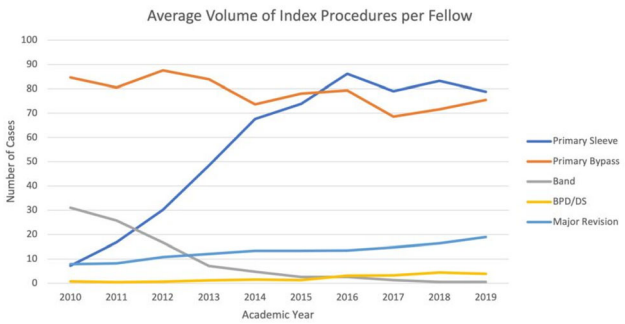
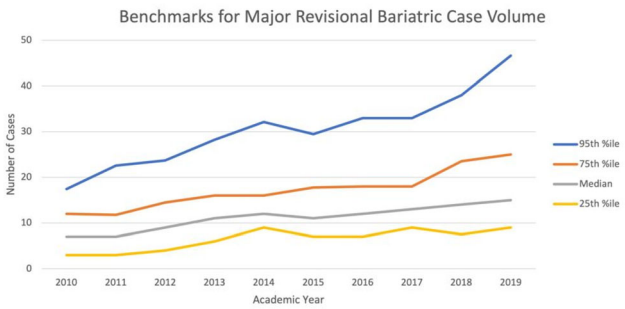


Figure 2



S043

A needs assessment for patient centered education and outcome metrics in robotic surgery

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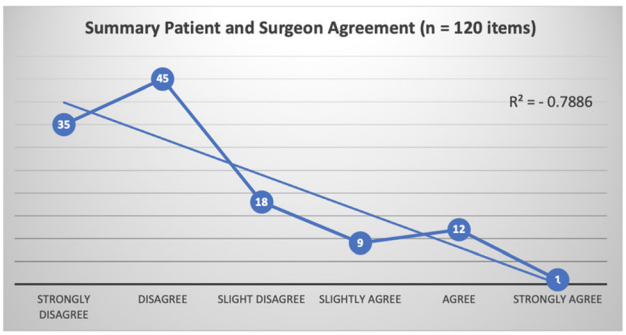
Background: There is an international emphasis on including patient related outcome (PROM) and experience metrics (PREMS) in the processes of care to improve surgical quality. From clinical experience, many patients undergoing robotic assisted surgery (RAS) have a poor understanding of the technology. To ensure true informed consent and appropriate patient expectations with robotic procedures, a needs assessment for patient-centered education and outcome metrics in RAS is warranted. The goal of this study was to perform an assessment of patient understanding, comfort with robotic technology, and ability to obtain critical information from their surgeon when planned to undergo RAS.
Methods: Twenty consecutive patients planned for RAS by three separate surgeons were asked to complete a survey prior to signing informed consent. At this point, the surgeons had explained their treatment plan and solicited questions. A 6-item Likert agreement scale was used to capture responses. The same study coordinator administered all surveys, while the surgeon stepped out of the room. Indicator statements were crafted to reduce bias and two-way evaluated for consistency. The surgeons were additionally asked their perception of each patient's understanding and comfort with RAS. Frequency statistics and tendencies were analyzed.
Results: All 20 patients completed the survey. Patients were predominately not familiar with RAS and their surgeon did not explain exactly how RAS worked. There were widely variable responses on if the patient currently understood how RAS worked for their treatment. The tendency was overwhelming that patients were not completely comfortable with RAS for their care, did not understand the risks of RAS compared to other surgical approaches, and did not feel their surgeon understood the information they needed about RAS to make treatment decisions. The surgeons strongly agreed 100% of patients appropriately understood how RAS functioned and would ask more questions before signing consent, if needed. There was strong discord between the surgeon's expectations of their patient's understanding and comfort of RAS.



Conclusions: This needs assessment demonstrated critical gaps in patient knowledge about RAS, surgeon communication skills, and the ability of surgeons to know what was important from the patient perspective. The development of patient-centered education and outcome metrics in RAS could help address these precarious gaps.

S044

Cost analysis of training residents in robotic assisted surgery

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Introduction: Robotic assisted surgery is increasing, and resident involvement may lead to higher cost. We investigated whether senior resident involvement in noncomplex robotic cholecystectomy (RC) and inguinal hernia (RIH) would take more time and cost more when compared to non-robotic cholecystectomy (NRC) and inguinal hernia repair (NRIH).
Methods: We extracted operative time and total cost of NRC, NRIH, RC, and RIH from 07/2016 to 06/2020 with senior resident (PGY4-5) involvement. We excluded complex cases as well as prisoner cases and those with new faculty and research residents. We assessed differences between robotic and non –robotic cases in operative time and total cost per minute, using one-way ANOVA.
Results: We included 1608 cases (non-robotic 1145 vs. robotic 463). On average, RC cases with a senior resident took less time than NRC ($179.4 < 185.8$, $p = 0.401$); operative time of RIH cases was similar with NRIH cases (Table 1). The total cost per minute of RC cases with a senior resident on average was $9.30 higher than NRC cases for each minute incurred in the operating room, but did not lead to a significant change in overall cost. RIH cases, on the other hand, costed less per minute than NRIH cases ($114.1 < 126.5$, $p = 0.399$).
Conclusions: Training in robotic surgery is necessary. Noncomplex RC and RIH involving senior residents were not significantly longer nor did they incur significantly more cost than non-robotic procedures. Senior resident training in robotic surgery can be efficient and should be included in the residency curriculum and training portfolio.

Table 1. Comparisons of Operative Time and Total Cost/Minute of Case with Senior Resident

Category	Non-Robotic Cases		Robotic Cases		Difference*	P value^
Chole	N	Mean (95%CI)	N	Mean (95%CI)		
Operative Time (min)	825	185.8 (179.8, 191.9)	165	179.4 (165.8, 193.1)	-6.4	0.401
Total Cost/Minute ($/min)	825	117.5 (105.5, 129.5)	165	126.8 (99.9, 153.7)	9.3	0.536
Inguinal Hernia						
Operative Time (min)	320	188.1 (178.0, 198.2)	298	187.6 (177.1, 198.1)	-0.5	0.942
Total Cost/Minute ($/min)	320	126.5 (106.5, 146.4)	298	114.1 (93.4, 134.8)	-12.4	0.399

Note: * Difference = Robotic value – Non-robotic value. ^P<0.05 is defined as statistical significance.

S045

Implementation of entrustable professional activities into fellowship council accredited programs—a pilot project

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Objective: The Fellowship Council (FC) is transitioning to a competency-based medical education model. This includes the introduction of Entrustable Professional Activities(EPAs) for training and assessment of Fellows. This study describes the implementation process employed by the FC during a ten-month pilot project and presents data regarding feasibility and perceived value.
Methods: The FC coordinated the development of EPAs in collaboration with the sponsoring societies for Advanced GI/MIS, Bariatrics, Foregut, Endoscopy and Hepatopancreaticobiliary(HPB) fellowships encompassing the preoperative, intraoperative, and postoperative phases of care for key competencies. During the 2020–21 academic year, 15 accredited fellowship programs participated in a pilot project to implement EPAs. The assessments were collected through a unique platform accessed through the FC website. The evaluation could be initiated by either fellow or faculty, but both were required for a complete assessment. Pilot programs were asked to convene a Clinical Competency Committee(CCC) on a quarterly basis. The pilot group met monthly to support and improve the process. An exit survey evaluated the perceived value of EPAs.
Results: The 15 participating programs included 18 fellows and 106 faculty. Program designations included: Advanced GI/MIS(6), Advanced GI/MIS/Bariatric(3), Advanced GI/MIS/Bariatric/Foregut(2), Advanced GI/MIS/Foregut(1), Foregut/Flex Endo(1), Advanced GI(1) and HPB(1). A total of 655 assessments were initiated with 429(65%) completed. The average(SD) number of EPAs completed for each fellow was 24(18); range 0–72. Intraoperative EPAs were preferentially completed (71%) compared to the preoperative(15%) and postoperative(11%) phases. The average(SD) time for both the fellow and faculty to complete an EPA was 27(78) hours. Engagement increased from 39% of fellows completing at least one EPA in September to 72% in December and then declined to 50% in May. Entrustment level increased throughout the year from 6% of EPAs evaluated as "Practice Ready" in September to 75% in June. The exit survey was returned by 59/94 faculty(63%) and 13/18 fellows(72%). Of faculty, 53% agreed that EPAs helped identify areas for improvement and 69% of fellows agreed that feedback from CCC was valuable. Having to request and complete EPAs was viewed as an administrative burden by fellows but not faculty. Overall, 46% of fellows and 74% of program directors recommended full-scale implementation of the EPA framework.
Conclusion: A competency-based assessment framework was developed by the Fellowship Council and piloted in several programs. Participation was variable and required ongoing strategies to address barriers to implementation. There was overall agreement by respondents that EPAs should be incorporated across all FC training programs.

S046

The robot doesn't lie: real-life validation of robotic performance metrics

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Introduction: Degree of resident participation in a case is often used as a surrogate marker for operative autonomy, an essential element of surgical resident training. Previous studies have demonstrated a considerable disagreement between the perceptions of attending surgeons and trainees when it comes to estimating operative participation. The Da Vinci Surgical System dual console interface allows machine generated measurements of trainee's active participation, which has the potential to obviate the need for labor intensive direct observation of surgical procedures by a third-party observer. However, the robotic metrics require additional validation and analysis against surgeon and objective third-party direct observation. We present a comparison of operative participation as perceived by the resident, faculty, trained research staff observer (gold standard), and robotic machine generated data.
Methods: A total of 28 robotic inguinal hernia repair procedures were observed by the research staff. Operative time, percent active time for the resident, and number of handoffs between the resident and attending were recorded. Attending evaluations and resident self-evaluations of operative performance and their perceptions of percent active time for the resident were collected using standardized forms. Robot generated console data was extracted to evaluate time active on the trainee console and compared against the research staff record. Wilcoxon two-sample tests and Pearson Correlation coefficients statistical analysis were performed.
Results: Robotic inguinal hernia repair cases had a mean operative time of 89.68 (30.4) minutes and an attending-rated mean difficulty of 3.1 (1.26) out of 5. There was a mean of 9.71 (5.11) handoffs between faculty and trainee, and residents were recorded to be the active surgeon 66.12% (19.53) of the total case time. The robotic machine generated data demonstrated the highest accuracy when compared to the gold standard (research staff observed data), with $r = 0.98$, $p < 0.0001$. Resident reported ($r = 0.66$, $p = 0.0001$), and faculty reported ($r = 0.55$, $p = 00.22$) perceptions of resident active operative time were far less accurate.
Conclusion: Our findings suggest that robot-generated performance metrics are an extremely accurate and reliable measure of intraoperative resident participation indicated by a very strong correlation with the data recorded by research staff's direct observation of the case. Residents demonstrated a more accurate awareness of their degree of participation compared with faculty surgeons. With high accuracy and ease of use, robotic surgical system performance metrics have the potential to be a valuable tool in surgical training and skill assessment.

S047

Introducing artificial intelligence to laparoscopic simulation skills training: can it help assessment?

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Introduction: An important limitation to expanding robust laparoscopic simulation training programs with ongoing learning is the low availability of expert trainers. In 2017 a new platform for remote and asynchronous simulation training in laparoscopy was developed, called LAPP. This platform is now used in 14 cities across 8 countries and has collected over 5,500 videos of laparoscopic training exercises. The use of artificial intelligence (AI) has emerged over the past decade in surgical simulation, showing usefulness in the assessment of training, virtual reality scenarios, and laparoscopy virtual reality simulation. Our team developed an algorithm of AI to assess basic laparoscopic training exercises. The aim of this study was to analyze the concordance between this AI algorithm and expert trainers in the assessment of basic laparoscopic training exercises.

Methods and Procedures: An AI algorithm to assess basic laparoscopic exercises was developed using: Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology, Python programming language, and PyTorch as a deep learning library. A segmentation model was elaborated using U-NET for grasper tracking and YOLO V4 for element, receptacle and pin detection. To train the algorithm a total of 400-bean drop (BD) and 400-peg transfer (PT) videos were used. Both exercises involve using laparoscopic graspers to move objects across an acrylic board without dropping any objects. This algorithm can detect object movement, identify if objects have fallen, and can measure exercise time, understanding when to start/end the timer; from the first to the last contact between the graspers and the objects.

Results from AI were compared to the assessments performed by a team of expert evaluators from the LAPP platform using Cohen's Kappa to evaluate the degree of agreement between both evaluating groups.

Results: The algorithm achieved a 98% precision index for grasper-arms location and 62% accuracy for grasper-clamps. After the algorithm was trained, 64 BD and 43 PT videos were randomly selected for analysis. When comparing both assessments, 76.5% and 86.1% of agreement was observed in BD and PT, respectively. The Kappa coefficients observed for BD and PT were: 0.55 (moderate agreement) and 0.72 (substantial agreement), respectively.

Conclusion: This first approach of AI use in the LAPP training system shows promising results in simulated laparoscopic training and provides a preliminary framework through which to expand the use of AI to other exercises learned through LAPP. However, further improvement of the AI algorithms is needed in order to achieve higher agreement accuracy.

S048

Gamification of robotic simulation to train general surgery residents

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Introduction: The incorporation of gamification concepts into robotic simulation training may increase participation and improve performance of general surgery residents on the robotic simulator. Gamification applies game design elements to non-game contexts in order to engage participation and increase learner motivation. Robotic surgery is gaining popularity in general surgery but requires specialized technical skills. We sought to determine whether gamification of robotic simulation training could increase robotic simulator utilization among general surgery residents.

Methods and Procedures: General surgery residents (n = 15) were recruited under IRB approval. Participants were sent weekly progress on simulator performance including leaderboards for 4 weeks during the intervention periods. There were also two control periods setup in an ABAB study design. Usage time and mean scores were compared between the control periods and intervention periods.

A post study qualitative assessment interview using semi-structured interviews determined barriers and motivational components of simulator usage.

Results: 15 general surgery residents enrolled in the study (n = 15). Intervention increased total simulator usage time 9.7-fold from 153 to 1485 min. Total simulator days increased threefold from 9 to 27 days. Resident participation increased from 33 to 53%. Median average scores were higher during the intervention periods (58.8 and 81.9 vs 44.0). During the first intervention period, median individual-level simulator usage time increased 17 min (p = 0.03). However, there was no individual-level increase in median usage minutes or days during the second intervention period.

Qualitative assessment determined barriers to be limited time due to clinical duties, and simulator availability while motivational factors included competitive factors such as leaderboards and gaming aspects. Potential improvements were increasing attending visibility of scores to increase recognition of progress by the residents and creating dedicated time for training.

Conclusion: Gamification of robotic simulation training increased general surgery resident participation, usage time and scores. Impact was not durable. Instituting dedicated practice time and more attending engagement may increase trainee motivation and performance.

S049

Validity of video-based generic and procedure-specific self-assessment tools for surgical trainees in laparoscopic cholecystectomy

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Introduction: Self-assessment and reflection using video recordings of surgical procedures offers new opportunities for trainees to extend technical learning outside the operating room. However, systematic reviews report mixed results regarding the accuracy of trainee self-assessments. Valid tools for performance self-assessment are required in order to evaluate the effectiveness of video review in enhancing technical learning by trainees. Therefore, we aimed to investigate the validity of intra-operative assessment tools for video-based self-assessment by general surgery trainees in laparoscopic cholecystectomy.

Methods and procedures: Using a web-based platform, general surgery trainees in a university-based residency program submitted video recordings of laparoscopic cholecystectomy procedures where they acted as the supervised primary surgeon. Operative performance was measured by the attending surgeon at the time of surgery using generic and hybrid (combined generic and procedure-specific) assessments (GOALS and OPRS, respectively) and with the O-SCORE Entrustability scale. Trainees later reviewed their videos for self-assessment using the same instruments. Validity of GOALS and OPRS as self-assessment tools were investigated by testing the hypotheses that self-assessment scores correlate with (H1) expert assessment scores (H2) O-SCORE (H3) procedure time, and that (H4) self-assessment based on these instruments differentiates junior (postgraduate year (PGY)1–3) and senior trainees (PGY4-5), as well as (H5) simple (Visual Analogue Scale (VAS) ≤ 4) versus complex cases (VAS > 4). Hypotheses 1–3 were tested using Spearman's rank Correlation and Hypotheses 4–5 using multiple linear regression. All hypotheses were based on previous literature, defined a priori, and were tested according to the COSMIN consensus on measurement properties.

Results: 35 videos were submitted and self-assessed by 11 trainees (32% female and 51% senior trainees). The data supported 2 out of 5 hypotheses (H1 and H4) for the GOALS tool and 3 out of 5 hypotheses (H1, H4 and H5) for the OPRS tool for video-based self-assessment by trainees in laparoscopic cholecystectomy.

Conclusions: OPRS, a hybrid operative assessment tool, was better able to differentiate between groups expected to have different levels of intraoperative skills, compared to GOALS, a generic assessment tool. Given the interest in video-based learning, there is a need to further develop procedure-specific assessment tools to support video-based self-reflection by trainees.

S050

Comparative analysis of laparoscopic versus robotic inguinal hernia repair: 8-year experience

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Background: Minimally invasive inguinal hernia repair (IHR) has gained increasing popularity among surgeons. Although the advantages of laparoscopic IHR (LIHR) have been described, guidelines regarding robotic IHR (RIHR) have yet to be established, despite its increased adoption as a minimally invasive alternative. Studies comparing LIHR and RIHR have shown no major differences regarding early clinical outcomes. This study compares the largest single-center cohorts of LIHR and RIHR and aims to shed light on the differences in mid-term outcomes between these two techniques.

Methods: Patients who underwent LIHR or RIHR over an 8-year period were included as part of a retrospective analysis. Variables were stratified by preoperative, intraoperative, and postoperative timeframes. Complications were listed according to the Clavien-Dindo classification system, and patients were assigned morbidity scores using the Comprehensive Complication Index (CCI®). The study groups were compared using univariate analyses as well as Kaplan–Meier's time-to-event analysis.

Results: A total of 1153 patients underwent minimally invasive IHR between 2012 and 2020. From these, 606 patients underwent LIHR while 547 underwent RIHR. While demographics and comorbidities were similar between the groups, the American Society of Anesthesia (ASA) scores were higher in the robotic group. The RIHR group also included a higher proportion of recurrent hernias. Operative times were in favor of LIHR (42 vs. 53 min, $p < 0.001$), while RIHR had a smaller number of peritoneal breaches (0.4 vs. 3.8%, $p < 0.001$) as well as conversion to other approaches (0.2 vs. 2.8%, $p < 0.001$). There were no differences between groups regarding the number of patients lost-to-follow-up or the average follow-up times ($p = 0.821$ and $p = 0.304$, respectively). Regarding postoperative complications, no differences were found between groups in terms of prolonged pain/discomfort ($p = 0.968$), but more patients in the LIHR group required interventional therapy under local or general anesthesia for pain management ($p = 0.013$). Although the CCI® scores did not differ between the two groups (media $n = 0$, $p = 0.380$), Grade-IIIB complications (1.2 vs 3.3%, $p = 0.025$) and recurrences (0.8 vs 2.9%, $p = 0.013$) were in favor of RIHR. Furthermore, estimated recurrence-free time was higher in the RIHR group [$p = 0.032$; 99.7 months (95%CI = 98.8–100.5) vs 97.6 months (95%CI = 95.9–99.3).

Conclusion: This study demonstrated that RIHR may confer advantages over LIHR in terms of reduced operative conversion rates and recurrence rates while confirming previous studies showing prolonged operation times. However, further large-scale prospective studies and randomized controlled trials are needed to validate these findings and better understand whether RIHR offers substantial clinical benefits compared with LIHR.

S051

Hospital level variation in mesh use for ventral and incisional hernia repair

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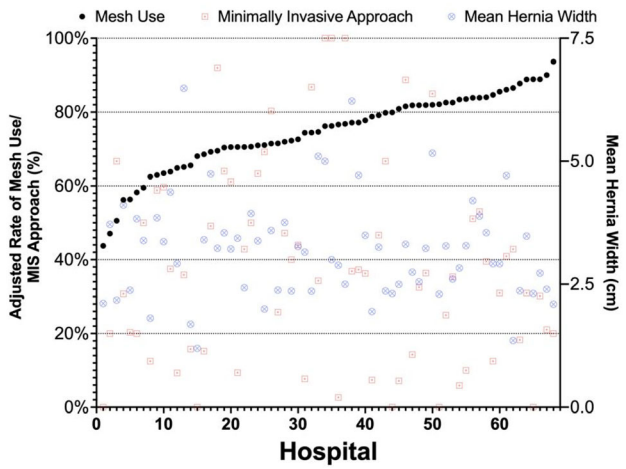
Introduction: Placement of prosthetic mesh during ventral and incisional hernia repair has been shown to reduce the incidence of postoperative hernia recurrence. Consequently, multiple consensus guidelines recommend the use of mesh for ventral hernias of any size. However, the extent to which real-world practice patterns reflect these recommendations is unclear.

Methods: We performed a retrospective review of the Michigan Surgical Quality Collaborative Hernia Registry to identify patients undergoing clean ventral or incisional hernia repair between January 1, 2020 to March 1, 2021. The primary outcome was mesh use. To investigate variation in mesh use between hospitals, two-step statistical modeling was used to calculate the risk- and reliability-adjusted rate of mesh use while accounting for differences in hospital case mix. First, a multivariable logistic regression was performed to estimate the risk-adjusted rate of mesh use while controlling for patient characteristics such as age, sex, body mass index, and comorbidities, as well as technical characteristics such as hernia location, size, prior repair, and surgical approach. Second, these estimates were included in a mixed effects logistic regression model with hospital-level random effects to calculate empirical Bayes predictions of hospital-level mesh use.

Results: A total of 3,063 patients underwent ventral and incisional hernia repair at 68 hospitals with a mean age of 53.5 (14.6) years, 1,388 (45.3%) females, and a mean hernia width of 3.3 (3.5) cm. Mesh was used in 2,332 (76.1%) cases. At the patient level, the strongest predictors of mesh use were hernia width and surgical approach. Specifically, mesh use was 5.0% (95% CI 3.5%-6.4%) more likely with each centimeter of hernia width and 30.4% (95% CI 28.1%-32.8%) more likely for minimally invasive repair compared to open repair. Despite these associations, there was significant variation in mesh use across hospitals, ranging from 43.8% (95% CI 26.3%-63.0%) to 93.7% (95% CI 88.2%-96.7%), that was not associated with hospital-level differences in hernia size (β = -0.01, p = 0.561) or surgical approach (β = 0.02, p = 0.753) (**Figure**).

Conclusions: Despite evidence supporting the use of mesh in ventral and incisional hernia repair, there is substantial variation in mesh use between hospitals. Importantly, this variation is not explained by differences in hernia characteristics or operative approach between hospitals. This suggests that opportunities exist to standardize surgical practice to better align with the evidence supporting the use of mesh in ventral and incisional hernia repair.

Figure—Variation in hospital-level mesh use, hernia size, and surgical approach.



S052

Incidence of incisional hernia repair after kidney transplantation

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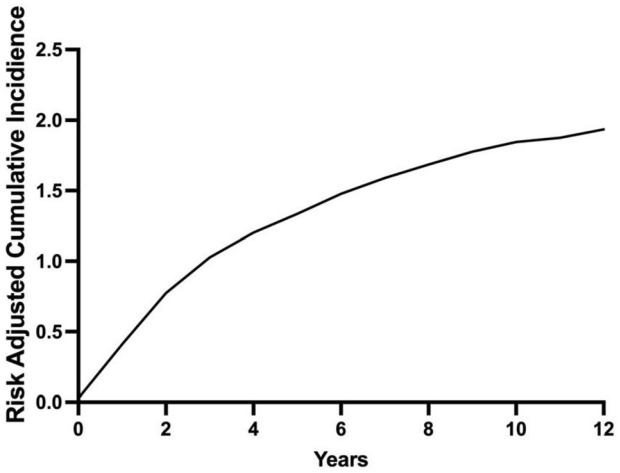
Introduction: As survivorship following kidney transplant continues to improve, so does the probability of intervening on common surgical conditions, such as incisional hernia, in the transplant population. The population-level incidence of incisional hernias following transplant remains unknown, however, limited data suggest outcomes of hernia repair are highly morbid and variable. In this context, we sought to examine the incidence of hernia repair after kidney transplant using a Medicare claims data set.

Methods: We performed a retrospective review of 100% inpatient Medicare claims to identify patients who underwent kidney transplant between 2007–2018 using appropriate diagnostic and procedure codes. The primary outcome was the incidence of hernia repair and time to repair after kidney transplant. Patients with multiple recurrences were also identified. The risk-adjusted cumulative incidence of reoperation for incisional hernia was calculated up to 12 years after surgery using patient, age, sex, race, and Elixhauser comorbidities to perform risk adjustment.

Results: A total of 139,751 patients underwent kidney transplant during the study period. The mean (SD) age of the cohort was 52 (14) and 61% were female. The overall median time to follow up was 5.4 years. A total of 2218 (1.6%) patients underwent incisional hernia repair after kidney transplant. The median time to hernia repair was 1.2 years. After adjusting for patient demographics and comorbidities, the risk-adjusted cumulative incidence of incisional hernia repair at 12 years after kidney transplant was 1.91% (95% CI 1.89–1.93%) (Figure). Among those that underwent hernia repair, 240 (11%) had 1 recurrence, 69 (3%) had 2 recurrences, and 25 (1%) had 3 + recurrences.

Conclusions: In a large cohort of Medicare patients undergoing kidney transplant, the incidence of hernia repair was uncommon and for some patients, the time to hernia repair was within the first year post-transplant suggesting the potential of a technical component driving recurrence in addition to patient factors. Future work will examine the operative outcomes and evaluate hospital and surgeon level variation of hernia repair incidence in this vulnerable population.

Figure Risk-adjusted cumulative incidence of hernia repair post-kidney transplant.



S053

Can fibrin glue replace drains for abdominal wall reconstruction?

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Introduction: Surgical site infections (SSI) account for 20% of hospital acquired infections. Drains are often used to minimize fluid collections and SSIs after abdominal wall reconstruction (AWR). However, drains can negatively impact a patient's recovery and potentially worsen infection in some cases. Fibrin glue has been increasingly used during AWR for hemostasis and mesh fixation. It is unknown if fibrin glue use can eliminate drains in retromuscular AWR. This study aims to identify whether the use of fibrin glue fixation with mid-weight polypropylene mesh without drains is associated with a significant difference in 30 day wound events compared to retromuscular drain use without fibrin glue.
Methods: We retrospectively identified adult ventral hernia patients undergoing elective AWR using mid-weight polypropylene mesh within the Abdominal Core Health Quality Collaborative (ACHQC). Patients with fibrin glue fixation without drains (FG group) were compared to patients with retromuscular drains without fibrin glue (RD group). The primary outcome measure was SSI rate at 30 days with a secondary outcome of 30-day SSOPI (surgical site occurrence requiring procedural intervention). Chi-square tests were used to test SSI/SSOPI for each group. Adjusted analysis was obtained using logistic regression.
Results: 2804 patients were identified: 149 FG and 2655 RD. Patients were mostly White (86%) and female (53%). The mean body mass index was 32.19 kg/m^2. Unadjusted analyses show a higher rate of post-op complications in RD group (25%) compared to FG (15%) ($p = 0.01$), but no evidence of a difference in SSI (RD 5.2%, FG 2.0%, $p = 0.09$) or SSOPI rates (RD 6.4%, FG 3.4%, $p = 0.14$). No difference in reoperations were found (FG 1.3%, RD 2.0%, $p = 0.57$). In adjusted analysis RD was not associated with an increased odds for SSI compared to FG (OR 1.38 (95% CI 0.42–4.54)). A similar finding was noted for SSOPI (OR 0.93 (95% CI 0.37–2.39). Increased hernia width and history of abdominal wall SSI were associated with higher odds of SSI and SSOPI.
Discussion: Fibrin glue fixation of mid-weight polypropylene mesh without drains used in AWR results in comparable wound complications as traditional retromuscular drains. Minimizing drain use can lead to less pain and better patient satisfaction after AWR.

S055

Ventral hernia mesh use in women of childbearing age

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Introduction: A substantial knowledge gap exists in understanding sex as a biological variable for abdominal wall hernia repair, which also extends to hernia repair practices in females of childbearing age. Recent qualitative work has demonstrated variation in surgeon attitudes towards repair in this population, specifically with regards to mesh utilization. How these motivations and beliefs impact practice remains unknown. In this context we sought to determine practice patterns of mesh use for this population using a clinically nuanced population-level hernia registry.
Methods and procedures: Using the Michigan Surgical Quality Collaborative Hernia Registry (MSQC-HR), we conducted a retrospective study identifying females of childbearing age, defined as 18–44 per CDC guidelines, who underwent clean ventral hernia repair (VHR) between January 2020-March 2021. The primary outcome was mesh use. Multivariable logistic regression was used to examine factors associated with mesh use, including demographics, comorbidities, hernia characteristics, and emergent vs elective surgical priority. To further delineate whether childbearing status may affect decision to use mesh, we also examined mesh practice stratified by age, comparing women 18 to 44 to those 45 and older.
Results: Among 508 females of childbearing age, 70.3% identified as white and the median age was 35 years. Mesh was used in 333 (65.6%) patients. Mesh use was significantly associated with minimally invasive approach (OR 32.2, 95% CI 14.01–74.03), increasing body mass index (OR 1.06, 95% CI 1.03–1.10, for each additional 1 kg/m^2), and increasing hernia size (OR 1.27, 95% CI 1.07–1.149, for each additional 1 cm). Importantly, age was not associated with mesh placement (OR 1.01, 95% 0.99–1.02; Figure 1). Compared to 875 women aged 45 and older, females of childbearing age did not have lower odds of mesh placement (OR 1.03, 95% CI 0.59–1.82).
Conclusions: The majority of females of childbearing age had mesh placed for VHR, which was driven primarily by hernia size, BMI, and surgical approach. Patient age was not associated with mesh use, with no difference in mesh use identified between females of childbearing age compared to older women. Insofar as existing evidence suggests that childbearing status is an important factor in deciding whether to use mesh, these findings suggest that real-world practice does not reflect that evidence. More research is needed to determine patient and surgeon factors contributing to surgeon decision-making in this understudied population.

S056

Development of a predictive model for unplanned Intensive Care Unit admission after pancreatic resection within and enhanced recovery pathway

Giovanni Guarneri; Mariateresa Salvioni; Stefano Turi; Pietro Barbieri; Alessia Vallorani; Domenico Tamburrino; Luigi Beretta; Massimo Falconi; Nicolò Pecorelli; IRCCS San Raffaele, Milan, Italy

Background: Postoperative admission to intensive care unit (ICU) is considered as an important component to a safe and effective pathway for prevention, early recognition and timely management of life-threatening perioperative complications. However, it is unclear whether the routine use of ICU can improve postoperative outcomes for patients undergoing elective pancreatic surgery. Aim of the study was to determine preoperative and intraoperative predictors of unplanned ICU access in patients undergoing pancreatectomy.
Methods: A retrospective single-center observational study was conducted on adult patients who underwent pancreatic resection (2015–2019) within an established enhanced recovery pathway. Multiple multivariate logistic regression models were constructed to verify the association of preoperative and intraoperative variables with study outcomes. Performance of multivariate models was assessed by computing the area under the receiver operating characteristic curve (AUC).
Results: The study included 1486 consecutive patients (pancreaticoduodenectomy 60%, distal pancreatectomy 29%; laparoscopic approach 20%; cancer diagnosis 60%). Vascular resection was performed in 138 (9%) patients, and multivisceral resection in 60 (4%) patients. Sixty-eight (4.6%) patients had an ICU access after surgery, of which 66 (4.4%) were unplanned. Early unplanned admission (within 48 h) occurred in 26 (39%) patients, while late ICU admission in 40 (61%) patients. Main reason for unplanned ICU admission included: hemorrhagic shock ($n = 29$, 50%), septic shock ($n = 11$, 17%), monitoring after reoperation ($n = 7$, 11%), respiratory failure ($n = 6$, 10%). A comprehensive model including preoperative and intraoperative variables identified ASA score > 3 (OR 5.59, p-value < 0.001), history of hypertension (OR 2.29, $p = 0.029$), history of chronic obstructive pulmonary disease (OR 3.05, $p = 0.026$), proximal pancreatic resection (OR 2.79, p-value 0.046), multi-visceral resection (OR 8.86, p-value < 0.001), high intraoperative blood loss (OR 1.01 per ml, $p < 0.001$), and increased serum lactate at the end of surgery (OR 1.25, $p = 0.017$) as independent factors associated with ICU admission. The model yielded an AUC of 0.891. A model including only preoperative parameters (older age, ASA score > 3, chronic obstructive pulmonary disease) showed a lower AUC of 0.707.
Conclusion: Patient comorbidities, surgical complexity and lactic acidosis at the end of surgery are associated with unplanned postoperative ICU admission. Our findings suggest that patients with comorbidities and additional intraoperative risk factors could benefit from upfront postoperative ICU admission to decrease the risk of complications and potentially improve postoperative outcomes. Patients with multiple preoperative risk factors may also represent a target for prehabilitation strategies.

S057

Textbook outcomes and benchmarks of minimally-invasive left lateral sectionectomy across North-America

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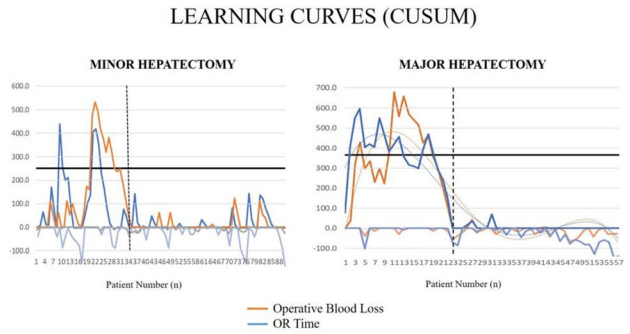
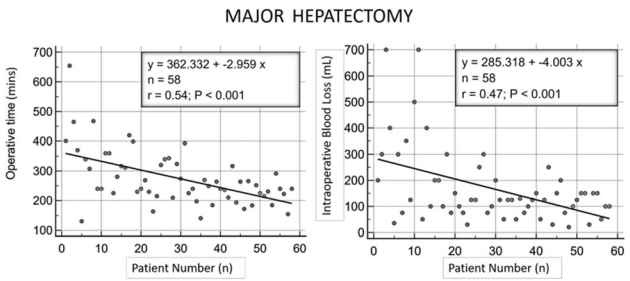
Background: Minimally-invasive approach represents the gold standard1 for the resection of the left lateral section of the liver. Recently, the American Minimally Invasive Liver Resection (AMILES) registry has become available to track outcomes of laparoscopic and robotic liver resection in the Americas.The aim of the present study is to determine the benchmark performance of MILLS throughout the AMILES database.
Methods: The AMILES registry was interrogated on cases of minimally invasive left lateral sectionectomies (MILLS). Centers with the best practice according to the achievement of textbook outcomes (TO) were identified and were used to define benchmark performances2-6.
Results: Eight institutions from US and Canada entered 1665 minimally-invasive liver resections, encompassing 203 MILLS performed by six of them. Overall, 41% of cases of MILLS reached textbook outcomes. While all centers obtained TO with different rates of success, the outcomes of the two top-ranking centers were used for benchmarking.
Benchmark performance metrics of MILLS across North-America are: conversion rate $\leq 3.7\%$, blood loss ≤ 200 ml, OR time ≤ 199 min, transfusion rate $\leq 4.5\%$, complication rate $\leq 7.9\%$, mortality $\leq 0.7\%$, LOS ≤ 4 days.
Conclusion: Benchmark performances of MILLS have been defined on a large multiinstitutional database in North America. As more institutions join the collaboration and more prospective cases accrue, benchmark for additional procedures and approaches will be defined.

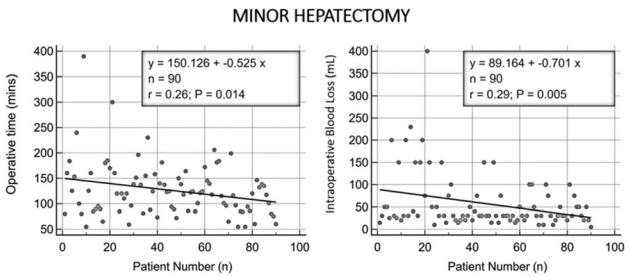
S058

Robotic major and minor hepatectomy: critical appraisal of learning curve and its impact on outcomes

Ali Ahmad, MD; Hadley Freeman, MD; Hillary Morrison, DO; Sarah D Corn, MD; University of Kansas-Wichita







	MINOR HEPATECTOMY			MAJOR HEPATECTOMY		
	Early (1-34)	Proficient (35-90)	*p*-Value	Early (1-22)	Proficient (23-58)	*p*-Value
OR TIME (MIN)	168 (55-300)	125 (55-230)	**0.014**	330 (148-655)	247 (141-393)	**0.0002**
BLOOD LOSS (ML)	115 (15-400)	54 (10-600)	**0.005**	242 (50-700)	118 (40-250)	**0.0004**
CONVERSION TO OPEN	0	1 (2%)		1 (4%)	0	
TUMOR MARGINS						
• POSITIVE	1 (3%)	1 (2%)		1 (4%)	1 (3%)	
• NEGATIVE	33 (97%)	55 (98%)		21 (96%)	35 (97%)	
LENGTH OF STAY (DAYS)	2.8 (1-7)	2.1 (0-6)	**0.021**	5.7 (3-11)	4.1 (2-8)	**0.004**
COMPLICATIONS*	1 (3%)	1 (2%)		5 (23%)	1 (3%)	**0.039**
DEATH	0	0		1 (4%)	0	
30-DAY READMISSION	1 (3%)	1 (2%)		1 (4%)	1 (3%)	

*CLAVIEN-DINDO GRADE III/IV

Objective: To evaluate the respective learning curves for robotic major (≥ 3 couinaud segments) and minor hepatectomy and the impact of such experience on peri-operative outcomes.

Background: Robotic hepatectomy has gained increased acceptance across the US. Although the robotic approach offers significant technical advantages, it is still bound by the individual surgeon's learning curve. Proficiency in this approach should theoretically lead to improved peri-operative outcomes.

Methods: Between 2017 and 2020, data on 148 consecutive robotic hepatectomies performed by a single surgeon was retrospectively analyzed. Using cumulative sum (CUSUM) method, intraoperative blood loss and operative time were used as parameters to assess learning curves for robotic major hepatectomy ($n = 58$) and minor hepatectomy ($n = 90$) patients. Perioperative outcomes were compared in regards to proficiency.

Results: Proficiency for robotic major and minor hepatectomy was achieved after 23 cases and 35 cases respectively. No significant differences were observed in patient demographics or tumor characteristics. For robotic major hepatectomy, when compared to early experience, proficiency was associated with a significant improvement in mean intraoperative blood loss (242 vs 118 mL, $p = 0.0004$), operative time (330 vs 247 min, $p = 0.0002$), decreased overall complication rate (23% vs 3%, $p = 0.039$) and length of hospital stay (5.7 vs 4.1 days, $p = 0.004$). No difference in conversion rate, mortality or 30 day readmission was seen. For robotic minor hepatectomy, proficiency was associated with significantly decreased mean intraoperative blood loss (115 vs 54 mL, $p = 0.005$), operative time (168 vs 125 min, $p = 0.014$) and length of hospital stay (2.8 vs 2.1 days, $p = 0.021$). No difference was observed in conversion rate, overall complications, mortality or 30-day readmission.

Conclusion: In the modern era, robotic hepatectomy offers a safe approach with excellent perioperative outcomes. However, learning curves for robotic major and minor hepatectomy can influence such outcomes. Results from our study can serve as a guide to surgeons and programs looking to adopt this technique.

S059

Comparison of postoperative outcomes in totally robotic vs open hepatectomy

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Objective: To compare postoperative length of stay, complication rate, and narcotic pain medication usage in totally robotic vs open hepatectomy procedures.

Background: Unlike many areas of surgery, hepatobiliary surgery has not seen wide adoption of laparoscopic minimally invasive surgery due to procedure complexity and concerns for bleeding. Robotic surgery provides solutions to these limitations, including improved wristed instrumentation and 3-D visualization. Robotic surgery is emerging as an innovative technique that enables minimally invasive liver resection without the need for large incisions or ribcage retraction.

Methods: This is a retrospective single-center study of robotic ($n = 89$) versus open ($n = 25$) hepatectomies performed at our academic center. Patient characteristics were equivalent in both groups (age, $p = 0.49$; sex, $p = 0.72$; body mass index, $p = 0.74$; cirrhosis, $p = 0.06$). Types of liver resections performed were also equivalent ($p = 0.43$) and included wedge resection, anatomical single segmental resection, anatomical 2–3 segmental resection, and major hepatectomy.

Results: Compared to those who underwent open liver resection, patients who underwent robotic hepatectomy had a significantly shorter post-operative length of stay (4.5 ± 3.10 vs 7.08 ± 6.95 days, $p = 0.01$). Robotic hepatectomy patients also had fewer overall

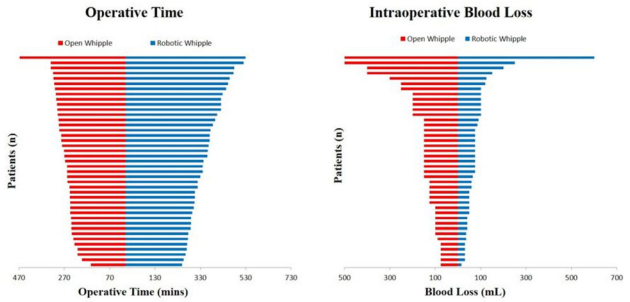
complications than open hepatectomy patients (13% vs 48%, $p = 0.0002$). Readmission rates for robotic hepatectomy patients were less than half that of open hepatectomy patients (4.5% vs 16%, $p = 0.03$). Additionally, robotic hepatectomy patients required less than half of the total narcotic dosage than open hepatectomy patients (37.42 ± 34.2 vs 93.08 ± 104.90 mg morphine-equivalent dose, $p = 0.0049$). Length of narcotic usage was also decreased for post-operative robotic patients (42.38 ± 26.09 vs 66.09 ± 25.65 h, $p = 0.016$). Finally, open hepatectomy patients were also significantly more likely to require an epidural post-operatively (76.92% vs 12.09%, $p < 0.00001$).

Conclusions: Patients who underwent robotic hepatectomy had fewer complications, reduced readmission rates, shorter postoperative lengths of stay, and decreased requirements for epidural placement and narcotic usage than conventional open hepatectomy patients.

S060

Robotic versus open whipple: a matched comparison of perioperative and short-term outcomes

Hadley D Freeman, MD; Sarah D Corn, MD; Ali Ahmad, MD; University of Kansas-Wichita



	Robotic (n=41)	Open (n=41)	p-value
Age (years)	69.7 (47-88) ± 9.88	69.41 (41-86) ± 10.91	0.899
Gender			
• Male (%)	18 (44%)	20 (49%)	0.652
• Female (%)	23 (56%)	21 (51%)	
BMI	26.0 ± 4.38	27.0 ± 4.89	0.332
ASA	2.7 ± 0.455	2.73 ± 0.44	0.762
Neoadjuvant Chemo	3 (7%)	4 (10%)	0.628
Pathology			Matched
• Ductal Adenocarcinoma	28 (68%)	28 (68%)	
• IPMN	4 (10%)	4 (10%)	
• Neuroendocrine Tumor	3 (7%)	3 (7%)	
• Ampullary Adenocarcinoma	2 (5%)	2 (5%)	
• Cholangiocarcinoma	1 (2.5%)	1 (2.5%)	
• Duodenal Adenocarcinoma	1 (2.5%)	1 (2.5%)	
• Other	2 (5%)	2 (5%)	
Tumor Size (cm)	3.11 ± 1.25	3.67 ± 1.56	0.078

	Robotic (n=41)	Open (n=41)	p-value
OR time (Min)	357.34 (248-528) ± 74.34	271.05 (152-467) ± 49.57	**<0.0001**
Blood Loss (mL)	89.15 (30-600) ± 92.41	172.93 (75-770) ± 105.15	**0.0003**
Tumor Margins			
• Positive	1 (3%)	1 (3%)	
• Negative	40 (97%)	40 (97%)	
Lymph Node Yield	23.68 (13-49) ± 8.16	24.95 (9-55) ± 9.75	
• Positive Nodes (Mean)	2.44 ± 3.41	3.00 ± 3.96	
Length of Stay (Days)	6.22 (3-15) ± 2.85	8.54 (5-19) ± 3.27	**0.001**
Complications	6 (14.6%)	17 (41.5%)	**0.007**
• POPF (Grade II/III)**	2 (4.88%)	3 (7.32%)	
• Delayed gastric emptying	1 (2.5%)	8 (19.5%)	**0.036**
• Hemorrhage	1 (2.5%)	1 (2.44%)	
• Atrial Fibrillation	1 (2.5%)	2 (4.88%)	
• Pulmonary Embolism	1 (2.5%)	0 (0%)	
• Pneumonia	0 (0%)	2 (4.88%)	
• Wound Infections	0 (0%)	7 (17.1%)	**0.006**
Death	0 (0%)	1 (2.88%)	
30-day Readmission	1 (2.88%)	7 (17.1%)	**0.033**

*Non-significant P-values not reported.
**Postoperative pancreatic fistula

Introduction: Robotic approach to pancreaticoduodenectomy appears to be safe, however debate still exists on its benefit over the traditional open approach. The complexity of the surgery paired with surgeon dependent learning curve poses significant hurdles to its widespread acceptance. The objective of our study is to derive a critical comparison of perioperative and short-term outcomes between robotic and open whipple procedure in matched patient cohorts.

Methods: Between 2018 and 2020, data on patients undergoing Robotic ($n = 41$) and Open ($n = 41$) pancreaticoduodenectomy was retrospectively analyzed after 1:1 individual matching. Matching was performed based on patient demographics and tumor characteristics. Univariate and multivariate comparisons were derived to compare perioperative and short-term outcomes between the two groups.

Results: After 1:1 matching, patient demographics and tumor characteristics between both groups were comparable as expected. Robotic pancreaticoduodenectomy (RPD) was similar to open (OPD) approach with regard to lymph node yield and pathologic tumor margins. Patients undergoing RPD had longer operative times (357 vs 271 min, $p < 0.0001$). Robotic PD was associated with decreased intra-operative blood loss (89 mL vs 173 mL, $p = 0.0003$) as well as lower overall complication rate (14.6% vs 41.5%, $p = 0.007$), which included lower rates of wound infection (0% vs 17%, $p = 0.0059$) and reduced rates of delayed gastric emptying (2.5% vs 19.5%, $p = 0.036$). Additionally, robotic approach was associated with significantly reduced length of hospital stay (6.22 vs 8.54 days, $p = 0.001$) and 30-day readmission rate (2.9% vs 17.1%, $p = 0.033$). Mortality rates were not statistically different between study groups. On multivariate analysis, RPD was independently associated with decreased overall complication ($p = 0.014$), shorter hospital length of stay ($p = 0.004$), and lower 30-day readmission rate ($p = 0.029$).

Conclusion: Our study is one of the largest series of matched comparison between robotic and open pancreaticoduodenectomy. The robotic approach appears to be safe and is associated with improved short-term outcomes as evidenced by decreased morbidity of wound infection and delayed gastric emptying, as well as decreased length of hospital stay and lower 30-day readmission rate.

S061

Management of clinically-relevant postoperative pancreatic fistula after distal pancreatectomy

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Background: The postoperative course of distal pancreatectomy (DP) is frequently influenced by clinically relevant pancreatic fistula (CR-POPF). Despite the use of peripancreatic drains, CR-POPF may lead to abdominal collections which often require additional treatment (antibiotics, percutaneous or endoscopic drainage), thus prolonging patient recovery. The aim of this study was to describe the management of CR-POPF and identify factors associated with the need for interventional procedures for CR-POPF.

Methods: A retrospective study was performed in patients who underwent DP between 2015 and 2020. Preoperative patients' characteristics and perioperative variables were reviewed. Indications for percutaneous or endoscopic drainage were discussed in multidisciplinary fashion, based on patient clinical status and CT-scan findings. Factors correlated with CR-POPF and variables influencing operative versus non-operative management were evaluated.

Results: Overall 518 patients were included in the study. Median [IQR] patient age was 64 [53–75] years, 57% were female, 29% had an ASA score of 3, 40% had pancreatic cancer. Minimally invasive approach was successfully carried out in 56% patients. Median length of hospital stay was 7 [6–9] days. At 90-days after surgery, CR-POPF occurred in 208(40%) patients. Of these patients, 173(83%) were discharged carrying an abdominal drain. Factors correlated with CR-POPF were elevated drain fluid amylase (DFA) on postoperative day 2 ($n = 125$ (65%) with DFA > 1500 U/ml had CR-POPF versus $n = 90$ (31%) who did not, $p < 0.001$), male gender (52% in CR-POPF group compared to 37%, $p = 0.001$), increased BMI (median 25.2 kg/m^2 [22.6–27.4] in the CR-POPF group versus 23.9 kg/m^2 [21.51–26.66], $p = 0.011$) and higher intraoperative blood loss (median 250 ml [100–400] in the CR-POPF group versus 200 ml [100–300], $p = 0.004$).

Among patients with CR-POPF, 109(52%) were treated by maintaining the surgical drain, while 99 needed specific treatment for organ-space surgical site infection. Of these, 33(16%) patients were treated by only antibiotics, 47(23%) by interventional radiology percutaneous drainage and 10 (9%) by endoscopic drainage. Percutaneous drainage was performed at median POD 16 [11–24], while endoscopic drainage at median POD 31 [15–54]. The only patients' characteristics associated to operative treatment for CR-POPF were ASA score ≥ 3 (37% in the operative group versus 21%, $p = 0.010$) and malignant disease (48% in the operative group versus 31%, $p = 0.016$).

Conclusions: After DP, occurrence of CR-POPF-related intrabdominal collections requiring interventional drainage procedures is a frequent event, affecting one third of patients with CR-POPF. In this series, the only predictive factors for the need of interventional treatment were ASA score ≥ 3 and malignancy diagnosis.

S062

Increased stoma creation rates and postoperative complications leading to longer hospital stays. Evaluation of racial disparities in the surgical management of Inflammatory Bowel Disease

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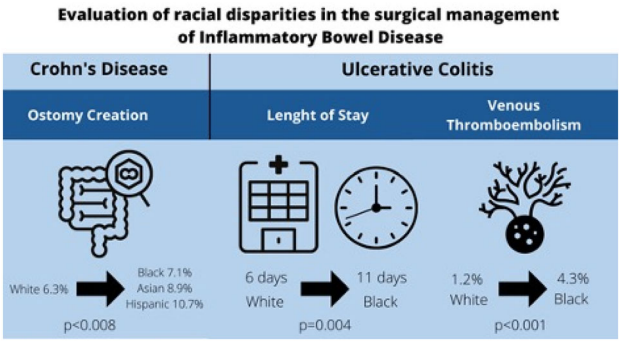

Introduction: Disparities in management of inflammatory bowel disease (IBD) are multifactorial and occur at all stages of treatment. These include treatment with immunomodulators, use of steroids, and adequate surgical management. A targeted analysis of the impact of racial disparities in surgical management of Crohn's Disease (CD) and Ulcerative Colitis (UC) is warranted in order to identify areas requiring active intervention to improve surgical outcomes for minority patients.

Methods and Procedures: Patients were identified using the National Surgical Quality Improvement Project (NSQIP) file along with the targeted proctectomy (2016–2019) and colectomy file (2012–2019). All patients undergoing elective surgical management for ICD9/10 codes for CD and UC were included. Current procedural terminology codes were used to identify surgical procedures. Patients undergoing colon resection for CD and colectomy, proctectomy and pouch creation were included in the analysis for UC. Propensity score was used in order to match for all available variables known to impact outcomes (age, sex, BMI, tobacco use, steroid use, preoperative albumin level, and surgical approach).

Results: 18,104 patients were found to have IBD, 11,405 with Crohn's disease and 6,699 with Ulcerative colitis. In the unadjusted analysis there was a statistically significant higher rate of stoma creation in Black (7.1%), Asian (8.9%) and Hispanic (10.7%) patients compared to White (6.3%) patients undergoing segmental colon resection for Crohn's disease (Figure 1, $p < 0.008$); this remained statistically significant in an adjusted analysis comparing Hispanic and Asian patients to their White counterparts. In Ulcerative colitis, postoperative ileus (21.3% vs 12.1%) and length of stay (11 vs 6 days) were significantly higher for Black patients undergoing total abdominal colectomy ($p < 0.001$) compared to White patients, which remained significant after adjusted analysis ($p = 0.004$). Postoperative bleeding requiring transfusion and length of stay were found to be significantly longer for Asian and Black patients undergoing completion proctectomy with IPAA, and remained significant after adjusted analysis for Asian patients ($p < 0.001$). Postoperative DVT rate and readmission rates were significantly higher before and after adjusted analysis for Black patients ($p < 0.001$).

Conclusion: Racial disparities in stoma creation exist in patients undergoing colon resection for CD. Increased length of stay, postoperative bleeding, ileus and DVT rate were found to be significantly different among racial groups of patients undergoing surgery for UC. Longitudinal studies are needed to measure the long-term impact of disparities in quality of life. Including higher number of minority patients to large databases is needed in order to further evaluate and improve disparities in IBD management.

S063

Socioeconomic disparities in the utilization of primary robotic hernia repair

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Objective: This study aimed to examine socioeconomic disparities in the utilization of primary robotic hernia repair (RHR), utilizing statewide population level data. It was funded by the SAGES Robotic Surgery Research Grant.
Methods and Procedures: The New York Statewide Planning and Research Cooperative System (SPARCS) administrative database was used to identify adult patients who underwent primary open, laparoscopic, and robotic hernia repair (inguinal, femoral, umbilical, ventral) from 2010 through 2016. Utilization trends were compared between the surgical approaches, assessing for difference in age, sex, race, insurance status, and socioeconomic status (as defined by median income for zip code). Multivariable regression models were used with statistical significance set at 0.05.
Results: A total of 280,064 patients underwent primary hernia repair: $n = 216{,}892$ (77.4%) open, $n = 61{,}037$ (21.8%) laparoscopic, $n = 2{,}135$ (0.8%) robotic. After adjusting for confounding variables, senior age (OR 1.01, $p = 0.002$), male sex (OR 1.35, $p < 0.001$), and non-Hispanic race (OR 1.3–1.54, $p < 0.001$) were significantly associated with the use of robotic compared to open or laparoscopic surgery. Additionally, patients with commercial insurance were more likely to undergo RHR compared to those with Medicare (OR 1.32) or Medicaid (OR 1.54) ($p < 0.0001$). Income was significantly correlated with RHR such that every $10,000 increase in income would increase the odds of having RHR by 6% (OR 1.06, $p < 0.0001$). Academic facilities were also associated with a significantly higher likelihood of utilizing RHR (OR 1.88, $p < 0.0001$).
Conclusions: There are significant socioeconomic disparities in the utilization of robotic compared to laparoscopic or open hernia repair. While the robotic approach is overall increasing in popularity, adoption of new technology should not be limited to specific societoeconomic cohorts of the population. Recognizing these disparities is a necessary first step in providing equal and consistent care.

S064

Contribution of Low- and Middle-Income Countries to research at SAGES meetings: a 5-year analysis

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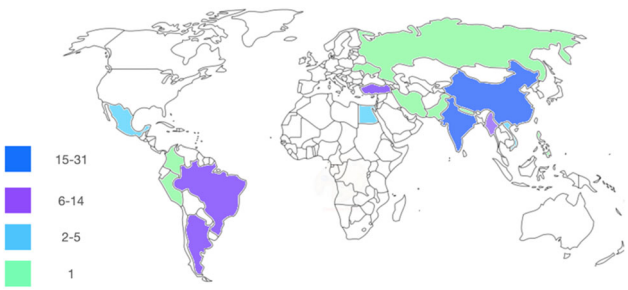
Background: Eighty percent of the world's population lives in low- and middle-income countries (LMICs). However, LMICs have been reported to be under-represented in scientific research. While SAGES is an American based organization, it has multiple international outreach initiatives (concerning safe surgery, use of surgical energy, etc.). The aim of this study is to quantify contributions to research at SAGES meetings from LMICs.
Methods: abstracts for SAGES meetings from 2016–2020 were obtained. Given the supposed higher quality of submissions, only oral and (podium) video presentations were included. Country of origin was noted according to self-reported affiliation. Some projects involve international collaboration; if this was the case the country assigned was that of the first author. Countries were classified as either high, middle, or low income according to classification from the World Bank.
Results: 1211 abstracts were reviewed, 1096 (90.5%) were from high income countries and 115 (9.5%) were from LMICs. Within the latter group, 73 (63.5%) abstracts were from upper middle-income countries and 42 (36.5%) from low middle-income countries. Of the 115 LMIC submissions, 5 (4%) were international collaborations. Zero abstracts from low-income countries were presented.
Conclusions: LMICs contribute only a fraction of research presented at SAGES, and international collaboration is infrequent. Within research from LMICs, most accepted abstracts come from Upper Middle Income Countries, with zero representation from low income countries. This data underscores the need for more robust research systems in underprivileged countries as well as increased international collaboration.



S065

Impact of race and ethnicity on rates of emergent ventral hernia repair (VHR): has anything changed?

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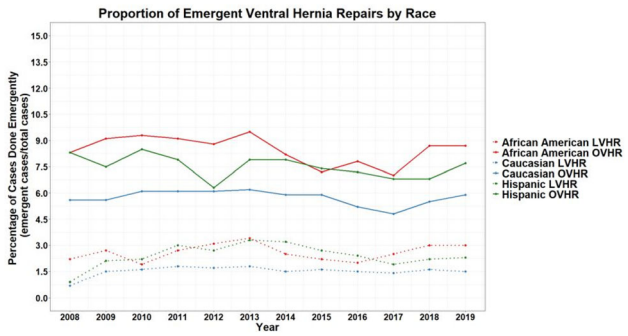
Introduction: VHR is one of the most common operations performed by general surgeons. Non-White patients have been shown to have higher rates of emergent VHR, though no study to date has characterized this trend over time.

Methods National Surgical Quality Improvement Program database was queried for patients with a CPT code for open or laparoscopic (lap) VHR between 2008–2019. White and Black/African American (AA) patients were identified using the race variable, and patients who identified as Hispanic ethnicity were grouped independently. Two time periods were defined for comparison: T1 (2008–2011) and T2 (2016–2019).

Results: In the 12-year period, there were 665,809 patients who underwent VHR with 61.7% performed open. White patients represented 68.6% of open and 73.0% of lap VHRs, but proportionally decreased by 3% ($p < 0.0001$) for open and 6.7% ($p < 0.0001$) for lap VHRs. AA patients made up 10.4% of open cases, increasing by 0.6% ($p = 0.0007$) from T1 to T2 eras, and 9.0% of lap cases, increasing by 1.5% ($p < 0.0001$). Hispanic patients represented 8.3% of open and 7.9% of lap VHRs, increasing by 2.4% ($p < 0.0001$) and 2.6% ($p < 0.0001$) respectively. Asian, American Indian, Alaska Native, Native Hawaiian, and Pacific Islander patients were < 2% of all cases when combined. Other/not specified race was found for 10.4% of open and 7.9% of lap VHRs.

For open VHRs, the average proportion of emergent cases decreased between time periods: White-5.9% to 5.3% ($p < 0.0001$), AA-9.0% to 8.0% ($p = 0.009$), and Hispanic-8.0 to 7.1% ($p = 0.026$). Odds ratios for emergent open VHR repair, when compared to White patients, decreased from 1.53 to 1.51 for AA and 1.37 to 1.34 for Hispanic. The proportion of emergent lap VHR were similar between time periods, therefore odds ratios were not included: White-1.6 to 1.5% ($p = 0.67$), AA 2.4 to 2.6% ($p = 0.59$), and Hispanic 2.4% to 2.6% ($p = 0.59$).

The figure below demonstrates that the proportion of VHRs performed emergently for both open and lap VHR was lowest for White patients in every year between 2008–2019. P-values comparing proportion of emergent open or lap VHRs for AA or Hispanic patients, respectively, to White patients for each individual year were < 0.001, except for White vs Hispanic in 2012, for which $p = 0.056$.



Conclusions: The proportion of non-white patients undergoing VHR increased over time. White patients consistently had lower proportions of emergent cases. The proportion of emergent open VHR decreased between time periods for all groups, but there was minimal decrease in the odds ratios comparing AA or Hispanic patients to White patients.

S066

30-Day colectomy outcomes by race within the VA system

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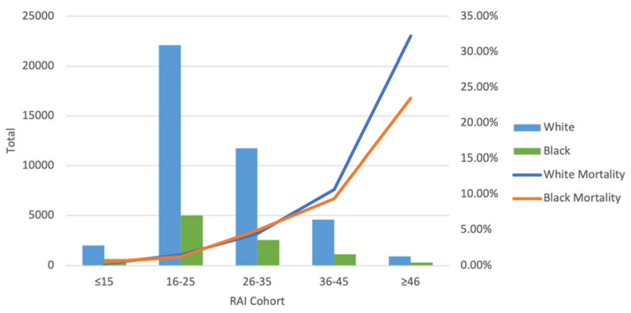
Introduction: Inequity in surgical outcomes is a significant concern. Several studies have described worse outcomes for minority patients undergoing surgery compared to white patients. We aim to identify disparities in 30-day outcomes between white and black patients who underwent colectomies within the VA system.

Methods: This retrospective review identified patients undergoing surgery for colonic pathologies from 1999–2019 by studying the Veteran Affairs Surgical Quality Improvement Program database. Demographics, comorbidities, frailty, operative approach, and 30-day outcomes were compared between white and black patients; other racial groups were excluded due to insufficient numbers. Risk Analysis Index (RAI), which has been previously validated in the VA population, was used to measure frailty among the racial groups. Pearson's X2, ANOVA testing, and binary logistic regression were used to analyze the two groups.

Results: White patients comprised 65.1% of patients, 15.1% were black, 4.9% were Hispanic, 0.6% were Native American, 0.3% were Asian or Pacific Islander, and 14.0% were unknown. We focused on white and black patients, given they were the largest groups. White patients on average were older (66.6 vs 64.5 years-old, $p < 0.001$), had a higher BMI (29.1 vs 28.2, $p < 0.001$), but fewer comorbidities (1.7 vs 1.8, $p < 0.001$). Specifically, white patients were more likely to have a diagnosis of heart disease, COPD, and steroid use ($p < 0.001$, respectively). There was no statistical difference between overall morbidity and mortality. Black patients were more likely to have hypertension, diabetes, neurologic deficits, ESRD requiring dialysis, smoke ($p < 0.001$, respectively), and cancer ($p = 0.012$). Black patients were more likely to experience cardiac arrest, renal failure, and bleeding ($p < 0.001$, respectively) compared to white patients who experienced more MIs ($p = 0.017$), superficial wound infections ($p = 0.006$), and wound dehiscence ($p = 0.002$). RAI showed no significant difference between racial groups. After grouping patients into frailty groups, mortality rates increased equally between races, except in the frailest group, white patients had higher odds of dying (OR 1.56, $p = 0.005$).

Conclusion: Overall morbidity and mortality between black and white patients undergoing colectomy were similar within the VA system. This contrasts with previous studies indicating a possible health care disparity. However, in the highest frailty group, RAI > 46, mortality was significantly higher in white patients undergoing colectomy.



S067

Racial disparity in utilization of laparoscopic colectomy: an analysis of the nis database

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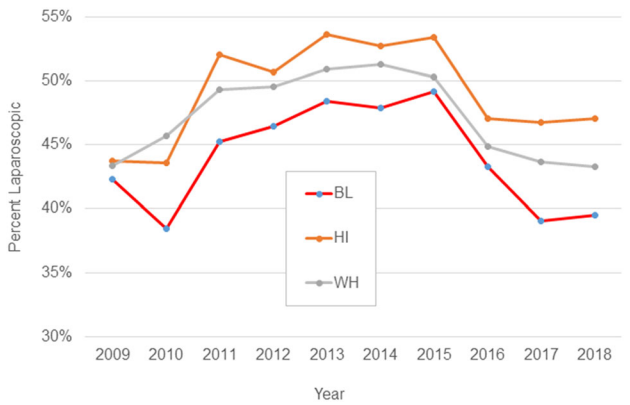
Introduction: Laparoscopic colectomy has been associated with improved recovery and decreased complications when compared to an open approach. Consequently, the rates of laparoscopic colectomy have increased. Race has been identified as a factor that influences a patient's likelihood of undergoing laparoscopic colectomy. Therefore, the purpose of this study was to analyze the rates of laparoscopic colectomy stratified by race over time.
Methods and Procedures: Patients were selected using procedure codes for colectomy within the National Inpatient Sample (NIS) database from 2009–2018. The primary independent variable was race (Black, BL; Hispanic, HI; White, WH), and the primary outcome was surgical approach (laparoscopic vs open). Covariates included age, sex, insurance status, case complexity, urban vs rural status, income, and year of surgery. We examined the univariable association of race with laparoscopic vs open colectomy with chi-square. We used multivariable logistic regression to examine the association of race with procedure type adjusting for covariates and included a race by year interaction. All analysis was done using SAS (version 9.4, Cary, NC) with $p < 0.05$ considered significant.
Results: 267,865 patients (25,000 BL, 19,685 HI, and 223,180 WH) were identified. Laparoscopy was used in 47% of cases, and this varied significantly by race (BL 44%, HI 49%, WH 47%, $p < 0.0001$). After adjusting for covariates, Black patients had significantly lower probability of receiving laparoscopic colectomy vs White patients (aOR 0.93 [95% ci 0.90–0.96], $p < 0.0001$). Utilization of laparoscopy was similar in Hispanic compared to White patients (aOR 1.01 [95% ci 0.98–1.04], $p = 0.45$). There were significant changes over time in the Black-White racial disparity, which remained fairly constant through 2014, was reduced in 2015 and 2016, and then increased again in 2017 and 2018 ($p = 0.0005$) (Figure 1).
Figure 1: Percent of laparoscopic vs open colectomy procedures by year, stratified by race.



Conclusions: Race was independently associated with the rate of laparoscopic colectomy, with Black patients less likely to receive a laparoscopic procedure than White patients. This disparity persisted over nearly a decade. Given the benefits of a laparoscopic approach, increasing the rates of laparoscopic colectomy in minority populations should be prioritized to optimize surgical care and minimize racial disparities in medicine.

S068

Impact of the coronavirus pandemic on severity of appendicitis with resultant resource utilization and mitigation strategies against hospital strain

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Introduction: We aimed to evaluate the effect of the coronavirus (COVID) pandemic on severity of appendicitis, managed operatively and non-operatively, on outcomes and resource utilization. An Emergency General Surgery (EGS) service was implemented within a year of the COVID pandemic and we further evaluated whether systems-based practices may mitigate such strains on hospitals.
Methods: Consecutive cases of acute appendicitis admitted to a single tertiary care hospital were captured from January 1, 2019 to December 31, 2020. During this time, a dedicated EGS service was implemented on July 1, 2019. A pre (1/1/2019–2/29/2020) and post (3/1/2020–12/31/2020) COVID period were defined. Clinical features, outcomes, and hospital resource utilization metrics were compared, pre/post COVID as well as pre/post EGS service.
Results: 381 cases were identified, 243 (63.8%) pre-COVID, 138 (36.2%) post-COVID; 90 (23.6%) pre-EGS, 291 (76.4%) post-EGS. In the subset of 291 post-EGS patients, there were more cases of complicated appendicitis, defined as perforated appendicitis with abscess or phlegmon, post (47.1%) versus pre (32.0%) COVID, $p = 0.009$. There were more cases of non-operative management post (5.1%) versus pre (0.7%) COVID, $p = 0.021$ and more dirty wound classes in operatively managed cases post (45.0%) versus pre (31.6%) COVID, $p = 0.014$. There were less discharges to skilled nursing facilities (SNF) post (2.2%) versus pre (9.2%) COVID, $p = 0.011$. There were no differences in hospital transfers, radiologic procedures, CT scans, extent of operation (e.g. bowel resection), ICU admission, length of stay, morbidity, and readmission pre versus post COVID.

In the entire cohort that included the creation of an EGS service, there remained more cases of: complicated appendicitis post (47.1%) versus pre (32.5%) COVID, $p = 0.005$; non-operative management post (5.1%) versus pre (1.7%) COVID, $p = 0.05$; dirty wound classes post (45.0%) versus pre (31.8%) COVID, $p = 0.019$. There remained less discharges to SNF post (2.2%) versus pre (8.6%) COVID, $p = 0.013$. The median length of stay decreased post versus pre COVID ($p = 0.05$).

When performing a subgroup analysis of the effect of the EGS service outside the COVID pandemic period, median length of stay was decreased post versus pre EGS ($p = 0.03$).
Conclusions: Although the COVID pandemic was associated with increased rates of complicated appendicitis, resulting in more non-operative management and dirty wound classes in operatively managed cases, there were no differences in outcomes and length of stay, other than decreased discharge to SNF. Mitigation of increased hospital resource utilization may have been from systems-based practices such as the creation of a dedicated EGS service.

S070

Assessing outcomes in laparoscopic vs open surgical management of adhesive small bowel obstruction

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Background: Small bowel obstruction is typically managed nonoperatively; however, refractory small bowel obstructions or closed loop obstructions necessitate operative intervention. Traditionally, laparotomy has long been the standard operative intervention for lysis of adhesions of small bowel obstructions. But as surgeons become more comfortable with minimally invasive techniques, laparoscopy has become a widely accepted intervention for small bowel obstructions. The objective of this study was to compare the outcomes of laparoscopy to open surgery in the operative management of small bowel obstruction.
Methods: This is a retrospective analysis of operative small bowel obstruction cases at a single academic medical center from June 2016 to December 2019. Data were obtained from billing data and electronic medical record for patients with primary diagnosis of small bowel obstruction. Postoperative outcomes between the laparoscopic and open intervention groups were compared. The primary outcome was time to return of bowel function. Secondary outcomes included length of stay, 30-day mortality, 30-day readmission, VTE, and reoperation rate.
Results: The cohort consisted of a total of 279 patients with 170 (61%) and 109 (39%) patients in the open and laparoscopic groups, respectively. Patients undergoing laparoscopic intervention had overall shorter median return of bowel function (4 vs 6 days, $p = 0.001$) and median length of stay (8 vs 13 days, $p = 0.001$). When stratifying for bowel resection, patients in the laparoscopic group had shorter return of bowel function (5.5 vs 7 days, $p = 0.06$) and shorter overall length of stay (10 vs 16 days, $p < 0.002$). Patients in the laparoscopic group who did not undergo bowel resection had an overall shorter median return of bowel function (3 vs 5 days, $p < 0.0009$) and length of stay (7 vs 10 days, $p < 0.006$). When comparing surgeons who performed greater than 40% cases laparoscopically to those with fewer than 40%, there was no difference in patient characteristics. There was no significant difference in return of bowel function, length of stay, post operative mortality, or re-admission laparoscopic preferred or open preferred surgeons.

S071

Impact of COVID-19 on common non-elective general surgery diagnoses

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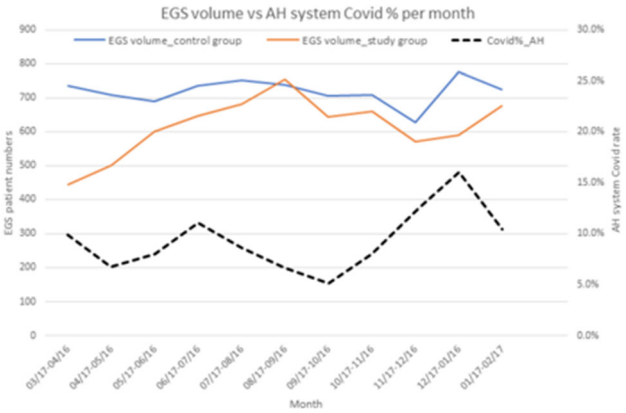

Background: During the COVID-19 pandemic, public health and hospital policies were enacted to decrease virus transmission and increase hospital capacity. Our aim was to understand the association between COVID-19 positivity rates and patient presentation with EGS diagnoses compared to historical controls.
Methods: In this observational cohort study we identified patients $\geq$ 18 years who presented to an Urgent Care, freestanding ED, or hospital in a regional health system with selected EGS diagnoses during the Pandemic (March 17, 2020 to February 17, 2021) and compared them to a pre-Pandemic cohort (March 17, 2019 to February 17, 2020). Outcomes of interest were EGS diagnosis per month, length of stay (LOS), inpatient mortality and 30-day readmission.
Results: There were 7908 patients in the pre-Pandemic and 6771 in the Pandemic cohort. The most common diagnoses in both cohorts were diverticulitis (29.6%), small bowel obstruction (28.8%), and appendicitis (20.8%). The lowest volume of EGS patients was seen in the first two months of the Pandemic period (29% and 40% decrease). Another decrease was seen during the second COVID peak (12/20–1/21, 24% decrease, Figure 1), though not as pronounced. Pandemic cohort had a higher percentage of patients with elevated lactate (8.8% vs. 5.6%), temperature (2.7% vs 3.6%) and WBC (55.9% vs. 57.0%). A higher percentage of patients were managed at a freestanding ED (9.6% vs. 8.1%) and patients who were admitted were more likely to be managed at a smaller hospital during the Pandemic. Rate of surgical intervention was not different, but a higher percentage of Pandemic cohort surgeries lasted longer than an hour. In the Pandemic cohort, 2.4% of patients had a COVID diagnosis (12.6% mortality). There was no difference in use of ICU, ventilator requirement, or LOS, but there was a higher 30-day readmission and lower 30-day mortality in the Pandemic cohort.
Conclusions: In the setting of the COVID pandemic, there was a decrease in patients with EGS diagnoses. This was most apparent in the earliest months of the pandemic, and also seen during a subsequent peak. The increase in patients managed at freestanding ED may reflect resources dedicated to supporting outpatient non-operative management and lack of bed availability during COVID surges. There was no evidence of a rebound in EGS case volume or substantial increase in severity of disease after a surge declined, however patients did present with more physiologic derangement suggesting a delayed presentation during the Pandemic.

S072

Outcomes of laparoscopic modified cellan-jones repair versus open repair for perforated peptic ulcer at a community hospital

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Introduction: Minimally invasive or open Graham Patch repair remains the gold standard approach for management of perforated peptic ulcer (PPU). Herein, we report outcomes of laparoscopic technique and comparing it with open approach at a community hospital.

Methods: Retrospective observational study conducted comparing laparoscopic modified Cellan-Jones Repair (mCJR) vs. the standard open repair of PPU. Patients aged 18–90 years during 2016–2020 were offered either a minimally invasive or open approach depending on surgeon laparoscopic capability, and were compared in terms of demographics, co-morbidities, intra-operative details, and short-term outcomes.

Results: A total of 47 patients were included (48.9% males, mean age 51.7 years, mean BMI 25, ASA $\geq$ III 74.4%, 76.6% smokers, 27.7% current NSAIDs use, and 72.3% alcohol drinkers). Duodenum was the most common perforation site (55.3%), and majority of ulcers were 1-2 cm (71.7%). Laparoscopic approach was performed in 14 patients (29.8%), with no conversions to open. Preoperative characteristics were similar for both groups (Table 1). Compared to open approach, laparoscopic group were taken to OR immediately (< 4 h) (85.7% vs. 15.2%, $p < 0.001$), had lower estimated blood loss (7.9 ml vs. 73.8 ml, $p = 0.049$), and longer OR time (107.9 min vs. 85.6 min, $p = 0.035$). Postoperatively, nasogastric tube was removed earlier in laparoscopic group (POD1-2, 85.7% vs. 24.2%, $p = 0.001$), with earlier resumption of diet (POD1-2, 46.2% vs. 9.1%, $p = 0.003$), less narcotic usage (< 3 days, 50.0% vs. 6.1%, $p < 0.001$), earlier return of bowel function (POD1-2, 46.2% vs. 9.1%, $p = 0.003$) and shorter LOS (3.8 days vs. 16.1 days, $p < 0.001$). Both in-house mortality and morbidity rates were lower in the laparoscopic group, but not statistically significant ((0% vs. 6.1%, $p = 0.347$) and (14.3% vs. 39.4%, $p = 0.599$), respectively).

Conclusion: Laparoscopic mCJR is a feasible method for repair of PPU, and it is associated with shorter LOS, less narcotics usage, lower morbidity and mortality rates in comparison to the open repair approach.

Table 1: Preoperative Patients' Characteristics.

	Laparoscopic (n=14)	Open (n=33)	*P* value
Gender (Male)	7 (50.0%)	16 (48.5%)	0.924
Age	51.4 ± 8.5	51.8 ± 16.6	0.929
BMI	23.7 ± 6.0	25.6 ± 6.4	0.348
ASA ≥III	8 (57.1%)	27 (81.8%)	0.060
Antiacid use	2 (14.3%)	14 (42.4%)	0.063
Smoking	12 (85.7%)	24 (72.7%)	0.336
Alcohol Intake	10 (71.4%)	24 (72.7%)	0.292
NSAIDs use	6 (42.9%)	7 (21.2%)	0.129
No Comorbidities	3 (21.4%)	9 (27.3%)	0.275
Previous abdominal surgery	5 (35.7%)	17 (51.5%)	0.321

S073

The impact of interval appendectomy timing on postoperative adverse outcomes

Mohammad Noubani, BS; Xiaoyue Zhang, MS; Jie Yang, PhD; Kinga Powers, MD, PhD; Konstatinos Spaniolas, MD; Aurora Pryor, MD; Stony Brook University School of Medicine

Objective: This large retrospective study aims to compare the different timing of interval appendectomy and their impact on postoperative adverse outcomes.

Methods: Using New York State SPARCS database, a retrospective analysis was performed for adult patients with a primary diagnosis of appendicitis between 2006 and 2017. IA was defined as a follow-up appendectomy > 1 week and < 2 years after the initial presentation. Time intervals were divided into 4 groups based on the quartiles: 1–6 weeks, 7–9 weeks, 10–15 weeks, and > 15 weeks. The primary outcome measure was length of stay (LOS). Secondary outcomes included unplanned 30-day readmission. Tertiary outcomes included colonoscopy findings of neoplasm or inflammatory bowel disease.

Results: In total, 340,610 appendicitis records were extracted from the SPARCS database from 2006–2017. Among these records, the earliest record from each patient was kept ($N = 299{,}582$). Patients with age < 18 ($N = 70{,}508$) or in-hospital death ($N = 677$) were excluded. Patients who underwent an appendectomy at the same hospitalization ($N = 163{,}534$) or were pregnant ($N = 66$) were excluded. 64,797 patients' first appendicitis records in years 2006–2017 were included. Thus, 5,069 patients' records whose interval appendectomy fell > 1 week and < two years after initial presentation were analyzed. Among them, 1,006 (19.85%) underwent initial percutaneous abscess drainage at diagnosis. The median timing for IA was 9.2 weeks. Patients with IA at 1–6 weeks were more likely to have an extended LOS when compared to 7–9 weeks (OR, 1.33, 95% CI, 1.2–1.48) and 10–15 weeks (OR, 1.38, 95% CI, 1.25–1.52). IA between 7–9 weeks (OR, 0.81, 95% CI, 0.73–0.89) and 10–15 weeks (OR, 0.78, 95% CI, 0.71–0.86) was associated with significantly shorter LOS compared to those receiving the operation after 15 weeks. Further, patients requiring abscess drainage (OR, 1.2, 95% CI, 1.13–1.34 or those with comorbidities (OR, 1.51, 95% 1.39–1.63) were more likely to have an extended LOS after IA. Socioeconomic differences were also identified with Medicaid patients having a greater LOS at IA (Table 1). No differences between 30-day unplanned readmission, appendectomy complications, mortality, and colonoscopy findings were identified across the different 4 quartiles.

Conclusion: LOS remains lowest among patients undergoing IA between 7–9 weeks and 10–15 weeks after initial appendicitis presentation. Patients with lower socioeconomic status or from racial minorities had a longer LOS after IA. No association between timing of IA and 30-day readmission, neoplasm findings, and post-procedural complications were identified.

Variable	Levels	Ratio (95% CI)	P-value*
Time interval (week)	1-6 vs 7-9	1.332 (1.202, 1.477)	<.0001
	1-6 vs 10-15	1.379 (1.247, 1.525)	
	1-6 vs >15	1.075 (0.983, 1.177)	
	7-9 vs 10-15	1.035 (0.926, 1.157)	
	7-9 vs >15	0.807 (0.729, 0.894)	
	10-15 vs >15	0.780 (0.706, 0.861)	
Abscess drainage	Yes vs No	1.235 (1.137, 1.341)	<.0001
Any comorbidity	Yes vs No	1.509 (1.393, 1.634)	<.0001
Insurance	Commercial vs Medicaid	0.736 (0.660, 0.822)	<.0001
	Commercial vs Medicare	0.757 (0.669, 0.857)	
Inpatient or Outpatient	Inpatient vs Outpatient	25.595 (22.597, 28.991)	<.0001
Race/ethnicity	Asian, non-Hispanic vs Black, non-Hispanic	0.721 (0.600, 0.866)	<.0001
	Black, non-Hispanic vs Hispanic	1.148 (0.993, 1.327)	
	Black, non-Hispanic vs Other	1.260 (1.116, 1.422)	
	Black, non-Hispanic vs White, non-Hispanic	1.303 (1.168, 1.455)	
	Hispanic vs White, non-Hispanic	1.136 (1.001, 1.289)	

*Other Factors adjusted in model included: Patients' group, age, region, Congestive heart failure (CAD), Valvular disease, Peripheral vascular disease, Other neurological disorders, Hypertension, Chronic pulmonary disease, Renal failure, Coagulopathy, , metastatic cancer, obesity, alcohol Use disorder, Pulmonary circulation, Diabetes, Pulmonary circulation disease, Deficiency Anemias, Depression, Fluid and electrolyte disorders,.

S074

Accuracy of conflict of interest disclosures among faculty at the 2020 SAGES national meeting

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Background: Financial relationships with industry can bias the presentation of educational content. SAGES has been a leader in responsible evaluation and mitigation of financial relationships, which heretofore have been based on physician self-reporting. Critical review of speaker disclosures is now possible using the Open Payments Database (OPD), in which industry-reported payments to United States (US) physicians are publicly available. We set out to examine the association between industry relationship disclosures among invited speakers at the 2020 SAGES annual meeting by comparing physician disclosures to SAGES, physician disclosures in presentations, and the OPD.
Methods: We reviewed all available presentations from the SAGES 2020 annual meeting through the virtual meeting platform. For each invited speaker, the presence of a disclosure slide and all slide-disclosed industry relationships were recorded. For US physicians, we queried the OPD and recorded all industry relationships greater than $500 USD for 2019, the year prior to presentation. We compared the slide-disclosed relationships for each speaker with those listed in the OPD as well as those provided by faculty directly to SAGES during the faculty disclosure process.
Results: Of the 386 invited presentations, 359 (93%) were available for review. Disclosure slides were present in 338 presentations (94%). There were 278 unique speakers in 2020 and the majority (88%) were listed in the OPD. A total of 158 speakers (57%) had OPD-reported financial relationships of $500 or more. The median total value of these industry relationships was $4,785 (IQR $1,510-$14,145). Of the speakers listed in the OPD, 130 (46%) had at least one industry-reported relationship greater than $500 that was not identified by the speaker on their disclosure slide. The median total value of these undisclosed relationships was $3,007 (IQR $1,152-$6,680). Of these 130 speakers, 118 (91%) did not self-report to SAGES one or more of the OPD-reported relationships.
Conclusions: While compliance with the SAGES disclosure slide requirement remains high, significant discordance exists between industry relationships reported to the OPD and those disclosed on slides by SAGES speakers in 2020. It is possible that presenters were not aware of these undisclosed payments (i.e. such as payments for an industry-sponsored course) or they may have believed that the financial relationships were not relevant to the topic of presentation and thus not necessary to disclose. We strongly encourage presenters to regularly review the OPD for industry-reported payments to ensure the accuracy of physician disclosures and to maintain the integrity of educational programs.

S075

Do the research priorities identified in sages Delphi studies resonate with rural general surgeons: a Washington state perspective

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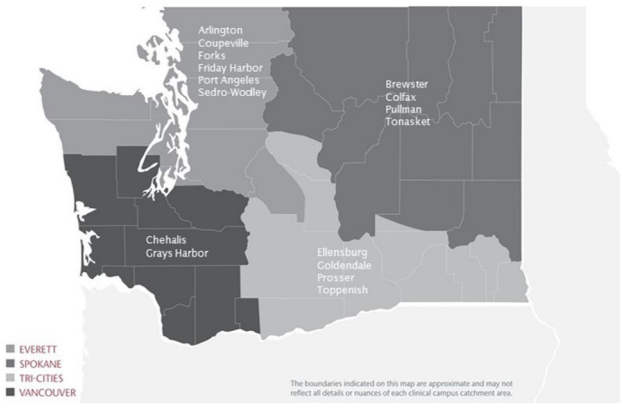
Introduction: Rural surgeons frequently work with independence and separation from their peers, with varying degrees of access to specific resources such as equipment/technology, customized instrument sets, and surgical staff training/retention. We hypothesized that the SAGES research agenda (as identified in the results of the 2014 Delphi survey) will differ in its priorities from those identified by rural surgeons. We aimed to pilot a study in Washington state that could be replicated in other areas of the U.S. and the world.
Methods and procedures: We identified general surgeons working at critical access hospitals in the state of Washington. Critical access hospitals were identified by the Washington State Department of Health that met the criteria outlined by federal designation under the Rural Hospital Flexibility Program. Surgeons were identified using online directories. CMOs/CEOs and college faculty provided additional introductions. We conducted virtual semi-structured interviews and followed up with surveys. The survey included the 2014 SAGES Delphi-ranked research priorities. We asked rural surgeons to note and rank their top 5 of these 40 priorities, and to detail any others that were not on the list.
Results: We contacted 81 surgeons with a 30% response rate. We conducted 25 semi-structured interviews and received 17 completed follow-up surveys. These interviews were followed by site visits at 3 of the 23 sites, which provided additional insight. Of the original Delphi research priorities, those most cited by rural surgeons were #8 "What is the best method for incorporating new techniques and technology for surgeons of variable levels of experience or training?" (cited 9x, ranked 1st 3x) and #1 "How do we best train, assess, and maintain proficiency of surgeons and surgical trainees in flexible endoscopy, laparoscopy, and open surgery?" (cited 6x, ranked 1st 6x). Only one surgeon agreed that the top 5 priorities of the Delphi were fully representative of rural research needs. Four surgeons included the last SAGES priority, number #40 "Is quality of life improved after ventral hernia repair?" among their top 5.
Conclusion: This study suggests that rural surgeons have unique priorities which differ from the published SAGES Delphi, perhaps because the study population of the Delphi is SAGES leadership who predominantly work in large academic centers. Plans for future SAGES Delphi survey could capture and delineate these unique priorities more specifically by intentional involvement of rural and community surgeons.



Washington state's clinical campus regions with locations of surgeons interviewed.

S076

The impact of disclosures of conflicts of interest on the outcomes in studies comparing robot-assisted and laparoscopic cholecystectomies—a persistent problem

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Introduction: Industry sponsored studies may produce favorable conclusions in support of the use of their products. Truthful disclosure of any conflicts of interest (COI) during presentation, publication, or even in reviewing maintains credibility and is critical to interpretation of results. In this study, we examined published studies to evaluate the association between non-disclosure of COIs by study authors and reported outcomes and safety profile of robot-assisted cholecystectomy (RAC) compared to laparoscopic cholecystectomy (LC).

Methods: Publications in Pubmed and Embase databases were selected using key words associated with "cholecystectomy" and "laparoscopy" and "robotic" (n = 345). We included papers, which were published between 2014 and 2019 and had at least one U.S. co-author to verify author disclosures on the CMS's OpenPayments database. After discarding duplicate results, the selected publications reported on clinical trials, observational studies, single/multicenter studies, case studies, case series, meta-analyses and systematic reviews that reported on the safety profile of RAC or compared RAC and LC with regard to perioperative and postoperative outcomes.

Results: The sample contained 38 publications in peer-reviewed journals, with 12 including pertinent author disclosures and 26 either did not report or authors did not have any disclosures to report. Among the papers with author disclosures, 4 reported positively on safety of RAC and/or deemed to be better than LC; 5 reported that RAC was not better than LC and was more expensive and finally 3 were neutral in their recommendations. Of the 26 papers without disclosure statements or authors reporting no disclosures, 16 of them reported positive outcomes for RAC, 6 reported negative or worse outcomes and 4 were neutral in their conclusion compared to LC. In addition, 13 of the 16 papers which reported positively and had no disclosures on the use of RAC still had authors who received payments in the categories of "Food and Beverage" and "Travel and Lodging", and 10 papers received payments in other categories, which included "Education", "Consulting Fee", "Gift" and "Grant" from 2014 to the year of the publication of these papers respectively.

Conclusions: We found significant disparities between authors COI disclosures and surgical robot industry payments. As the "CMS OpenPayments" database is free and easy to use, there is no reason for journal editors to not independently verify authors' COI disclosures. Such a gatekeeper role is critical to protect the process of scientific authorship which is the foundation of modern surgical care. "Doveryay, no proveryay"… "Trust but verify".

S077

The role of cholecystectomy for hyperkinetic gallbladder: A retrospective cohort study in a rural hospital

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Background: Biliary dyskinesia is a functional gallbladder disorder in which there is an absence of a structural or mechanical cause for biliary pain. A Cholecystokinin (CCK)—Hepatobiliary Iminodiacetic acid (HIDA) scan is typically performed during workup, with cholecystectomy being the gold standard treatment for low Gall Bladder Ejection Fraction (GBEF) (less than 33% as defined by our institution). However, few studies have examined the role of cholecystectomy in management of hyperkinetic gallbladder (GBEF $\geq$ 80%). The role of our study was to examine symptom resolution following laparoscopic cholecystectomy in patients with hyperkinetic gallbladder.

Methods: A retrospective chart review was conducted at Robert Packer Hospital in Sayre, PA. Consecutive patients who underwent laparoscopic cholecystectomy for biliary colic, with GBEF $\geq$ 80% and no pathology on preoperative imaging were included in the study. The main outcome was symptom resolution at postoperative visit. Data collected included age, gender, GBEF, symptoms with CCK infusion, pathology, and symptom resolution at two weeks post-operatively.

Results: A total of 48 patients were included in the study. The mean age of patients was 41.2 years (SD (Standard Deviation) = 14.4) and a median age of 42.15 with a range of [17, 71]. Majority of the patients were female (83.3%). 58.3% of patients had a replication of symptoms with CCK infusion. The mean GBEF was 87.3% with a median of 87.0 and range of [80, 98]. 68.8% of patients had chronic cholecystitis on final pathology reports. There was a 95.9% symptoms resolution among these patients at 2 weeks post operatively.

Conclusion: The overwhelming majority of patients in our study experienced symptom resolution at their initial postoperative visit following laparoscopic cholecystectomy for hyperkinetic gallbladder. These results strongly suggest a role for surgical management in patients with high GBEF.

S078

Timing of laparoscopic cholecystectomy after percutaneous cholecystostomy tube: association with complications

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Introduction: Percutaneous cholecystostomy tubes (PCT) can be used to manage acute cholecystitis in critically ill patients, and serve as a bridge to laparoscopic cholecystectomy (LC). However, there is no standard duration between PCT and interval LC. This study aims to investigate the rates of LC after PCT and factors associated with LC complications.
Methods: ICD/CPT codes were used to identify all PCT placed at a single, large academic center from 2017–2020. We identified patients who underwent a subsequent LC and evaluated primary outcomes including duration of LC procedure (LC-D), estimated blood loss (EBL), operative complications, conversion to open, and 30/90-day readmissions/mortality. Pearson correlations and Chi-squared tests were used to analyze continuous and categorical variables, respectively.
Results: There were 197 PTC identified with 51 (25.8%) subsequent LC. Median age was 66.5 years; 61.9% were male. Average time to LC after PTC was 114.5 days (SD = 103.4). There were 4 major LC complications (7.8%), 15 cases (29.4%) were performed dome-down and/or subtotal/fenestrated, and 11 (21.6%) converted to open. Mean LC-D was 2.63 h (SD = 1.4); mean EBL was 71.8 mL (SD = 120.8 mL). There was no correlation between LC timing and EBL (r[46] = 0.232; $p = 0.112$) or LC-D (r[49] = 0.018, $p = 0.899$). Table 1 shows association between timing of LC and outcome variables.
Conclusions: PTC may be used as a bridge to LC, however optimal duration between these procedures is unknown. We found no difference in EBL or LC-D based on time timing of LC, nor did we find a difference in major outcome variables. This study is limited by relatively small sample size, but is strengthened by our ability to obtain granular intraoperative data including EBL, surgery duration, and specific complications/events.

Table 1. Association of LC timing with Primary Outcomes

	< 6weeks (N=6)	6w– 12w (N=23)	12w – 6m (N=15)	>6months (N=7)	X^2, p=value
Conversion Open (N=11, 21.6%)	2 (33.3%)	6 (26.1%)	2 (13.3%)	1 (14.3%)	X^2= 1.59; p=.662
Dome-down/Subtotal, (N=15, 29.4%)	0 (0%)	7 (30.4%)	7 (46.7%)	1 (14.3%)	X^2 = 5.43; p=.143
Any Complication (N=4, 7.8%)	0 (0%)	2 (8.7%)	1 (6.7%)	1 (14.3%)	X^2= .96; p=.810
30d Readmission (N=9, 17.6%)	0 (0%)	3 (13.0%)	5 (33.3%)	1 (14.3%)	X^2 = 4.22; p=.234
90d Readmission (N=23, 45.1%)	2 (33.3%)	8 (34.8%)	10 (66.7%)	3 (42.9%)	X^2 = 4.16; p=.245
30d Mortality (N=0, 0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	N/A
90d Mortality (N=2, 3.9%)	1 (16.7%)	0 (0%)	1 (6.7%)	0 (0%)	X^2= 4.11; p=.250

S079

Challenging orthodoxy: the problems with the critical view of safety

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Introduction: The critical view of safety (CVS) has been widely accepted as a surgical gold standard for performing safe cholecystectomy and minimizing the incidence of common bile duct (CBD) injuries. This view requires three criteria: complete clearance of the hepatocystic triangle of fibrous tissue, separation of the lower third of the gallbladder from the cystic plate, and two structures alone entering the gallbladder. However, biliary anatomy varies widely, with frequent aberrant arterial supplies, which can mislead or disorient those attempting to acquire the CVS. This study was designed to examine the nature and frequency of posterior cystic artery anatomic anomalies.
Methods: We conducted a prospective observational study from 2018 to 2020, compiling photos of the critical view of safety of 100 consecutive elective cholecystectomies performed at our institution. During each procedure, the gallbladder was dissected up to the parallel portion of the cystic plate in order to achieve the CVS. All tubular structures were carefully preserved and clipped. The operative reports were examined for mention of a posterior cystic artery or an aberrant arterial supply. Similarly, photos of all cholecystectomies were reviewed for an adequate critical view of safety and the presence of an aberrant arterial supply. The rate of aberrant arterial supply was determined and photos were reviewed for patterns of common abnormalities.
Results: There were 121 patients who underwent an elective cholecystectomy; 21 lacked intraoperative pictures and were excluded from the study (six were subtotal cholecystectomies, one was converted to open, fourteen had missing photos). There were no bile leaks or bile duct injuries. One patient had a retained stone requiring an ERCP, and one patient had a fatal myocardial infarction within 30 days. Of the 100 patients included, 57 (57%) had an aberrant arterial supply with more than one cystic artery, and 7 had three concurrent arteries. Of those with more than one cystic artery, 21% had a recurrent cystic artery, 21% had a posterior dominant cystic artery, and 12% had a low branching anterior cystic artery.
Conclusion: It is important to recognize the high frequency of aberrant arterial supply to the gallbladder. Even with appropriate dissection for the CVS, surgeons can expect to frequently visualize more than two structures entering the gallbladder when a posterior cystic artery is present. It is therefore integral to distinguish this aberrant anatomy to prevent an inadvertent injury to the CBD.

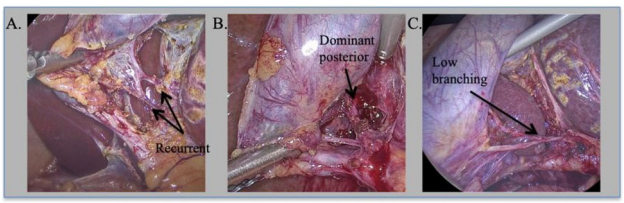

Image: Representative pictures of aberrant cystic arterial supply. The most frequent patterns of arterial supply when more than one artery was encountered were recurrent cystic artery (A), dominant posterior cystic artery (B), and low anterior cystic branching (C)

S093

Outcome prediction in bariatric surgery through video-based assessment

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Introduction: The relationship between intraoperative surgical performance scores and patient outcomes has not been demonstrated at a single case level. The GEARS score is a Likert-based scale that quantifies robotic surgical proficiency in 5 domains. Given that even highly skilled surgeons can have variability in their skill among their cases, we hypothesized that at a patient level, higher surgical skill as determined by the GEARS score will predict individual patient outcomes.
Methods: Patients undergoing robotic sleeve gastrectomy between July 2018 and January 2021 at a single health care system were captured in a prospective database. GEARS scores were assigned through crowd-sourced evaluators by a third party. Bivariate Pearson's correlation was used to compare continuous variables and univariable logistic regression for categorical outcome variables. Significant variables in the univariable screen were included in a multivariable linear regression model. Two-tailed p-value < 0.05 was considered significant.
Results: Of 162 patients included, 11 patients (6.8%) experienced a serious morbidity within 30 days. The average excess weight loss (EWL) was $72 \pm 12\%$ at 6 months and $74 \pm 15\%$ at 12 months. GEARS score was not significantly correlated with EWL at 6 months ($p = 0.349$), 12 months ($p = 0.468$) or serious morbidity ($p = 0.848$) on unadjusted analysis. After adjusting for BMI, ASA and Charlson comorbidity index, total GEARS score was not correlated with serious morbidity ($p = 0.914$); however, GEARS score did predict EWL at 6 ($p < 0.001$) and 12 months ($p < 0.001$). All GEARS subcomponent scores, bimanual dexterity, depth perception, efficiency, force sensitivity, and robotic control, were predictive of EWL at 6 months ($p < 0.001$) and 12 months ($p < 0.001$) on multivariable analysis.
Conclusion: For patients undergoing sleeve gastrectomy, surgical skill as assessed by the GEARS score was correlated with EWL, suggesting that better performance of a sleeve gastrectomy can result in improved postoperative weight loss.

S094

Increased incidence of marginal ulceration following sleeve to roux-en-y gastric bypass: a multi-institutional experience

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Introduction: Marginal ulcer (MU) formation is a known and potentially serious complication following Roux-En-Y Gastric Bypass (RYGB). Anecdotally, our group suspected a higher incidence of MU following conversion of Sleeve to RYGB (S-RYGB), and hypothesized that this would be demonstrated on analysis of our data. A possible etiology for increased MU rate is related to the size of the remnant stomach and associated retained antrum. Herein we evaluate the incidence of MU after primary versus secondary RYGB.
Methods: After IRB approval, each institution's electronic medical record and MBSAQIP database were queried to retrospectively identify all adult patients who underwent primary RYBG (P-RYGB), band to RYGB (B-RYGB), or S-RYGB between 2014 and 2019, with minimum one year follow-up. Patient demographics, operative data, and post-operative outcomes were compared. Two sample t-test, Wilcoxon test or Kruskal Wallis rank sum test were used to compare numeric variables between the groups. Two samples proportion test or Fisher's exact test were used to compare binary or categorical variables. $p < 0.05$ was considered statistically significant.
Results: A total of 860 patients underwent RYGB (P-RYGB $n = 584$ [67.9%]; B-RYGB $n = 183$ [21.3%]; S-RYGB $n = 93$ [10.8%]). The majority of patients were female (83.5%) with a mean age of 45.9 years. Fifty ($n = 5.8\%$) patients developed MU, a median of 14.3 ± 42.8 months (range 0.5–83.8) after surgery. The incidence of MU was significantly higher for patients undergoing S-RYGB ($n = 11$ [11.8%]), compared to P-RYGB ($n = 34$ [5.8%]) and B-RYGB ($n = 5$ [2.7%]) ($p = 0.012$). Median time (months) to MU was significantly shorter for patients who underwent S-RYGB (5 ± 6) compared to P-RYGB or B-RYGB (19 ± 41) ($p = 0.014$). Amongst those who developed MU, there was no significant difference in H. pylori status, NSAID, steroid, or tobacco use, irrespective of surgery type. GERD was more commonly an indication for conversion to S-RYGB (63.6%) compared to B-RYGB (0%) ($p = 0.029$). Although not statistically significant, patients with MU after S-RYGB trended toward requiring surgical intervention (45.5%) compared to those who had P-RYGB or B-RYGB (17.9%) ($p = 0.1$).
Conclusion: In this large multi-institutional cohort, patients who have undergone S-RYGB have a significantly higher incidence of MU than those with P-RYGB or B-RYGB, possibly owing to a smaller retained gastric antrum, although other etiologies are possible. Further research is needed to elucidate its pathophysiology and prevention strategies.

S095

Patient engagement in a virtual patient navigation platform

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Introduction: Virtual patient navigation platforms (VPNP) are becoming increasingly used as the pandemic has created a shift towards remote care. Patient engagement is important for bariatric surgery patients due to the long, complex nature of their preoperative work-up. Therefore we aimed to analyzed engagement of a VPNP, designed to guide patients through the pre-surgical steps to bariatric surgery.

Methods and Procedures: After IRB approval, data was collected retrospectively on patients enrolled in our bariatric program between January-May 2021, and who had consented to use the third iteration of the VPNP. Baseline sociodemographic and medical history was collected using the EMR. Additionally, the "System Usability Scale (SUS)", which ranks questions on 5-point Likert scale, was completed via a phone-call, to assess the usability of the platform. From this, 2 groups emerged:

1. Engaged (ENG; $n = 30$): activated their account and completed the SUS.

2. Not Engaged (NEG): activated their account, but could not complete the SUS because they did not use the VPNP ($n = 22$), or did not activate their account ($n = 13$).

For group 2, patients were asked why they did not engage and their responses were grouped thematically. Continuous and categorical variables were appropriately summarized and between-group comparisons were performed using Student's t-tests/Wilcoxon rank-sum tests or chi-squared tests/Fisher's exact tests, respectively. A p-value ≤ 0.05 was considered statistically significant.

Results: Of 92 eligible patients, 27 patients could not be reached by phone after 4 attempts, leaving 65 in the final analysis. Comparisons demonstrated ENG patients were more likely to have private insurance (60% versus 40%, $p = 0.0382$), and a master's degree or greater (85.7% versus 14.3%, $p = 0.0499$). There were no differences in age, gender, race, obesity-related comorbidities, or baseline weight. The SUS demonstrated that patients engaged in the VPNP thought it was uncomplicated (1.75 ± 1.14), easy to learn (4.47 ± 0.78) and use (4.47 ± 0.78). In the NEG group, the top 3 reasons for disengagement included patients being too busy (22.9%), unsure about how to use the VPNP (17.1%) and forgetting to use the app (14.3%).

Conclusions: The VPNP was designed to help patients navigate the complex process towards bariatric surgery approval. Given that the platform was more likely to be used by patients in a higher socioeconomic bracket [SEB] (i.e. privately insured with an advanced degree) and we have shown that this app shortens time to surgery, further work needs to be done to ensure that patients outside this bracket are able to engage in this VPNP.

S096

Comparison of post-operative outcomes between staple line reinforcement and oversewing in robotic sleeve gastrostomies from 2015–2019: A 5-Year MBSAQIP Analysis

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Background: Robotic sleeve gastrectomy (RSG) is an increasingly common modality of sleeve gastrectomy (SG), the most performed bariatric operation. Staple line reinforcement (SLR) is well-discussed in laparoscopic SG literature, while RSG literature instead focuses on oversewing– likely due to the absence of dedicated SLR devices for robotic systems. Despite this, roughly half of RSG cases report SLR utilization. This retrospective MBSAQIP analysis compares post-operative outcomes in RSG cases reporting (1) any reinforcement/augmentation vs none and (2) SLR vs oversewing.

Methods: MBSAQIP was queried for adults who had undergone RSG from 2015–2019. We excluded patients who received open procedures, Natural Orifice Transluminal Endoscopic Surgery, hand-assisted, single-incision, concurrent procedures, and patients with illogical BMIs of < 30 or > 100 ($n = 3,444$). Final sample included 52,354 patients.

Two comparisons were made: any staple line augmentation (SLA) (SLR, oversew, or both) ($n = 34,886$) vs neither ($n = 17,468$); and SLR alone ($n = 22,217$) vs oversew alone ($n = 5,620$). To examine associations between SLA and post-operative outcomes, we fitted multivariable regression models to estimate risk ratios (RR) and 95% confidence intervals (CI).

We performed propensity score analysis with inverse probability of treatment weight (IPTW) based on patient demographics, BMI, history of cardiovascular or pulmonary disease, renal disease, smoking status, prior bariatric surgeries, and preoperative steroids or anticoagulation.

Results: Most RSG cases utilized SLA (66.6%). Patients who underwent any form of SLA had a reduced risk of organ space SSI (RR 0.68 [0.49, 0.94]), 30-day reoperation (RR 0.77 [0.64, 0.93]), 30-day reintervention (RR 0.80 [0.67, 0.96]), sepsis (RR 0.58 [0.35, 0.96]), unplanned intubation (RR 0.59 [0.37, 0.93]), extended ventilator use (> 48 h) (RR 0.46 [0.23, 0.91]), and acute renal failure (RR 0.40 [0.19, 0.82]) when compared to patients without SLA.

In cases utilizing only one SLA modality ($n = 27,837$), the majority utilized SLR (79.8%). Patients who underwent oversew alone vs SLR alone had a higher risk of any SSI (RR 1.70 [1.19, 2.42]), superficial incisional SSI (RR 1.71 [1.06, 2.76]), septic shock (RR 6.47 [2.11, 19.87]), unplanned intubation (RR 2.18 [1.06, 4.47]), and extended ventilator use (> 48 h) (RR 4.55 [1.63, 12.71]).

Conclusions: Our data suggest SLA in RSG is associated with reduced risk of some adverse outcomes vs no SLA; but notably, no difference in transfusion rate was seen. In the single-SLA comparison, SLR generally demonstrated lower risk than oversewing. Of note, differential risks of all-cause mortality, cardiac arrest, and unplanned admission to ICU were not statistically significant in either comparison.

S097

Comparison of intestinal microbiome in hypertensive Roux-en-y gastric bypass (RYGB) patients receiving two different peri-operative antibiotics

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Introduction: A retrospective study of patients who underwent RYGB reported a prophylactic peri-operative, intravenous Clindamycin was associated with a significantly increased resolution of post-operative hypertension compared to Cefazolin. In this study, we performed a prospective, peri-operative antibiotic randomization of Cefazolin or Clindamycin at the time of RYGB to assess the effect on the gastrointestinal microbial composition up to 3 months after surgery.
Methods: Sixteen patients, undergoing RYGB, were prospectively randomized to a single, peri-operative antibiotic treatment arm of Cefazolin ($n = 8$) or Clindamycin ($n = 8$). Stool samples were collected from four time points: two weeks (-2w) and two days pre-operatively (-2d), and two weeks (+ 2w) and three months post-operatively (+ 3 m). At -2w, patients started a liquid whey protein diet (100 g/day) until surgery. Post-op patients started a pureed protein diet (60 g/day) and advanced to a soft protein enriched diet at + 2w after surgery. Stool samples were collected, preserved in RNA later, and shipped to the principal investigator's laboratory for genomic DNA isolation followed by Illumina 16S sequencing and analysis via QIIME2 to assess alpha and beta diversity, longitudinal changes, and feature volatility. This study was approved by the Medical College of Wisconsin IRB.
Results: A total of 60 stool samples (-2w, $n = 16$; -2d, $n = 15$; + 2w, $n = 16$; + 3 m, $n = 13$) from 16 patients were analyzed. The average patient age was 48.6 ± 12.15, 87.5% were female, and pre-operative BMI was 50.87 ± 23.26. There was no significant difference in the patient demographics between antibiotics groups. A two-week, high protein liquid diet did not affect microbial diversity (-2w vs -2d). When comparing the entire cohort pre- and post-operatively, RYGB induced significant differences in beta diversity at + 2w (weighted UniFrac $p = 0.026$), and alpha and beta diversity at + 3 m compared to -2d. There were statistically significant differences in alpha diversity at + 2w and beta diversity at + 3mo compared to -2d with longitudinal analysis due to antibiotic treatment (Jaccard dissimilarity PCoA2 $p = 0.04$).
Conclusion: We did not detect a significant effect of a 2-week whey protein diet on microbial composition and diversity. Previous studies have found that RYGB induces significant changes in the gut microbiome at 2 weeks that is maintained 3 months after surgery. However, we found that these changes differ based on antibiotic class. A single peri-operative dose at the time of RYGB induces unique and persisting changes that are antibiotic specific. These changes could affect the metabolic efficacy of RYGB when considering gut-microbiome driven mechanisms of disease improvement.

S098

The utility of preoperative upper endoscopy in patients undergoing bariatric surgery: an eleven-year retrospective analysis of 887 patients

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Introduction: The aim of this study was to evaluate the diagnostic yield of routine preoperative esophagogastroduodenoscopy (p-EGD) in patients undergoing bariatric surgery. Obesity is a risk factor for several chronic disease processes that impact the upper gastrointestinal (GI) tract. The prevalence of gastroesophageal reflux disease (GERD) is significant in the obese population. GERD is often related to a hiatal hernia (HH), which has important implications for patients undergoing bariatric surgery. While p-EGD is considered standard of care prior to anti-reflux surgery, the role of p-EGD in bariatric surgery patients remains controversial.
Methods and procedures: We performed a retrospective review of 657 patients who underwent bariatric surgery at a university hospital-based bariatric surgery program between August 2011 and July 2020. Clinical history and preoperative EGD reports were reviewed for abnormal findings.
Results: Of the 657 patients evaluated in this study, one or more abnormal EGD findings were observed in 81% of patients ($n = 535$). Fifty-two percent of patients ($n = 344$) presented with history of heartburn, reflux, or GERD. EGD findings demonstrated HH in 41% of patients [$n = 271$ (Type I: $n = 259$; Type II: $n = 1$; Type III: $n = 11$)]. Other findings included gastritis, esophagitis, or duodenitis in 34% of patients ($n = 226$). We found gastric ulcers in 7.0% of patients ($n = 46$). Biopsies for Helicobacter (H.) Pylori and Barrett's esophagus (BE) were taken from 39% ($n = 255$) and 9.3% of patients ($n = 61$), respectively. Pathology was consistent with H. Pylori in 9% of biopsies taken ($n = 41$) and consistent with BE in 19% ($n = 12$). Routine p-EGD influenced clinical management in 22.8% (149) of patients.
Conclusion: GERD and associated pathology are common in the obese population, and p-EGD in patients undergoing bariatric surgery frequently identifies clinically significant GI pathology. This may have important implications for medical and surgical management. Given the rate of abnormal preoperative endoscopic findings in obese patients, we believe the work-up for bariatric surgery should align with the current recommendations for anti-reflux surgery, and include p-EGD.

S099

Long term weight loss after bariatric procedures for morbidly obese adolescents: a single-institution analysis with a 15-year follow-up

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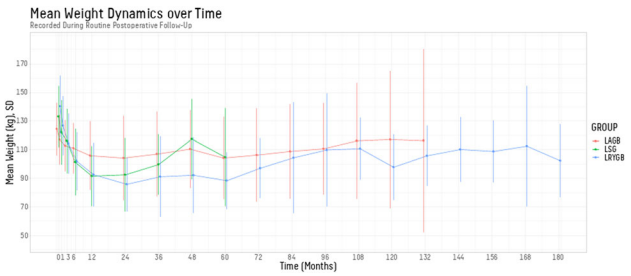
Introduction: Morbid obesity, particularly in adolescent populations, is becoming a health crisis in most developed countries. Bariatric surgery remains the most effective treatment for morbid obesity. Limited data exist regarding long-term outcomes and selection of optimal bariatric procedure for the adolescent population.

Methods: Adolescents between ages 15–24 undergoing laparoscopic bariatric procedures at a single institution were enrolled in a registry between 2001 and 2019. The three operations examined were Roux-en-Y gastric bypass (LRYGB), sleeve gastrectomy (LSG), and adjustable gastric band (LAGB). A 15-year comparison of weight loss patterns between the procedures was conducted to evaluate the long-term efficacy. One-way and mixed-design ANOVA models were used to determine statistically significant differences in variables between groups over time. All operations were completed laparoscopically by a single surgeon (PG) utilizing similar operative techniques and clinical pathways.

Results: A total of 167 adolescents were enrolled in the study. The mean age of participants was 21.3 ± 2.1 years, and 82.6% of participants were female. Mean initial BMI of participants was 48.5 ± 6.5 kg/m^2 (38.4–68.1 kg/m^2), and initial weight was 135.0 ± 21.7 kg (88.7–196.0 kg). For procedures, 71 patients underwent LRYGB, 74 patients underwent LSG, and 22 patients underwent LAGB. At five years, LRYGB produced a mean body weight reduction of 51.8 kg, followed by LSG (30.8 kg) and LAGB (16.0 kg, $p < 0.001$). Net BMI reduction at 5 years was 18.2 kg/m^2 for LRYGB, 11.0 kg/m^2 for LSG, and 6.2 kg/m^2 for LAGB ($p < 0.001$). Additionally, at 11 years, weight loss and BMI reduction for LRYGB were 45 kg and 15.9 kg/m^2 compared to 6.7 kg and 3.9 kg/m^2 for LAGB patients. At 15 years, LRYGB patients maintained significant weight loss (-41.8 ± 8.4 kg, BMI -15.9 ± 14.0 kg/m^2). Mixed-design ANOVA demonstrated significant divergence in body weight between the three operative groups over the first 5 years after surgery ($p = 0.01$). In the LAGB group, five (22.7%) patients underwent device explantation at mean 55.5 months after surgery. Among LRYGB patients, 14 (19.2%) underwent reoperation (including two emergent early reoperations and five internal hernia repairs). The LSG group had three late reoperations (4.1%).

Conclusion:: All procedures provided significant and sustained weight loss for adolescent patients. LRYGB provided the best and most sustained weight loss results up to 15 years after surgery. Both LSG and LAGB patients experienced maximum weight loss at one and two years after surgery followed by observable weight increase. Reoperation rates were highest among LAGB patients.



S100

Implementation of a standardized multimodal pain regimen significantly reduces postoperative inpatient opioid utilization in patients undergoing bariatric surgery

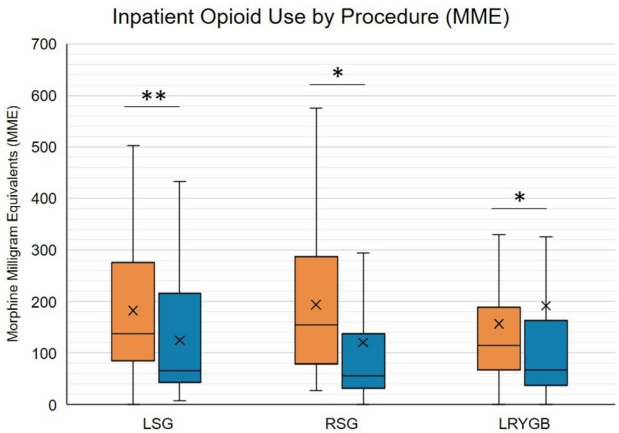
Wen Hui Tan, MD; Jordanne Ford, BA; Jon Gould, MD; Medical College of Wisconsin

Background: With the prescription opioid epidemic, efforts have been made to reduce opioid utilization in medicine, especially in the postoperative setting. Little is known about opioid use specifically in bariatric surgery, with even less data about opioid use in the inpatient setting. We hypothesize that a standardized multimodal pain regimen reduces postoperative inpatient opioid use in patients undergoing bariatric surgery.

Methods: A retrospective case–control study was conducted of bariatric surgery patients at a single academic institution from April 2018 to December 2020. A standardized multimodal pain regimen was deployed during the study period in which patients received transversus abdominis plane blocks, acetaminophen, and gabapentin preoperatively and methocarbamol, acetaminophen, and as needed opioids postoperatively. The primary outcome was postoperative inpatient opioid utilization (MME). Descriptive statistics, student's t-tests, and Wilcoxon-Mann–Whitney tests were used to compare outcomes in the pre- and post-intervention groups.

Results: A total of 359 patients were included in this study; 192 in the pre- and 167 in the post-intervention groups. Patients were similar in demographics. For all patients, mean age was 44.1 ± 12.1 years, mean BMI 49.2 ± 8.1 kg/m^2, and 79.7% were female. 47.9% of patients underwent laparoscopic sleeve gastrectomy, 33.7% laparoscopic RYGB, 17.3% robotic sleeve gastrectomy, 0.8% robotic RYGB. Following implementation of the multimodal pain protocol, postoperative inpatient opioid utilization was statistically significantly lower. In the pre-intervention group, median inpatient opioid utilization was 134.8 [79.0–240.8] MME compared to 61.5 [35.5–150.0] MME in the post-intervention group ($p < 0.001$). MME prescribed at discharge also significantly decreased, with a median of 300 MME prescribed at discharge in the pre-intervention group compared to 75 MME in the post-intervention patients ($p < 0.001$). 15.6% of post-intervention patients did not receive an opioid prescription at discharge, compared to 0 pre-intervention patients ($p < 0.001$). When examining inpatient opioid utilization by procedure, statistically significant reductions were seen for each operation: for laparoscopic sleeve gastrectomy, inpatient opioid utilization fell from a median of 136.75 [85.0–270.0] to 55.5 [31.5–129.75] MME ($p < 0.0001$); for laparoscopic RYGB, 114.5 [68.5–186.25] to 67.5 [38.0–154.0] MME ($p < 0.01$); and for robotic sleeve gastrectomy, 154.0 [79.0–286.0] to 65.5 [43.0–188.0] MME ($p < 0.01$).

Conclusions: Implementation of a standardized multimodal pain regimen significantly reduces postoperative inpatient opioid utilization in patients undergoing bariatric surgery.



S101

Success rates and outcomes of the robotic natural-orifice intracorporeal anastomosis with extraction (nice) procedure across complicated and uncomplicated diverticulitis cases

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Introduction: We implemented the NICE procedure as a robotic natural orifice colorectal resection utilizing the rectum to extract the specimen and complete an intracorporal anastomosis for diverticulitis in 2018. Although complicated diverticulitis is associated with higher rates of conversion and post-op morbidity, we hypothesized that the stepwise approach of the NICE procedure can be equally successful in this cohort. We aimed to compare feasibly and outcomes of the NICE procedure for complicated versus uncomplicated recurrent diverticulitis.

Methods: Consecutive patients presenting with diverticulitis who underwent robotic NICE procedure from May 2018 through June 2021 were included. Cases were stratified into recurrent diverticulitis and complicated diverticulitis (fistula, abscess or stricture). Demographic, clinical, disease, intervention, and outcomes data were analyzed. The main outcome measures were return of bowel function, length of stay, opioid consumption and postoperative complications.

Results: Of 196 patients, 47% consisted of complicated diverticulitis and 53% recurrent diverticulitis. Both cohorts had comparable age, gender and ASA. Complicated diverticulitis cohort had higher body mass index (30.5 kg/m^2 vs 28 kg/m^2, $p = 0.005$), higher rates of low anterior resection (54.8% vs 23.3%, $p < 0.001$), longer mean operative times (234.4 min vs 199.6 min, $p < 0.001$), greater mean estimated blood loss (59.7 ml vs 39.5 ml, $p = 0.003$), higher rates of splenic flexure takedown (96.8% vs 89.3% $p = 0.043$) and need for diverting loop ileostomy (19.4% vs 8.7%, $p = 0.031$).

Both cohorts had equal rates of successful intracorporeal anastomosis (100%) and successful transrectal extraction (98.9% vs 100%, $p = 0.472$). The complicated diverticulitis group required thinning of the mesentery for extraction in 67.4% of cases versus 18.4% in those with uncomplicated disease ($p < 0.001$). There were no conversions in either group.

Both cohorts had similar rate of return of bowel function (19 h and 21 h, $p = 0.553$), similar mean length of hospital stay (2.7 days vs 2.2 days, $p = 0.057$) and similar mean total opioid use (67.3 vs 68.4, $p = 0.906$). There were also no significant differences in overall postoperative complications rate (16.1% vs 9.7%, $p = 0.178$), including organ space surgical site infection (3.2% vs 2.9%, $p = 1.000$) and postoperative ileus (5.4% vs 1%, $p = 0.074$). Readmission (5.4% vs 6.8%, $p = 0.679$) and re-operative rates (4.3 vs 3.9, $p = 1.000$) were also comparable.

Conclusion: Despite inherently more complex and technically challenging, those with complicated diverticulitis have similar success rates and post-operative outcomes compared to those with uncomplicated disease when undergoing the NICE procedure. These results implicate the benefits of robotic natural orifice techniques may be even more pronounced in those with complex disease.

Table. Intraoperative variables and postoperative outcomes of all cases undergoing Robotic NICE procedure for diverticulitis

	Recurrent N=103	Complicated N=93	p-value
Type of surgery			**<0.001[b]**
Anterior resection	79 (76.4)	42 (45.2)	
Low anterior resection	24 (23.3)	51 (54.8)	
Operative time in minutes, mean (range)	199.6 (99-373)	234.4 (124-449)	**<0.001[a]**
Estimated blood loss in ml, mean (range)	39.5 (5-100)	59.7 (0-300)	**0.003[a]**
Diverting loop ileostomy	9 (8.7)	18 (19.4)	**0.031[b]**
Splenic flexure takedown	92 (89.3)	90 (96.8)	**0.043[b]**
Thinning maneuver	19 (18.4)	62 (67.4)	**<0.001[b]**
Converted to open or other approach	0 (0)	0 (0)	-
Return of bowel function in hours, mean (range)	21 (5-59)	19 (6-96)	0.553[a]
Length of hospital stay in days, mean (range)	2.2 (1-14)	2.7 (1-9)	0.057[a]
30-day readmissions	7 (6.8)	5 (5.4)	0.679[b]
30-day reoperations	4 (3.9)	4 (4.3)	1.000[c]
Overall postoperative complications	10 (9.7)	15 (16.1)	0.178[a]
Postoperative ileus	1 (1)	5 (5.4)	0.074[c]
Surgical Site infection			
Superficial	0 (0)	0 (0)	-
Deep	0 (0)	0 (0)	-
Organ Space	3 (2.9)	3 (3.2)	1.000[c]
Total Morphine Milligram Equivalents mean (SD)	68.4 (37.6)	67.3 (29.7)	0.906[a]

All values are count (percentage) unless specified otherwise
[a] Independent t-test [b] Pearson's Chi Square test [c] Fisher's exact test
Significant p-values are in bold

S103

DAMASCUS (diverticulitis management, a snapshot collaborative audit study): global profile of patients presenting with acute diverticulitis and index management

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Background: Acute diverticulitis is a common surgical emergency increasing in frequency worldwide. Initial management varies from conservative strategies such as antibiotics and drainage procedures, to more invasive surgical procedures such as laparoscopic lavage and bowel resection. Retrospective studies suggest international variability in the index management of acute diverticulitis, and that such differences may contribute to the observed differences in global mortality rates. The DAMASCUS study aims to prospectively study the global management of patients presenting with acute diverticulitis and correlate index management with clinical outcomes.

Methods: A 6-month prospective, global study of the management and short-term outcomes of patients presenting with acute diverticulitis was conducted. Patient and disease covariates along with short term clinical outcomes were recorded anonymously via a RedCap database hosted by the University of Birmingham centre for observational studies (BiCOPS). Regions were divided into North America, Europe, UK, Australasia and Asia/Africa/South America (LMIC's) in order to assess international variation in index management.

Results: 6098 patients were recruited between October 1st 2020 to August 31st 2021 from 248 surgical units across 48 countries. Complete datasets were available for 5659 patients (UK, 2872 [51%], Europe 1739 [31%], North America 394 [7%], Australasia 323 [6%], LMIC's 331[6%]). CT was performed in 98% of the cohort, however this was significantly lower in LMIC's (88%, $p < 0.001$). The majority of patients were managed as an inpatient, however this varied significantly between regions (39% North America to 96% Australasia, $p < 0.001$). 5452 (96%) of patients received antibiotics, with the ratio of oral:iv use significantly higher in North America (3.4:1) compared to the overall cohort (1:2.5, $p < 0.001$). Anti-inflammatories were used in 22% of patients, with use varying significantly from 4% (Australasia) to 43% (Europe, $p < 0.001$). 199 (4%) of patients underwent percutaneous drainage, rates varied significantly between regions 2% (UK) to 9% (LMIC's, $p < 0.001$). 709 (13%) patients underwent surgery as their initial treatment with rates by regions varying significantly from 6% (North America) to 24% (LMIC's). 614/709 of the surgical patients underwent resection with 456 (74%) having a stoma performed (88% end stomas). End stoma rate varied significantly between regions from 2% (North America) to 9% (Australasia, $p < 0.001$).

Conclusion: The DAMASCUS study is the largest, global prospective study of the management of acute diverticulitis. The study has confirmed that significant geographical variation exists in the index management of the disease. Further analysis will be performed to determine whether such variation is associated with short term clinical outcomes.

S105

Development of machine learning models to predict readmission after colorectal surgery

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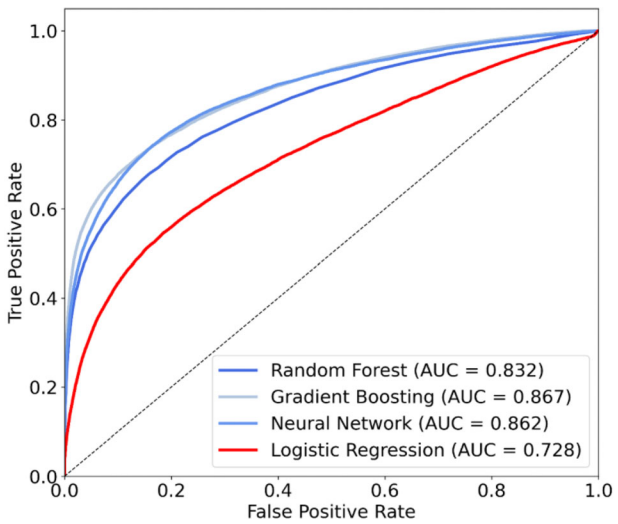
Background: Readmission after colorectal surgery is a marker of negative outcomes and a focus of quality improvement and cost reduction efforts. Previous work has created statistical models that predict readmission after colorectal surgery with modest accuracy, with area under the receiver operating characteristic curve (AUC) score of 0.76. Machine learning has shown promise in improving upon the results of traditional modeling approaches by identifying subtle, non-linear patterns in data. We sought to create a more accurate prediction model for readmission after colorectal surgery using machine learning.

Methods and Procedures: Patients who underwent colorectal surgery were identified in the American College of Surgeons National Quality Improvement Program (NSQIP) database including years 2012–2019. Data from 2012–2018 were split into training and validation sets in an 80/20 ratio, with 2019 data used as an external test set. Patients missing data on readmission or who were still in hospital at 30 days were excluded. All available pre-discharge variables were used to train machine learning models with three approaches: random forest (RF), gradient boosting (XGB), and artificial neural network (ANN). A logistic regression (LR) model was also created for comparison. Model performance was evaluated using AUC on the test set. AUC measures a model's discriminatory ability and is scaled from 0.5 (random guessing) to 1.0 (perfect classification).

Results: The dataset included 211,716 patients after application of exclusion criteria. 132,919 were included in the training set, 33,230 in the validation set, and 45,567 in the test set. 26,417 (12.5%) of patients experienced readmission. Infectious complications, followed by dehydration/renal failure, and venous thrombosis were the most common reasons for readmission. RF obtained an AUC of 0.832 (95% CI 0.825—0.840). XGB obtained an AUC of 0.867 (95% CI 0.864—0.870). ANN obtained an AUC of 0.862 (95% CI 0.859—0.866). LR obtained an AUC of 0.728 (95% CI 0.724—0.732). Index admission length of stay, post-operative organ space infection, BMI, and total operative time were identified as the most contributory inputs.

Conclusions: Machine learning approaches (RF, XGB, and ANN) outperformed traditional statistical methods in the prediction of readmission after colorectal surgery (AUC 0.867 vs 0.728). This improved prediction model could be used to target interventions to reduce readmission rate.

Figure 1. Receiver Operating Characteristic Curves for Various Approaches in the Prediction of Readmission after Colorectal Surgery.



S106

A comparison of short- and long-term outcomes following intracorporeal and extracorporeal anastomotic techniques in laparoscopic right hemicolectomies

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Background: Laparoscopic-assisted right hemicolectomy with extracorporeal anastomosis (ECA) requires intestinal exteriorization with associated mesenteric traction through an upper or mid-abdomen incision. This may be associated with post-operative ileus, prolonged length of stay and hernia formation at the extraction site. We sought to assess whether totally laparoscopic intracorporeal anastomotic (ICA) technique could mitigate these risks.

Methods: Adult patients undergoing elective laparoscopic right hemicolectomies between 2012 and 2020 at a single institution were included and followed-up for one year. Operative time was recorded and compared. Multivariable negative-binomial and logistic regression models were used to estimate the association between anastomotic technique and both length of stay and extraction-site hernia development at one year, as appropriate. Sensitivity analyses were performed excluding patients who underwent surgery between 2012 and 2015 when uptake of ICA was low and patients undergoing surgery for non-neoplastic diagnoses.

Results: A total of 188 patients met inclusion criteria, of which 101 (53.7%) underwent ICA and 87 (46.3%) underwent ECA. Patients undergoing ICA were generally older (mean 68 [STD 14.1] vs. 63 years [STD 16.2], $p = 0.02$), and underwent surgery more recently (median 2018 [IQR 2016–2019] vs. 2015 [IQR 2014–2017], $p < 0.001$). Groups were otherwise similar according to sex, comorbidity index and indication for surgery. Operative time (non-surgical + surgical time) was longer in the ICA group (median 249 (IQR 221–296] vs. 209 min [IQR 180–243], $p < 0.001$). ICA patients were discharged sooner (median 4.1 [IQR 3.1–5.3] vs. 5.1 [3.3–7.2] days, $p = 0.002$). On multivariable analysis ICA was significantly associated with decreased length of stay (aRR 0.81 [95% CI 0.68–0.96], $p = 0.02$). This result estimate was robust to described sensitivity analyses. The incidence of extraction-site hernias at one year was inferior in ICA patient (1.0% vs. 8.0%, $p = 0.02$), and ICA was associated with a 88% decrease in the odds of developing an extraction-site hernia on multivariable analysis (aOR 0.12 [95% CI 0.01–0.98], $p = 0.048$).

Conclusions: Despite increased operative time, intracorporeal anastomosis in laparoscopic right hemicolectomy was associated with several advantages, including decreased length of stay and fewer extraction site hernias.

S107

Fluorescent ICG angiography in laparoscopic rectal resection—a randomized controlled trial

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Introduction: Leakage of the intestinal anastomosis is one of the most dangerous complications after colon surgery. It may cause prolonged hospitalization, systemic complications, result in lowering the quality of life and worse results of oncological treatment. It is more common after rectal resections. One of the reasons for an anastomotic leak is insufficient blood supply to the anastomotic intestine. Intraoperative infrared angiography with indocyanine green with the use of special electronic image filters is to improve the assessment of intestinal blood flow and thus prevent leakage of the anastomosis after surgery.

The aim of the study is to assess the usefulness of intraoperative fluorescence angiography with indocyanine green assessed in the 4 K image during rectal resection procedures due to cancer.

Material and methods: The study included 76 patients undergoing scheduled rectal cancer surgery using 4 K imaging. Patients were randomized into 2 groups. Group I—41 patients with ICG intraoperative angiography and Group II—35 patients with intestinal blood flow assessed only under standard lighting. Both groups were comparable in terms of age, sex, BMI and the advancement of the neoplastic process. The study was approved by the local ethics committee.

Results: Group I patients received 25 mg of indocyanine green intravenously before the anastomosis. The average time of intestinal wall contrasting was 42 s (22–65 s). The average time needed to carry out the entire procedure was 4 min, which was about 3.2% of the total time of surgery. 3 patients (7.3%) after angiography revealed intestinal ischemia requiring widened resection. In the postoperative period, no anastomotic leak was found, no side effects were observed after the administration of the contrast. In group II, 3 rectal anastomotic leakages (8.6%) were diagnosed, 2 of which required reoperation. The mean hospitalization time in group I was 4.4 days, and in group II 4.9 days ($p < 0.05$).

Conclusions: Intraoperative angiography with indocyanine green in near-infrared light is a safe and effective method of assessing intestinal perfusion. The use of fluorescence angiography changes the surgical plan and reduces the risk of leakage of the rectal anastomosis.

S108

Patient-guided narcotic prescriptions and preoperative pain management education decreases excess opioid burden

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Introduction: Managing postoperative pain requires an individualized approach in order to balance adequate pain control with risk of persistent opioid use and narcotic abuse associated with inappropriately outsized narcotic prescriptions. We report here the results of a quality improvement initiative instituting prescribing guidelines and preoperative pain expectation and management education.

Methods: Pre-intervention prescribing habits were obtained by retrospective review perioperative pharmacy records for patients undergoing general surgeries in the 24 months prior to initiation of intervention. Patients scheduled to undergo General Surgery procedures were given a survey at their preoperative visit. Preoperative education was performed by the surgical team as a part of the Informed Consent process using a standardized handout and patients were asked to choose the number of narcotic pills they wished to obtain within prescribing recommendations. Postoperative surveys were administered during or after their 2-week postoperative visit.

Results: 101 patients completed preintervention and postintervention surveys. The average prescription size decreased from 12.39 oxycodone pills per surgery prior to institution of pathway to 7.06 pills per surgery after institution of pathway ($p < 0.001$). The percentage of unused pills after surgery decreased from an estimated 68.65% preintervention to 45.16% ($p < 0.001$) postintervention. 62.7% of patients with excess pills returned or planned to return medication to the pharmacy with an additional 13.4% of patients reporting alternative disposal method. 23.9% of patients reported a plan to keep remaining pills or had no plan. There was no difference in patient-reported dissatisfaction between prior surgeries and recent surgery (5.5% vs. 3.9%, $p = 1.45$).

Conclusion: Preoperative pain education and prescribing recommendations significantly decreases opioid prescription without decreasing patient satisfaction, resulting in significantly fewer unused opioid pills available in the community. The results of a 12 month interim update are pending and will be available at time of presentation.

S109

The effects of using telemedicine for introductory bariatric surgery seminars during the COVID-19 pandemic

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Background: The COVID-19 pandemic required immediate systematic change in healthcare delivery to maintain safety for patients and healthcare workers. Many institutions relied on telemedicine platforms as an alternative to in-person visits. There is limited data in the bariatric surgery literature to determine if telemedicine could be a long-term tool in the post-pandemic era to provide healthcare without compromising safety or efficacy. This paper evaluates the effects of using telemedicine for the Introduction to Bariatric Surgery Seminar at a single institution.
Methods: A retrospective review was performed before and after implementing virtual introductory seminars for bariatric surgery patients at a comprehensive metabolic and surgery center. The effect on attendance rates for introductory seminars and completion rates of bariatric surgery was evaluated.
Results: The introductory seminar attendance rate for the pre-telemedicine period, April 2019 to February 2020, was compared to that of the post-telemedicine period, June 2020 to April 2021. A total of 836 patients registered for an introductory seminar in the pre-telemedicine period with a 65.79% attendance rate. In the post-telemedicine period, 806 patients registered with a 67.87% attendance rate, which was slightly improved but not statistically different ($p = 0.37$, 95% CI -0.03 – 0.07). Completion rates of bariatric surgery were also analyzed using June 2019 to October 2019 as the pre-telemedicine period and June 2020 to October 2020 as the post-telemedicine period. Similarly, there was no statistical difference between the pre-telemedicine surgery rate of 23.43% and the post-telemedicine surgery rate of 19.68% ($p = 0.31$, 95% CI -0.11 – 0.04).
Conclusions: Despite abruptly transitioning to virtual introductory bariatric seminars, there was no change in attendance rates nor was there a difference in the number of patients progressing through the program and undergoing bariatric surgery at our institution. This demonstrates similar efficacy of telemedicine and in-person introductory seminars for bariatric surgery patients, which supports telemedicine as a promising tool for this patient population in the post-pandemic era.
Keywords: telemedicine, virtual, bariatric surgery, COVID, pandemic, attendance rate, efficacy.

S110

Opioid-free analgesia after outpatient general surgery: A qualitative study focused on the perspectives of patients and clinicians involved in a pilot trial

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Background: The overprescription of opioids to surgical patients is an important contributor to the current opioid crisis. From the perspective of surgeons, the answer to this crisis may be prescribing opioid-free analgesia (OFA); however, the value of this approach should be assessed in randomized controlled trials (RCTs). Undertaking an RCT on OFA raises important practical concerns including surgeon and patient hesitation regarding pain management without opioids and optimal strategies for recruitment, randomization, and outcome measurement. Thus, the objective of this qualitative study is to explore patients' and clinicians' perspectives and experiences with a pilot RCT focused on OFA after outpatient general surgery.
Methods: We conducted qualitative interviews with patients and clinicians involved in a pragmatic pilot trial comparing opioid analgesia (OA) versus OFA after outpatient general surgery (abdominal and breast procedures). A maximum variation sampling method was used to ensure the recruitment of participants with diverse characteristics. Interviews followed semi-structured guides comprised of open-ended questions designed to elicit participants' personal perspectives and experiences with the trial interventions and procedures. Transcribed interviews were assessed using an inductive thematic analysis approach.
Results: Ten patients [8 randomized (5 OA, 3 OFA), 2 refused participation; 5 abdominal surgeries, 5 breast surgeries) and 10 clinicians (6 surgeons, 2 anesthesiologists, 2 nurses)] were interviewed. The results revealed three major themes: acceptability of trial interventions, acceptability of trial design, and trial refinement. While most patients were open to postoperative analgesia without opioids, some had a priori concerns about inadequate pain control. Clinicians expressed willingness to prescribe OFA, particularly after minimally invasive surgery and when using peripheral nerve blocks (PNBs), but some (1) argued that prescribing a small number of opioid pills has limited harms and (2) expressed concerns about the safety of non-opioid drugs (e.g., NSAID-induced bleeding and kidney injury). Patients and clinicians were enthusiastic about the trial and recognized its relevance. Overall, experiences with the pilot trial were positive: clinicians praised the study design and organization, and patients valued the possibility of responding to outcome questionnaires electronically. Suggestions for improvements included preventing potential bias arising from the use of PNBs (i.e., standardizing procedures or stratifying randomizations) and reducing patient burden (i.e., decreasing postoperative questionnaires).
Conclusion: Findings from this qualitative study support the acceptability and feasibility of a full-scale RCT comparing OA versus OFA after outpatient general surgery. Lessons learned from patients and clinicians will optimize trial design to better inform evidence-based postoperative analgesia prescribing.

S111

A Self-Selecting Prophecy: Prevalence of Burnout in Surgical Fellows

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Introduction: Burnout among trainees has recently become a prominent topic in surgical education, but there is limited data on the manifestation of this phenomenon among surgical fellows in comparison to medical students, residents or attending surgeons. The goal of this study is to better elucidate the prevalence of burnout in surgical fellows and determine if there are predisposing factors that may increase the risk of burnout in this population.
Methods: A confidential electronic survey was distributed to all fellows participating in Fellowship Council programs during the 2020–2021 academic year. Demographic information, fellowship type and future plans were queried. The fellows were then asked to complete the Maslach Burnout Inventory (MBI), Perceived Stress Scale (PSS), Short Grit Scale (SGS), Satisfaction with Life Scale and General Self-Efficacy Scale (SE). Data was analyzed using a combination of Chi square, independent samples t-test and ANOVA with p values of ≤ 0.05 being considered statistically significant. Data analysis was done using JASP (JASP Team, Version 0.14.1).
Results: At the end of the survey period, 92 out of 196 (46.9%) fellowship trainees responded with a 36.7% complete response rate. Notable demographic findings include 69.6% of respondents identifying as women, 30.4% as international medical school graduates (IMGs) and 21.7% non-US IMGs. Based on the criteria defined by the MBI, there was an 8.4% rate of burnout in our study group. Both of the thoracic trainees who responded were burnt out ($p = < 0.001$). None of the hepatopancreaticobiliary trainees screened positive for burnout. Most respondents noted low stress levels (62.3%), good satisfaction with life (69.9%), a moderate amount of grit and a high level of self-esteem. Respondents identifying as male were found to have a higher mean score for grit in comparison to the respondents identifying as female ($p = 0.025$).
Conclusion: The rate of burnout among fellows was 8.4% in our study, which is well below the rate supported in the literature for younger trainees and attending surgeons. This may be reflective of a self-selecting effect, as trainees who choose to undergo additional training are likely those who demonstrate increased resilience and grit. In addition, there may be a protective factor during fellowship that results from inherent mentoring, increased specialization and autonomy. Further investigation of the high prevalence of burnout in thoracic trainees is warranted based on the results of this study.

S112

Multiple Year Review of Cholecystectomy Outcomes In Telehealth Follow Up

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Background: The COVID-19 pandemic has brought many challenges including the ability to deliver high quality surgical care and follow-up while minimizing the risk of infection. Telehealth has been increasingly utilized for post-operative follow-up yet little data exists to guide surgeons in its efficacy and safety. We sought to determine this in patients undergoing cholecystectomy during the global pandemic at a VA Medical Center (VAMC).
Methods: A retrospective review of patients undergoing cholecystectomy, as determined by CPT, at a tertiary VAMC over a 2-year period from 8/2019 to 8/2021. Baseline demographics, post-operative complications, readmissions, emergency department (ED) visits and need for additional procedures were reviewed. Patients who experienced a complication before discharge, underwent a concomitant procedure or went home with drains were ineligible for telehealth follow-up and excluded.
Results: Over a 2-year period, 319 patients underwent cholecystectomy; 170 (53%) were excluded as above. Thirteen (9%) missed their follow-up, 52 (35%) were seen via telehealth and 77 (52%) followed-up in person. There was no difference between the two groups regarding baseline demographics or intra-operative variables. (Table 1) There was no difference in the utilization of telehealth based upon distance to the medical center. There was no difference in post-operative complications between telehealth and in-person follow up (8%(4) vs. 8%(6), $p > 0.9999$), ED utilization (10%(5) vs. 9%(7), $p = 0.7804$, 30-day readmission (6%(3) vs. 8%(6), $p = 0.7390$) or the need for additional procedures (4%(2) vs. 5%(4), $p = 0.4076$).
Conclusion: Telehealth follow-up after cholecystectomy is safe and effective in Veterans. There was no difference in post-operative complications, ED visits, 30-day readmission or the need for additional procedures between patients that followed up in-person vs. those that were seen via phone or video. Routine telehealth follow-up after surgery should be considered an option in all patients after uncomplicated cholecystectomy.

	In Person %(n = 77)	Telehealth %(n=52)	
Age, average	56	56	P=0.8845
BMI, average	29.92	30.28	P=0.7955
ASA Classification			P=0.8995
I	4(3)	2(1)	
II	40(31)	38(20)	
III	53(41)	58(30)	
IV	3(2)	2(1)	
Urgency			P=0.3470
Urgent cases	31(24)	40(21)	
Elective	69(53)	60(31)	
Conversion to Open	7(5)	0(0)	P=0.0852
Emergency Department Visit	9(7)	10(5)	p=0.7804
Complications	8(6)	8(4)	P>0.9999
Cardiopulmonary	4(3)	0(0)	P=0.1721
Infection complications	3(2)	6(3)	P=0.1204
Superficial	0(0)	4(2)	
Deep	0(0)	2(1)	
Organ/space	3(2)	0(0)	
Bile leak	0(0)	2(1)	P=0.4031
30-day Readmission	8(6)	6(3)	P=0.7390
Additional Procedures	5(4)	4(2)	P=0.4076
Operative	3(2)	0(0)	
ERCP	0(0)	2(1)	
Bedside I&D	3(2)	2(1)	

S124

Comparing artificial intelligence and surgeon annotators to label roux-en-y gastric bypass videos at the step level

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Introduction: Artificial intelligence (AI) and machine learning (ML) may improve surgical education and patient care. There are few published data on how AI/ML model labeling accuracy compares with surgeon annotators at the step level. This study focuses on understanding the level of inherent subjectivity in surgery, and as a result, the current limitations of AI/ML to advance the field of surgical data science and create large databases of consistently labeled video data.

Method/procedures: Videos of bariatric surgeons were collected from at least 17 surgeons across Europe and the US. 11 surgeon annotators, with roles ranging from 4th year residents to attendings, were trained to label the 12 steps of an RYGB using internally developed definitions based on previously published literature. Videos were annotated with a 2 + 1 structure. 2 first pass surgeons independently annotated each video. 1 internal "super annotator" resolved discrepancies to generate a consensus set. A fully convolutional model was trained and tested. Model performance at the step level was compared with the performance of first pass annotators using ANOVA analysis to determine which factors were more likely to impact model accuracy.

Results: 545 complete RYGB recordings were annotated and used to train and test a model. Model f1 reached > 90% for 7/12 steps and > 80% for 11/12 steps (Figure 1). The model performed better than first pass annotators on > 5 steps for 3 annotators, 2–5 steps for 4 annotators, and < 2 steps for 4 annotators. Variations in model and first pass annotator performance were similar for similar steps (p = 1.20e-70, Figure 2). Certain videos were more or less difficult to annotate (p = 3.44e-17) for both annotators and AI. Even when both factors are controlled for, the annotator F1 was still predictive of the model F1 for individual procedure steps (p = 9.54e-9), suggesting the difficulty of annotation definitions and/or the inherent subjectivity of surgical events.

Conclusion(s): Machine learning models can detect RYGB steps with an accuracy better than surgeon annotators at times. However, surgical steps are inherently subjective even for highly trained surgeon annotators, leading to a bottleneck in model performance. Therefore, while this technology can scale video-based assessment, there are limitations to the accuracy of data creation that must be addressed to ensure clinical significance.

S125

Utility and usability of laser speckle contrast imaging (LSCI) for displaying real-time tissue perfusion/blood flow in robot assisted surgery (RAS): comparison to indocyanine green (ICG) use and in laparoscopic surgery

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Introduction: Utility and usability of minimally invasive LSCI in detecting/displaying real-time tissue perfusion in Robot Assisted Surgery (RAS) are not known. Clinical adoption of indocyanine green (ICG)-based tissue perfusion, which detects fluorescence signal in blood volume, is challenged by hardware/cost, ICG pharmacokinetics, and subjective interpretation. LSCI generates a color heatmap of real-time blood flow on demand by capturing the interference or "speckle" pattern of coherent laser light on red blood cells. LSCI advantages over ICG for perfusion visualization include repeat use on demand, lack of need for external fluorophore, no latency between injection and display, and potential for more objective quantitative perfusion measurement. Herein, we report the clinical use of dye-less LSCI in real-time perfusion assessment during RAS and its comparison to ICG use in comparable laparoscopic surgeries.

Methods: ActivSight™ is an FDA-cleared device consisting of an imaging module positioned between a white light camera head and laparoscope, capable of detecting/displaying tissue blood flow via LSCI and visualizing ICG, initially developed for laparoscopic use. From November 2020 to July 2021, we studied its use across two institutions during elective intra-abdominal robotic cholecystectomies, colorectal and bariatric surgeries. For robotic surgeries, a laparoscope with ActivSight imaging module was inserted at key intraoperative moments to visualize the operative field in ICG/LSCI whereas in laparoscopic surgeries, the imaging module and laparoscope were in place throughout the case. We compared usability and utility of LSCI and ICG in RAS to laparoscopic approach. Usability (set-up, form-factor) by end-user/surgeon human factor testing (Likert scale 1–5) and utility in detecting/displaying tissue perfusion were measured and analyzed using two-tailed t-tests.

Results: LSCI and ICG were studied in 40 RAS (cholecystectomy, bariatric, colorectal) surgeries compared to 27 laparoscopic surgeries. Patient characteristics and demographics were similar in both groups. No adverse events were observed in both laparoscopic and RAS groups. Using a laparoscopic form factor had minimal impact on workflow and usability during RAS as evidenced by surgeon ratings of device usability (set-up 4.2/5 and form-factor 3.8/5). LSCI ability to detect perfusion (97.5% in RAS vs 100% in laparoscopic cases) was comparable to ICG use in both RAS and laparoscopic cases.

Conclusions: In contrast to ICG which detects fluorescence signal in blood volume, LSCI demonstrates comparable utility and usability in detecting/displaying real-time tissue perfusion and blood flow in RAS compared to laparoscopic surgery despite its form factor optimized for laparoscopy.

	Total		RAS		Laparoscopic		
Type of Case	**67**		**40**		**27**		
Bariatric	23		14		9		
Colorectal	17		16		1		
Laparoscopic Cholecystectomy	27		10		17		
Adverse Events	**0**		**0**		**0**		
Demographics	Mean	SD	Mean	SD	Mean	SD	P-value
Age (years)	53.78	14.40	56.35	13.60	49.68	14.90	N.S.
BMI	35.52	9.27	33.87	8.61	38.01	9.83	N.S.
Males # (%)	19 (28%)		10 (25%)		9 (33%)		N.S.
Race - White # (%)	49 (73%)		30 (75%)		19 (70%)		N.S.
Device Usability (Likert scale 1-5)							
	Mean	SD	Mean	SD	Mean	SD	P-value
Setting up	**4.2**	**1.0**	**4.2**	**1.0**	**4.1**	**1.0**	N.S.
Form Factor	**3.8**	**1.0**	**3.9**	**0.9**	**3.7**	**3.4**	**<.05**
LSCI Perfusion Display (Likert scale 1-5)							
Display	**4.1**	**0.9**	**4.1**	**0.7**	**4.1**	**1.0**	N.S.
	Yes		Yes		Yes		
Real-time perfusion detection? (Yes/No)	**98.2%**		**97.5%**		**100.0%**		N.S.

S126

Addressing dogma in surgery: video-based analysis to objectively identify stapler load sequence variations in sleeve gastrectomy and roux-en-y gastric bypass

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Introduction: Stapling-related complications remain a significant concern in bariatric surgery. Video-Based Analysis (VBA) offers a method to measure operative technique, contributing to foundational methods in surgical data science. Currently published methods of VBA focus predominantly on procedural technique. VBA for stapler-related events and outcomes are not well studied. This study demonstrates a novel method to objectively identify and visualize surgeons' choices of stapler load colors and sequence. The future aim of this data is to facilitate a more objective understanding of the causative factors in stapling-related complications.

Methods and procedures: Videos were collected from 23 surgeons across institutions in Europe and the US, representing both Roux-en-Y Gastric Bypass (RYGB) and Sleeve Gastrectomy (SG). Each video was annotated using a standardized guide to identify stapling events including stapler manufacturer, load color, buttress presence, and buttress type. Load color sequence was studied and compared across surgeons to identify trends in usage. Given varying volumes of data per surgeon, all analysis normalized load counts by the number of procedures contributed per surgeon so that all surgeons were equally represented in the final analysis.

Results: 950 total cases were identified, including 603 SG and 347 RYGB recordings. A total of 3716 stapler loads were labeled. Among SG data, color choice generally follows a logical progression from taller to shorter staples for thicker to thinner gastric tissue (Figure 1a). However, cord diagrams can reveal deviations in this progression for surgeons who tend to use purple and blue loads (Figure 2). Since RYGB technique is more variable, this analysis requires a breakdown by task (Figs. 1b and 3). Though blue and purple loads are preferred for gastric pouch creation, deviations to white and even gray are seen in horizontal stapling (Figure 3). Though gold, tan, and white loads are preferred for bowel division and anastomosis creation, deviations to purple and gold are also seen (Figure 3).

Conclusion(s): VBA can be leveraged to facilitate objective measurement of more granular stapler use techniques, including the frequency and sequence of task-specific use. Noting the most common and outlier sequences can guide surgeons in their choice of stapler, while driving questions more specifically around the potential causes of stapler-related complications. This study outlines a novel method of scalable data collection that can assist in measuring the variability in stapler use, with the aim of understanding the correlation between variability and surgical outcomes.

S127

Objective performance metrics can predict flow and length of robotic proctectomy

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Objective: To define operative flow of robotic proctectomy at an academic institution using previously defined key steps for video annotation. Our goal is to understand which tasks are predictive of console time (CT) and total operative time (TOT), which have the most variability, and which are likely to act as significant nodes during procedure flow.

Methods: Robotic proctectomies at our institution are recorded with an Intuitive Data Recorder (IDR), which records endoscopic video and synchronized objective performance metrics (OPMs). Using a previously developed annotation card for robotic proctectomy (Figure 1), we reviewed and annotated IDR video from 31 procedures. We evaluated time spent on each task, number of times each task was visited, CT, TOT, and transitions between each task. Time and frequency were reported using means and standard deviation (Figure 2). Transitions between tasks were estimated based on frequencies and reported using a circos plot (Figure 3). Associations of steps with CTs and TOTs were done using Spearman's correlation.

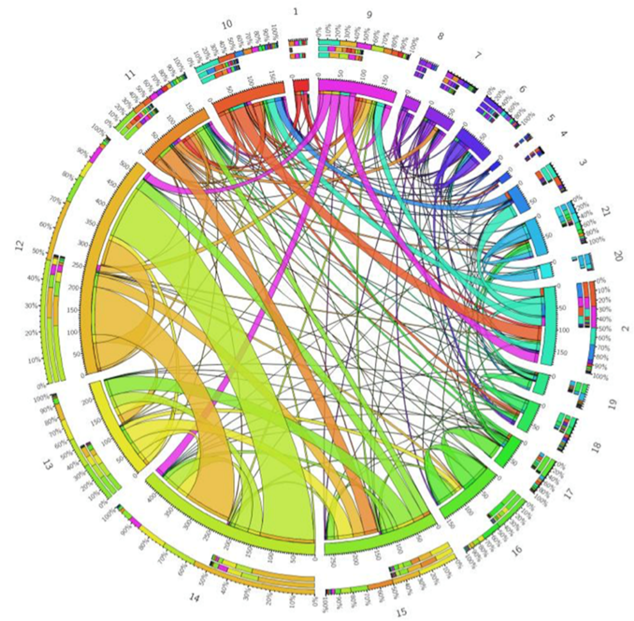
Results: During 31 robotic proctectomies, mean CT and TOT were 213 (± 90) and 283 (± 108) minutes. The tasks requiring the longest times were colorectal anastomosis (mean 18.02 [± 8.5] minutes), mesorectal dissection (15.69 [± 10.7] minutes), and posterior rectal dissection (13.36 [± 13.1] minutes). Posterior rectal dissection and right lateral rectal dissection had the most task visits, 261 and 220 respectively. Inferior mesenteric vein (IMV) ligation required the shortest time (5.55 min) and the least amount of task visits (6). There were highly positive correlations for splenic flexure mobilization task visit number and both CT (ρ = 0.746) and TOT (ρ = 0.67), for mesorectal dissection time and CT (ρ = 0.713), and a moderately positive correlation for IMV dissection time and TOT (ρ = 0.6). Mobilization of the left and sigmoid colon are nodal tasks, i.e. greater than 10 types of tasks both precede (13 and 16 respectively) and follow (11 and 15 respectively). Medial to lateral mobilization of the rectum is a convergent task (13 types precede, while 7 follow), while transection of the rectum is divergent (6 types precede, 12 follow).

Conclusion: By evaluating OPMs during robotic proctectomy at an academic institution, we objectively determined patterns of operative flow, which tasks require longer times and repeat visits, and how these relate to console time and total operative time. We have also defined nodal, convergent and divergent tasks.

Task ID	Task Name	Description	Start Parameter	Stop Parameter	Comments
1	Initial exposure	Initial exploration of abdomen, inspect for metastasis, adhesiolysis, retract bowel for visualization of target anatomy. Often, omentum is flipped over transverse colon and small bowel is retracted for exposure.	Initial tool interaction with bowel or adhesion	Initiate any dissection task/step below	Surgeon often will work with assistant in coordinated fashion to get small bowel out of pelvis - ie, hand over hand technique
2	Mesenteric dissection, identification and skeletonization of named artery	Pedicle is exposed by retracting sigmoid mesentery and beginning mobilization near sacral promontory. IMA is skeletonized. Lymph nodes around IMA should be dissected and removed with specimen.	First tool interaction with mesentery (i.e., scoring or grasping or retracting) around IMA with sigmoid on tension.	IMA skeletonized, ready for transection	During mobilization the ureter and gonadal vessels (optional) will be identified to avoid injury.
3	Ligation and division of named artery	IMA is ligated and divided, utilizing vessel sealer, clip applier, vascular stapler, laparoscopic device or stapler.	Tool interaction with IMA	IMA transected	Ureter typically is identified. Gonadal vessels may be identified. There may be identification of the aorta and/or iliac bifurcation.
4	Mesenteric dissection, identification and skeletonization of named vein	Pedicle is exposed by retracting left colon mesentery and beginning mobilization near duodenum. Dissection around IMV with fine instrument.	First tool interaction with mesentery (i.e., scoring or grasping or retracting) around the IMV with left colon on	IMV skeletonized, ready for transection	During mobilization the duodenum (optional) will be identified to avoid injury.
5	Ligation and division of named vein	Transection of IMV with any devices from IMA step.	Tool interaction with IMV	IMV transected	Duodenum may be separated from these tissues. May overlap with medial to lateral dissection.
6	Splenic flexure mobilization: Medial to lateral (submesocolic) (optional)	View is redirected towards LUQ, with the aim of freeing up the proximal end of the desending colon for a tension free anastomosis	Tool interation with mesentery in left middle quadrant, inferior to IMV, anterior to the aorta (blunt or sharp	Splenic flexure mobilized (surgeon backs out camera)	Pancreas comes into view as landmark of superior extent of dissection.
7	Splenic flexure mobilization: Lateral to medial (optional)	View is redirected towards LUQ, with the aim of freeing up the proximal end of the desending colon for a tension free anastomosis	Tool interaction with lateral attachments while left colon is retracted medially	Splenic flexure mobilized (surgeon backs out camera)	Pancreas comes into view as landmark of superior extent of dissection.
8	Splenic flexure mobilization: Supracolic (optional)	View is redirected towards LUQ, with the aim of freeing up the proximal end of the desending colon for a tension free anastomosis	Tool interaction with gastrocolic ligament while colon retracted caudad	Splenic flexure mobilized (surgeon backs out camera)	Pancreas comes into view as landmark of superior extent of dissection.
9	Mobilization of the rectum: Medial to lateral	Mobilization of rectum and mesorectum from sacral attachments. Surgeon will identify and preserve presacral nerves.	First tool interaction with medial mesorectum	Preceeds either IMA ligation or posterior TME	Left pelvic structures (ureter, iliac vessels) will come into view as dissection is completed
10	Mobilization of sigmoid and left colon: Medial to lateral	The plane between mesentery and posterior peritoneum is bluntly or sharply (vessel sealer) dissected laterally and cranially. Once mesentery has been mobilized, lateral attachments (Line of Toldt) are dissected from the abdominal sidewall.	Tool interaction with the mesentery at the ligated pedicle	Mobilization of the line of Toldt just inferior to the splenic flexure	
11	Mobilization of sigmoid and left colon: Lateral to medial	All lateral attachments of descending and sigmoid colon are divided enabling the descending and sigmoid colon to be separated from the left abdominal wall. Ureter often identified at this time.	First tool interaction with Line of Toldt while sigmoid is retracted medially	Surgeon backs out camera, begins to reposition colon for subsequent step	
12	Pelvic rectal dissection with TME: Posterior dissection of rectum	Surgical view is moved into pelvis to mobilize the rectum. This is the posterior dissection, operating from 3-9 o'clock. Preserving pelvic autonomic nerves.	Tool interaction to expose posterior peri-rectal tissue	Posterior rectum is dissected (surgeon backs out camera)	
13	Pelvic rectal dissection with TME: Anterior dissection of rectum	Preserving pelvic autonomic nerves, the anterior plane for dissection either forward or behind Denovillier's fascia. Protect anterior anatomy (vagina or prostate)	Tool interaction with anterior peri-rectal tissue	Anterior rectum is dissected (surgeon backs out camera)	
14	Pelvic rectal dissection with TME: Right lateral dissection of rectum	Separating rectum and mesorectum from lateral pelvic wall.	Tool interaction to expose right lateral dissection	Right lateral dissection is completed (surgeon backs out camera)	
15	Pelvic rectal dissection with TME: Left lateral dissection of rectum	Separating the rectum and mesorectum from lateral pelvic wall. Left side can be more difficult because of sub-optimal view (based on port placement)	Tool interaction to expose left lateral dissection	Left lateral dissection is completed (surgeon backs out camera)	
16	Division of mesorectum	Dissection and ligation of all vessels of mesorectum to skeletonize rectum	Tool interaction with mesorectum	Rectum skeletonized	Typically done with scissors, bipolar, vessel sealer
17	Rectal transection	Laprascopic or robotic stapler used to divide rectum. Transection line can be verified with Firefly. May require multiple stapler fires and variation in regularity/distance/margin.	Stapler enters the abdomen makes contact with rectum	Rectum is divided (after last staple load fired)	May be done without stapler, instead with scissors
18	Division of mesocolon	Dissection and ligation of all vessels of the mesocolon to skeletonize colon	First tool interaction with proximal colon (typically will begin after surgeon relocates camera higher in abdomen from	Colon is skeletonized	Typically done with scissors, bipolar, vessel sealer
19	Proximal colon transection	Identify the location of proximal bowel resection. Transection line can be verified with Firefly. Stapler traditionally used.	Stapler enters the abdomen makes contact with colon	Proximal colon is divided (after last stapler load is fired)	May be done without stapler, instead with scissors
20	Testing for anastomotic leak (optional)	Pelvis filled with saline and rectum insufflated with air to ensure no bubbles are seen. May be done with syringe and/or sigmoidoscopy.	Last tool interaction with newly anastamosed bowel as abdomen is filled	Start of suction of saline out of abdomen	Often, Tilepro will be used during sigmoidoscopy
21	Colorectal anastomosis	Reconnection of proximal colon to rectal stump. Often transanal circular stapler used. Stapler is passed through transected rectal stump. Anvil is connected to stapler. Surgeon ensures no tension and no twisting of colon. Stapler is fired.	First tool interaction with proximal colon in order to insert anvil.	Last tool interaction, anastomosis is complete	This may be done with pure intracorporeal technique.

Task	Total Task time (mins)	# visits per task	Correlation of tasktime with CT	Correlation of tasktime with TOT	Correlation of # visits with CT	Correlation of # visits with TOT
Initial exposure	235.1062913	31	**0.087944664**	0.6	-0.026974656	-0.116701428
Mesenteric dissection, identification and skeletonization of named artery	249.1152003	92	-0.066923077	0.117626946	0.367546507	0.172234938
Ligation and division of named artery	39.15590401	32	0.402307692	-0.177911593	0.31896572	0.344163454
Mesenteric dissection, identification and skeletonization of named vein	16.96186722	8	0.6	0.416586838	0.335410197	0.223606798
Ligation and division of named vein	**5.547136635**	**6**	**0.6**	-0.142857143	NA	NA
Splenic flexure mobilization: Medial to lateral (submesocolic) (optional)	142.1536724	44	0.575757576	0.490909091	**0.746208774**	**0.669752957**
Splenic flexure mobilization: Lateral to medial (optional)	150.8137058	34	0.631868132	0.585714286	0.491396935	0.504307349
Splenic flexure mobilization: Supracolic (optional)	124.7956189	19	0.571428571	0.571428571	0.65492104	0.65492104
Mobilization of the rectum: Medial to lateral	232.2803199	92	0.329230769	0.127848258	0.129800243	-0.067475605
Mobilization of sigmoid and left colon: Medial to lateral	255.1595673	86	0.406923077	0.31170814	0.152308016	-0.071380202
Mobilization of sigmoid and left colon: Lateral to medial	305.5552861	90	0.333333333	0.114546127	0.247871185	0.141207511
Pelvic rectal dissection with TME: Posterior dissection of rectum	**400.683324**	**261**	0.351648352	0.565135169	0.219943163	0.420520331
Pelvic rectal dissection with TME: Anterior dissection of rectum	164.706843	118	0.104460757	0.291501976	0.227906766	0.428747888
Pelvic rectal dissection with TME: Right lateral dissection of rectum	126.3441503	**220**	0.384615385	0.410888044	0.190829259	0.296535605
Pelvic rectal dissection with TME: Left lateral dissection of rectum	177.945431	135	0.642246642	0.588942044	0.561142542	0.663552866
Division of mesorectum	**454.6829126**	78	**0.712820513**	0.549575075	0.405463334	0.338827782
Rectal transection	210.0404117	39	0.485384615	0.39989052	-0.071400555	0.130348001
Division of mesocolon	222.0538199	37	0.472332016	0.366224281	0.144337567	0.039119162
Proximal colon transection	58.17903359	25	0.371428571	0.3558317	0.375747653	0.324080621
Colorectal anastomosis	**396.5202086**	26	0.036764706	0.066695926	0.496177616	0.417295399
Testing for anastomotic leak (optional)	53.04661019	45	0.190977444	0.16266592	-0.131413378	-0.111252264

Figure 3. Circos plot of all 21 tasks during 31 robotic proctectomies



S128

Video-based analysis can be used to objectively measure the impact of optional surgical tasks

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Introduction: Video Based Analysis (VBA) offers a method to assess the impact of operative choices on surgical technique. Currently published methods of VBA focus on the broader procedure-specific step level, as defined by the SAGES AI Task Force. This study demonstrates a novel method of reproducible analysis at the granular and procedure-agnostic task level, to improve the depth of VBA-related insights related to surgical technique.

Methods and procedures: Videos were labeled by trained surgeon annotators, using internally developed definitions following previously published literature on the operative steps and tasks of RYGB. Tasks were categorized as Required or Optional. In this study we analyzed variable approaches to gastric pouch creation (GPC) and GJ or JJ anastomosis creation (GJ, JJ), asking the following questions. How are Mobilization of Stomach (MoS) and GPC times impacted by variability in approach to opening of the lesser sac (OLS), hiatal dissection (HD), or posterior gastric dissection (PGD)? Does preparation of anastomosis time correlate with anastomosis creation across surgeons? Finally, this study also examined the correlation between task switching and operative times from a step-agnostic perspective.

Results: A total of 386 de-identified video recordings from 12 different bariatric surgeons were collected. MoS times were higher with the perigastric technique than the pars flaccida technique during OLS (median 471 vs 146 s, $p = 0.013$; Figure 1), but GPC time was not significantly different (462 vs 328 s, $p = 0.34$; Figure 1). MoS times were significantly higher when HD was performed versus not (299 vs 127 s, $p = 0.001$), but GPC times were not significantly affected (440 vs 353 s, $p = 0.42$). PGD time correlated with GPC times (r = 0.85) more than vertical stapling times (r = 0.76). Surgeons had widely varying correlations between their time spent preparing an anastomosis versus the enterotomy closure time, revealing both positive and negative correlations (Figure 2). More frequent task alternation was generally associated with higher operative times (Figure 3).

Conclusion(s): This is the largest task-annotated dataset of surgical video recordings published thus far. This study demonstrates that VBA can be performed at the more granular procedure-agnostic task level to gain clinically significant insights on surgical efficiency. Further studies are needed to understand how VBA can be used to impact surgical education and outcomes, and ultimately integrated into the flow of surgical practice.

S129

Supporting effective perioperative communication with artificial intelligence: a deep learning model to estimate remaining surgical duration

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Introduction: High value perioperative care depends on timely communication between surgical teams, including preoperative, intraoperative, and postoperative staff. Knowing when to expect the arrival of a patient can help post-anesthesia care units (PACU) and intensive care units (ICU) prepare for a potentially unstable patient, while also supporting operative room turnover. This study demonstrates how computer vision and deep learning can be used to estimate remaining surgical duration (RSD) of a surgery in real-time. This model is designed to estimate remaining surgical duration in real time solely from a laparoscopic camera feed.

Methods and procedures: Cholecystectomy recordings from the Cholec80 dataset (80 videos, 13 surgeon). Unsupervised deep learning was used to train a model to predict remaining surgical duration at each time point along the video. To predict remaining duration, the model analyzed a sequence of 64 frames randomly selected from time 0 to the current timepoint "t", including the frame at time "t" to gain context across the entire procedure duration. To test this method with a more complex procedure, another model was created with a surgeon-specific dataset of Roux-en-Y Gastric Bypass recordings, with videos trimmed to include opening of the lesser sac to final trocar removal.

Results: With the Cholec80 dataset, 54 videos were used to train and 26 to test the model. Model error was 6.6 min (STD = 5.3 min). Lowest accuracy was seen cases with outlying lengths, both long (57.2 min error) and short (16.4 min error) compared to average duration of the cases (35 min). The surgeon-specific dataset included 348 RYGB recordings. 244 were used to train, and 104 were used to test the model. This surgeon-specific model demonstrated an error of 7.9 min (STD = 18.4 min). This same model was evaluated on 43 videos of another surgeon to test the generalizability of the model. The model achieved a mean RSD error of 13.3 min (STD = 12.8 min). Highest errors were mostly observed in cases that were longer than the average video length, many of which included additional procedures such as a cholecystectomy. Presence of bleeding or unintended bowel injury increased the error.

Conclusion(s): Deep learning models can estimate remaining surgical duration before the end of a case, even with long-segment video data of entire operations. These tools could automate certain aspects of perioperative communication, facilitating efficient and safe patient handoffs. In addition, they can be used in surgeon education portals to automatically retrieve outlier videos with notable surgical events such as excessive bleeding or unintended bowel injury.

S130

Chronic psychiatric diagnoses increase emergency department utilization following bariatric surgery

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Introduction: This study aims to evaluate the impact psychoses and mood disorders have on emergency department (ED) utilization following bariatric surgery. Few studies have evaluated the impact psychiatric diagnoses have on ED usage, and these studies included patients with a wide spectrum of psychiatric diagnoses. Whether more severe mental health disorders such as schizophrenia or bipolar disorder impact ED usage remains unknown. We hypothesize that the presence of preexisting psychiatric diagnoses is predictive of increased post-bariatric surgical ED usage as compared to a matched cohort without psychiatric comorbidities.

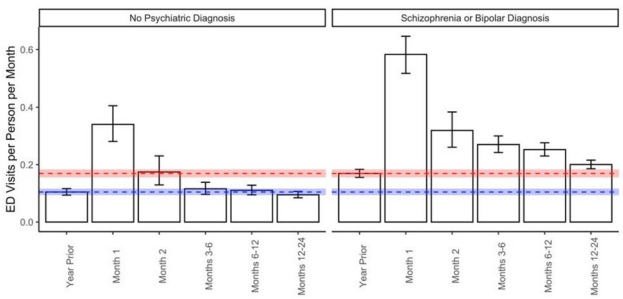
Methods: We utilized the Colorado All Payers Claim Database, a statewide insurance database and identified patients undergoing either laparoscopic sleeve gastrectomy (SG) or roux en y gastric bypass (RNYGB, $N = 5393$). We selected for patients with an isolated preexisting diagnoses of schizophrenia or bipolar disorder documented in the year prior to surgery ($N = 427$). Patients with a separate psychiatric diagnosis were excluded. Procedures were determined using Current Procedural Terminology codes and comorbidity diagnoses were identified using International Classification of Disease 9/10 codes.

A control group of patients without any psychiatric diagnosis (e.g. anxiety, depression or substance abuse) were used for comparison. Propensity score matching (PSM) in a 1:1 ratio was used to identify a cohort of patients with similar age, sex, obesity severity, procedure type and comorbidities. Baseline ED utilization was calculated over the year preceding surgery.

Results: Prior to matching, patients with bipolar/schizophrenia ($n = 240$) were more likely to have public insurance ($p < 0.001$) and had higher incidence of comorbidities including hypertension, COPD, asthma, obstructive sleep apnea, GERD and smoking compared to the control group ($N = 3356$). There were no significant differences between groups with regards to gender, age, procedure type, or BMI categories. After PSM there were no significant differences between groups.

After matching, baseline ED utilization was 62% higher in the psychiatric diagnosis group. ED utilization increased dramatically in the month following surgery for both groups, but quickly returned to baseline for the group without a psychiatric diagnosis following the two months after surgery (Figure 1). In the group with a psychiatric diagnosis, ED utilization remained elevated above baseline for two years post-surgery.

Conclusions: Bariatric patients with preexisting diagnoses of schizophrenia or bipolar disorder have higher baseline ED usage compared to a well-matched cohort; additionally, their usage increases post-operatively and to a greater extent than in patients without these diagnoses. These patients would benefit from intensive outpatient follow-up to limit unnecessary ED visits.



S131

Distal bypass revision for weight regain: initial experience and outcomes in an academic practice

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Background: Significant weight regain (WR) after Roux-en-Y gastric bypass (RYGB) occurs in up to 20% of patients and presents a challenge for the bariatric surgeon. While several nonoperative, endoscopic, and surgical interventions exist for this population, the optimal approach is unknown. This study reports our initial experience with distal bypass (DB) and provides a comparison with patients after primary RYGB.

Methods: Single-institution, retrospective review was conducted for patients who underwent DB from 2018–2020. A Roux and common channel of 150 cm each were constructed (total alimentary limb of 300 cm). A control group of primary RYGB patients operated on during the same period, with similar pre-RYGB weight, and similar WR in the postoperative period was selected for comparison. Demographics, comorbidities, surgical technique, complications, and weight loss outcome data were collected and compared. Patient postoperative weight loss was also compared after their primary and DB operations.

Results: Sixteen DB patients, all female, were identified and compared with twenty-nine controls. DB was performed on average 12.3 years after primary RYGB. Mean BMI was 53.7 before primary RYGB, 31.9 at nadir, and 44.1 prior to DB. Post DB, mean BMI was 40.9, 37.4, 35.0, and 32.7, at 3-, 6-, 12-, and 24-months, respectively. 25% of patients experienced complications including UTI, SSI/sepsis, DVT, and pneumonia. 31.25% were readmitted within 30-days for melena, SSI/sepsis, bowel obstruction (2), and bleeding gastric ulcer, with 12.5% requiring reintervention. Within the DB group, the mean 1-year %EWL after primary was higher than after revisional surgery (67.2 ± 33.2 vs. 50.3 ± 19.3; $p = 0.126$), yet 75% of DB patients achieved > 50%EWL at 1-year. Only vitamin D deficiency was noted in 16.7% of patients. Compared to controls, the DB group had lower %EWL at 3, 6, and 12 months but similar at 2 years postop (table 1).

Conclusion: DB resulted in excellent weight loss 1 year after surgery but was associated with high postoperative complication rates. The magnitude of the weight loss was not as high as after the primary operation, but 75% patients still achieved > 50%EWL. Results of this study are reassuring and can help counsel patients pursuing this treatment option for WR post-RYGB. The comparative effectiveness of this approach to other available options still needs to be determined.

Table 1

	Distal Bypass	Controls	P-value
Age	48.63 ± 9.96	42.07 ± 10.23	0.04
Comorbidities			
DM2	1	13	0.01
HTN	8	21	0.13
HLD	4	9	0.67
OSA	5	13	0.37
GERD	7	14	0.77
BMI nadir	31.88 ± 7.262068	33.67 ± 6.18	0.319
%EWL			
3 months	22.05 ± 7.68	31.21 ± 7.47	0.001
6 months	34.93 ± 11.10	46.79 ± 12.15	0.008
1 year	91.09 ± 16.01	90.80 ± 31.58	0.289
2 years	94.81 ± 21.67	84.53± 20.95	0.942

S132

Repairing small type 1 hernias at the time of rygb is not necessary to achieve resolution of reflux symptoms

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Introduction: Roux-en-Y gastric bypass (RYGB) is considered to be the gold standard operation for reflux in patients with morbid obesity, but there is variability in surgeon opinion regarding whether or not small sliding, type 1 hiatal hernias (HH) require repair concurrently with RYGB. We sought to examine whether leaving a small hiatal hernia unrepaired at the time of RYGB affected long term GERD symptoms in our practice.

Methods: All patients at our institution receive endoscopy prior to RYGB, and select patients with reflux symptoms receive preoperative esophogram depending on surgeon preference. Patients complete the validated GERD-HRQL questionnaire at regular pre- and postoperative intervals. We repair paraesophageal hernias concurrently with RYGB, but refrain from repair of small type 1 hernias. PPIs are routinely discontinued at 3 months postoperatively.

Records from 255 patients undergoing RYGB between November 2014 and February 2021 were reviewed for presence or absence of HH or paraesophageal hernia during routine preoperative EGD and/or imaging or identified intraoperatively. A series of Mann–Whitney U tests examined change in GERD-HRQL scores in patients with small type 1 hiatal hernias which were not repaired at the time of RYGB (HH group) and change in GERD-HQRL scores in patients who had no hernia identified pre- or intraoperatively (NH group).

Results: 77% of patients were female. Average age at surgery was 42.9 (SD = 12.1). Average preoperative BMI was 45.1 (SD = 7.52). 98 patients (38.4%) were in the HH group, and 133 patients (52.2%) formed the NH group. An additional 24 patients (9.4%) received hernia repair at time of surgery, and were excluded from analysis.

At 6 and 12 months postoperatively neither HH group nor NH group patients had clinically pathologic GERD-HRQL scores, with median scores of 1 for HH versus 2 for NH. HH patients experienced greater improvement in GERD-HRQL scores at six months postoperatively than NH patients ($n = 130$ respondents, median improvement 4 points vs. 1.75 points) ($U = 2524.5$, $p < 0.05$) and experienced a median 12-month postoperative improvement of 7.33 points vs. 2-point improvement in the NH group. ($n = 72$ respondents) ($U = 854.5$, $p < 0.01$).

Conclusion: Repair of small type 1 hiatal hernias is not necessary to achieve effective, durable resolution of reflux symptoms with RYGB. Omitting repair of small type 1 hiatal hernias during RYGB may potentially reduce cost, operative time, and undue exposure to additional risk imparted by repair without adverse impact on long term reflux outcomes.

S133

Battle of the buttress: 5-year propensity-matched analysis of staple line reinforcement techniques from the MBSAQIP database

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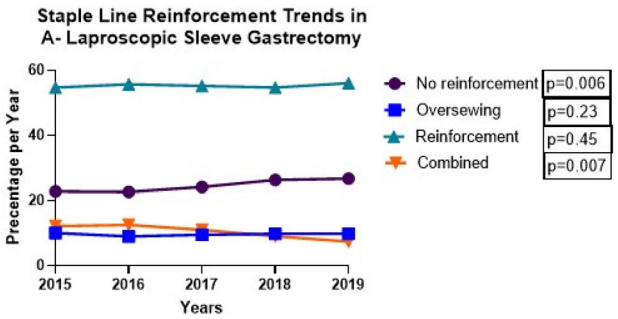
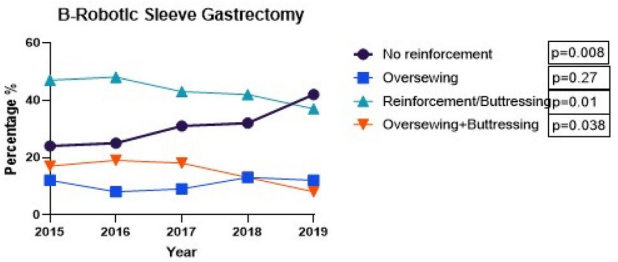
Intro: Sleeve gastrectomy has demonstrated to be safe. However, controversy still exists regarding the most efficacious way to decrease complications such as bleeding and staple line leaks. There is a considerable variation in operative techniques including no-reinforcement (NR), oversewing, and buttressing (SLR). Our goal was to evaluate the effect of those different methods on postoperative bleeding and staple line leaks using the Metabolic and Bariatric Surgery Accreditation Quality Initiative Program database (MBSAQIP).

Methods: We queried the MBSAQIP database from 2015–2019 for patients undergoing sleeve gastrectomy (VSG). A propensity matched analysis was performed between different methods (NR, oversewing, and SLR), and complications within 30 days were compared.

Results: 513,354 VSG cases were analyzed. 79.0% were female, mean age of 44 ± 9 years. Preop BMI was 43 ± 9 kg/m^2. 88.0% were laparoscopic cases, and 12.0% were robotic. 54% of cases used SLR, 25.6% no reinforcement, 10.8% combination of oversewing and SLR, and 9.8% oversewing. During the study period the use of NR increased (Figure 1). When compared to NR, SLR demonstrated lower rate of reoperations, overall bleeding, and major bleeding, but longer operative time and length of stay ($p < 0.05$). When compared to NR, oversewing demonstrated less overall bleeding, but longer operative times, and length of stay ($p < 0.05$). There were no differences in leaks (SLR vs NR/ oversewing vs NR). When compared to SLR, oversewing demonstrated longer operative times and length of stay ($p < 0.05$) and higher rate of post-operative ventilator use, postoperative pneumonia, and venous thrombosis ($p < 0.05$). When comparing patients that developed bleeding vs no bleeding, patients with bleeding had lower rate of SLR (56% vs 61%), oversewing (10.6% vs 10.9%) and higher rate of NR (34% vs 28%). Overall, leaks were more common amongst patients that had any bleeding (4.4% vs 0.3%), along with higher morbidity and mortality ($p < 0.05$).

Conclusions: The results of this study show: a) the use of NR continues to increase; b) SLR and oversewing were associated with a decreased incidence of bleeding, despite longer operative times; c) No method demonstrated a positive effect on leaks, but overall, patients with any level of bleeding were more likely to experience leaks, increased morbidity and mortality.





S134

Exocrine pancreatic insufficiency after bariatric surgery: a bariatric surgery center of excellence experience

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Introduction: Gastrointestinal complaints like diarrhea, bloating, abdominal pain, and nausea are common after bariatric surgery (BS). While exocrine pancreatic insufficiency (EPI) can cause these symptoms, the frequency and outcomes of EPI after BS is not well understood. We investigated the prevalence and outcomes of EPI after BS over 18 years at a tertiary bariatric referral center.

Methods: Records of patients treated with primary or revisional BS from 2002–2020 were reviewed. Demographics, symptoms, labs, and treatment outcomes were collected for patients suspected of EPI or underwent Fecal Elastase testing (FE-1). EPI diagnosis was defined as positive FE-1 testing or improvement with empiric pancreatic enzyme replacement therapy (PERT).

Results: Of 3,507 patients, 265 (7.6%) were suspected of having EPI and 191 were tested via FE-1 (170, 89.0%) or empirically treated (22, 11.5%). EPI was diagnosed in 84 (44.0%) patients: 73 (89%) after Roux-en-Y gastric bypass (RYGB), 7 (8.3%) after biliopancreatic diversion-duodenal switch or jejunoileal bypass (BPD-DS/JIB), 4 (4.8%) after sleeve gastrectomy(SG). Therapeutic PERT was given to 64 patients diagnosed with EPI: 52 (81.3%) had improvement in symptoms. Patients diagnosed with EPI were more likely to have RYGB and BPD-DS versus SG (51.4%, 55.6% vs 17.4%, $p < 0.01$ Chi square), and no patients with AGB had EPI.

Symptoms prompting FE-1 testing were available for patients whose index operations were performed at our institution (157/265, 59.2%). These included: diarrhea (82.8%), abdominal pain (36.3%), nausea (23.6%), bloating (8.9%), and excessive flatulence (6.4%). No symptoms were significantly associated with EPI diagnosis by Chi square analysis.

Conclusion: A high index of suspicion for EPI in bariatric patients with gastrointestinal complaints is recommended, especially following RYGB. Further work to define symptoms prompting work-up, optimal treatment, and prevention is necessary.

	Entire Cohort	RYGB	BPD-DS/JIB	SG	AGB
Suspected of EPI	265	205(77.4%)	10(3.8%)	34(12.8%)	16(6.0%)
No testing	75	63	0	11	1
EPI work-up:	191	143	10	23	15
FE-1 testing	170	127	8	21	14
Positive FE-1	71(41.7%)	65(51.2%)	4(50%)	2(9.9%)	0(0%)
Negative FE-1	99(58.2%)	62(48.8%)	4(50%)	19(90.5%)	14(100%)
Empiric PERT	22	16	3	2	1
Positive (improved)	13(59.1%)	8(50.0%)	3(100%)	2(100%)	0(0%)
Negative (not improved)	9(40.9%)	8(50.0%)	0(0%)	0(0%)	1(100%)
Total Diagnosed with EPI	84(44.0%)	73(51.4%)	7(70%)	4(17.4%)	0(0%)
Improved w/PERT	52(81.3%)	46(82.1%)	4(66.7%)	2(100%)	0(0%)
Not improved w/PERT	12(18.8%)	10(17.9%)	2(33.3%)	0(0%)	0(0%)

S135

Weight Loss Outcomes Are Not Compromised in Bariatric Patients Using Cannabis

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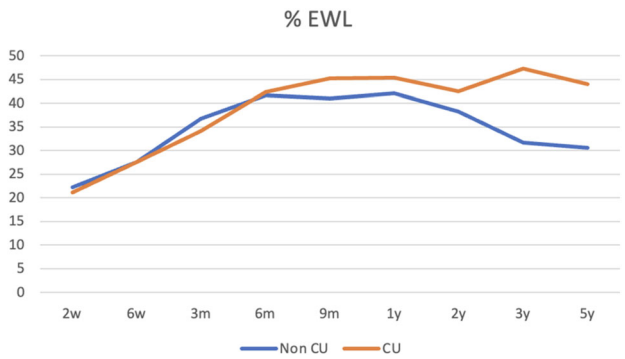
Introduction: The legalization of cannabis in several states has led to increased documented use of cannabis in the population. Bariatric surgery patients are no exception with estimates of anywhere from 6 to 8%. Cannabis is known to be associated with increased appetite, mood disorders, hyperphagia, and rarely hyperemesis which can potentially affect bariatric surgery outcomes. We aim to study the differences in bariatric surgery outcomes between cannabis users and non-users.

Methods: A retrospective review of a prospectively maintained database identified patients undergoing bariatric surgery. Patients were divided into two groups, cannabis users (CU) and non-cannabis users (non-CU). Cannabis users and a group of propensity score matched non-users were called to obtain additional information. Cannabis use was defined as use at least once a week. Patient factors included age, sex, BMI, Charlson Comorbidity Index. Primary outcome was weight loss. Secondary outcomes included incidence of post-operative nausea and vomiting (PONV), de novo and aggravated GERD, LOS, readmission, need for additional intervention.

Results: A cohort of 401 patients underwent sleeve gastrectomy, 31 (7.7%) CU and 371 (92.5%) non-CU. 86.5% were female, average age 42.5 years (range 18 – 84), average BMI 47.8 kg/m^2 (range 28 – 100), average Charlson Comorbidity Index 1.15 (range 0 – 10) with no significant differences between groups. There was no difference in EWL between CU and non-CU at 6 weeks (32.8% vs 32.9%, $p = 0.67$), 6 months (50.2% vs 50.6%, $p = 0.82$), 1 year (53.6% vs 50.5%, $p = 0.34$), and 2 years (51.2% vs 46.7%, $p = 0.68$), however CU had more EWL at 3 years (56.6% vs 46.7%, $p = 0.04$) and 5 years (49.8% vs 35.5%, $p = 0.10$). Incidence of chronic PONV the initial year after surgery was higher in CU at 38.7% vs 28.9% ($p = 0.45$) and became more pronounced beyond the one year after surgery with 32.3% of CU experiencing PONV vs 17.1% in non-CU ($p = 0.17$). CU also had higher incidence of de novo GERD (16.7% vs 10.6%, $p = 0.36$), aggravated GERD (9.7% vs 3.5%, $p = 0.12$), and increased PPI use (32.2% vs 21.4%, $p = 0.18$). LOS, readmission, and need for additional intervention did not differ between CU and non-CU.

Conclusion: Cannabis users experienced more weight loss further out from surgery, which could be attributable to an increased incidence of PONV.



S136

Operationalizing an enhanced recovery protocol after bariatric surgery: single institutional pilot experience forging data-driven standard work

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Introduction: Enhanced recovery protocols after metabolic and bariatric surgery (MBS) are relatively new compared to other surgical specialties with the literature heavily focused on patient outcomes. There is evidence to support decreased length of stay (LOS) and postoperative nausea/vomiting with MBS enhanced recovery pathways but implementation is often fraught with barriers to sustainability. The primary aim of this pilot study was to operationalize an enhanced recovery protocol following index MBS procedures with real-time data support to assess global and individual element compliance. The secondary aim was to evaluate 30-day outcomes including LOS, emergency department (ED) visits, and readmissions.

Methods and Procedures: A team of MBS champions assembled during the planning phase of implementation at a single academic center (5/2019–4/2020) to develop an enhanced recovery protocol, paper checklist, and virtual dashboard which were sequentially deployed during the active phase of implementation (5/2020–7/2021). The dashboard collected surgery scheduling, medication administration, and nursing documentation data along with 30-day outcomes from the Clinical Data Warehouse (sleeve gastrectomy and gastric bypass patients). The protocol, checklist, and dashboard were aligned on 6 preoperative, 8 intraoperative, and 11 postoperative patient care elements facilitating standard work and data collection. Perioperative enhanced recovery compliance was assessed for overall and individual element completion, pre- and post-implementation. Data was analyzed with a two-tailed Students t-test.

Results: A total of 481 patients were included in the study (pre-implementation: 200; post-implementation: 281). Post-implementation, the intraoperative phase of care had the highest median compliance for completion of all protocol elements at 35% ($p < 0.001$) compared to 17% preoperatively ($p < 0.001$) and 14% postoperatively ($p = 0.01$); median pre-implementation completion for all protocol elements was $\leq 6\%$. Preoperatively, acetaminophen administration had the highest median compliance at $\geq 94\%$, regardless of implementation phase. Intraoperative Transversus Abdominis Plane blocks increased 1.5 fold from a baseline median rate of 38% to 75% post-implementation ($p < 0.01$) with a downward trend in postoperative Milligram Morphine Equivalent use (Figure 1). Average LOS decreased from 2.0 to 1.75 days post-implementation with no significant changes in readmissions (average 3.1% to 3.2%) or reoperations (average 2.8% to 1.5%); ED visits decreased by 55% or twofold (average 9% to 4%; $p = 0.05$).

Conclusions: Creating standard work and real-time data collection infrastructure to support enhanced recovery pathways is key for process improvements and sustainability in compliance. Next steps include evaluation of updated postoperative enhanced recovery order sets, continued stakeholder engagement interventions, and larger scale data collection efforts.

Figure 1: Enhanced recovery dashboard showing preoperative acetaminophen administration, intraoperative transversus abdominis plane block (TAP) administration, and median postoperative Morphine Milligram Equivalents (MME) use. The red arrow indicates timing of enhanced recovery implementation (5/2020). The dashboard displays a rolling 18 month-period for process and outcome measures, which can be filtered by anesthesiologist, surgeon, and protocol element. The gray shaded area indicates index case volume per calendar month. The blue line indicates the number of cases compliant with select protocol elements.

S137

Prediction of thirty-day morbidity and mortality after duodenal switch using an artificial neural network

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Introduction: While providing optimal weight loss and diabetes resolution, the duodenal switch (DS) represents the most extensive bariatric operation currently approved. It should be offered only in circumstances with acceptably low postoperative morbidity and mortality. Therefore, understanding those patient factors that convey a higher risk of thirty-day morbidity and mortality is critical in making the decision to offer such a procedure. Artificial neural networks (ANN) are computational deep learning approaches that can model complex interactions among input factors to optimally predict an outcome. In this study, a large national database was assessed for patient factors associated with poor outcomes, while comparing the performance of multivariate logistic regression and ANN models in predicting these outcomes.

Methods: A cohort of 2,907 DS patients from the 2019 Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program national database was assessed for patient factors associated with the composite endpoint of a 30-day postoperative reintervention, reoperation, readmission or mortality using bivariate analysis, via chi-squared or *t*-tests, as appropriate. Variables associated ($P \leq 0.05$) with the endpoint were subsequently imputed in a multivariate nominal logistic regression model and a 3-node ANN with *k*-fold validation with 80% of the patients used for training, and 20% withheld for validation. Model goodness-of-fit was assessed using area under receiver operating curves (AUROC).

Results: There were 229 DS patients with at least one of the four outcomes comprising the composite endpoint (7.9%). Associated patient factors on bivariate analysis included advanced age ($p = 0.008$), non-white race ($p = 0.033$), cardiac history ($p = 0.030$), hypertension requiring 3 + medications ($p = 0.003$), previous foregut/obesity surgery ($p = 0.003$), obstructive sleep apnea ($p = 0.01$) and higher creatinine ($p = 0.007$). Upon multivariate analysis, independently associated factors were non-white race (odds ratio [OR] 1.40; $p = 0.075$), hypertension (OR 1.55; $p = 0.038$), previous foregut/bariatric surgery (OR 1.43; $p = 0.041$), and sleep apnea (OR 1.46; $p = 0.018$). The nominal logistic regression multivariate analysis ($n = 2{,}330$; Chi-squared statistic 25.9; $R^2 = 0.02$, $p < 0.001$) and ANN (Figure 1; $R^2 = 0.07$; $n = 1{,}864$ [training set], $n = 466$ [validation]) models generated AUROCs of 0.619, 0.671 (training set) and 0.664 (validation set), respectively.

Conclusions: Using the most comprehensive dataset available, a panel of simple, easily obtainable patient factors has been identified that may confer increased risk of thirty-day morbidity and mortality after DS. Moreover, use of an ANN to model these factors may optimize prediction of this outcome. This information may provide guidance to clinicians and patients alike in making the collective decision to undertake a DS.

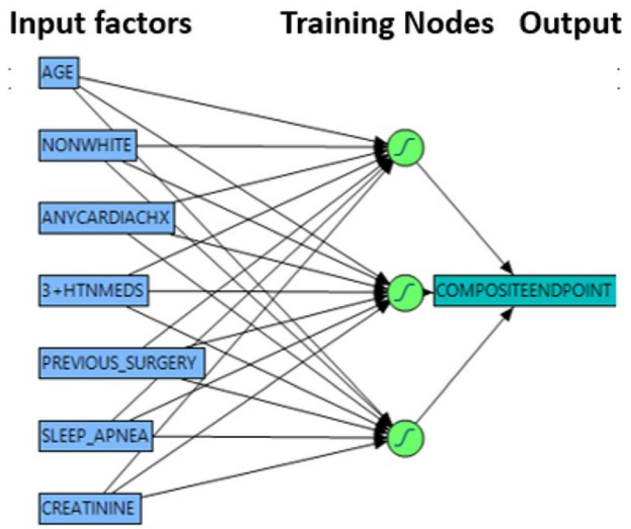

Figure 1- Diagrammatic representation of Artificial Neural Network Model

S138

The mesh-RTL project for prevention of wound abdominal dehiscence: clinical trial of non-inferiority to compare two aponeurotic closure techniques in midline laparotomy in patients with elevated risk

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Aim: Abdominal wound dehiscence (AWD) has an incidence of 2–4%, which can increase to 20% in specific risk groups. The aim of this study is to report the results of the use of the reinforced tension line (RTL) technique compared with the use of onlay mesh closure (OM) in the prevention of AWD in high-risk patients undergoing laparotomy.

Material and Methods: Non-inferiority open randomized controlled clinical trial. Included were patients older than 18 years who underwent midline laparotomy, emergency or scheduled, who were considered high risk. The patients were randomized 1:1 to the RTL technique or to OM. The objective was to report the incidence of AWD, and the complications associated with the closure method. Intention-to-treat analyses were performed.

Results: A total of 239 patients were randomized; 118 patients from the RTL group and 121 patients from the OM group. The global incidence of AWD was 8.8% (21 patients). We did not find a statistically significant difference between the two groups, RTL group (13/118, 11%) and OM group (8/121, 6.6%) ($p = 0.259$, OR 0.6, 95% CI 0.25–1.39). The groups were similar in the rates of surgical site infection, hematoma, seroma, and postoperative pain during follow-up.

Conclusions: The RTL and OM techniques are useful in the prevention of AWD in high-risk midline laparotomy patients, the advantage of RTL is that it can be used in patients with a contaminated, or dirty abdomen and its cost does not go beyond a couple of sutures. Clinical trials NCT04134455.

S139

Is minimally invasive groin hernia repair better? trends in operative recurrence among medicare patients

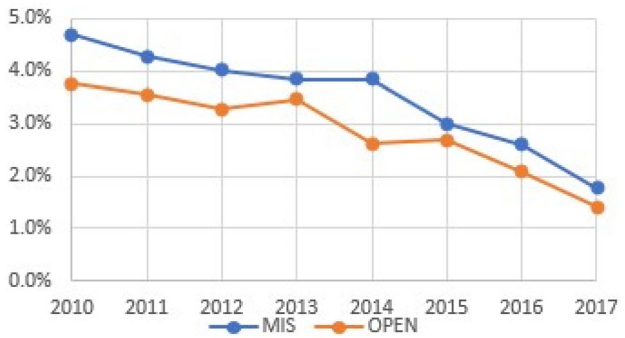
Anne P Ehlers, MD; Yen-ling Lai, MSPH, MS; May Hu, BDS, PhD; Ryan Howard, MD; Lia Delaney; Quintin Solano; Mary Shen; Michael J Englesbe, MD; Justin B Dimick; Dana A Telem; University of Michigan

Introduction: While initial studies indicated that minimally invasive (MIS) groin hernia repair was associated with a higher risk of operative recurrence, current opinion indicates equipoise between MIS and open approaches. However, contemporary rates of population-level operative recurrence are lacking. Within this context we sought to describe trends in operative recurrence rates over time among a Medicare population undergoing elective groin hernia repair.

Methods: This was a retrospective cohort study of adult patients undergoing elective groin hernia repair in a 20% representative Medicare sample from 2010–2017. Patients were required to have at least one year of follow-up to capture recurrence. Surgical approach (MIS vs open) was defined using CPT codes. The primary outcome was operative recurrence over time stratified by year. Secondary outcomes included time to recurrence, as well as the adjusted odds of recurrence by approach.

Results: Among 125,748 patients, 85% (n = 106,778) were male, with mean age 72.5 (9.5), and 3% (n = 3,769) experienced operative recurrence. While the number of hernia repairs performed was relatively constant across years, there was a linear increase in the use of MIS hernia repair. In 2010, 2,495 (15.8%) operations were performed with an MIS approach while in 2017 5,068 (32.3%) were performed with an MIS approach. Among MIS patients, 941 (3.3%) had an operative recurrence compared to 2,828 (2.9%) open patients. While operative recurrence declined overall, rates of recurrence were higher for patients undergoing MIS repair at all time points (Figure). Time to recurrence was also shorter among MIS patients (609 days vs 770 days). In the adjusted analysis, open hernia repair was associated with a lower risk of operative recurrence (aOR 0.88, 95% CI 0.81–0.96).

Conclusions: In this study we found that open groin hernia repair was associated with a lower risk of operative recurrence over time, and that operations for recurrences occurred later. Reasons for this may be related to the advent of robotics during this timeframe, introducing a new learning curve to MIS. Future work should focus on the impact of approach on patient subgroups (e.g., females, octogenarians) to provide tailored recommendations to reduce operative recurrence among all patients.



S140

Sex disparities in treatment and outcomes of ventral and incisional hernia repair

Ryan Howard, MD; Anne Ehlers, MD, MPH; Lia Delaney, MS; Quintin Solano, BS; Mary Shen, MD; Michael Englesbe, MD; Justin Dimick, MD, MPH; Dana Telem, MD, MPH; Michigan Medicine

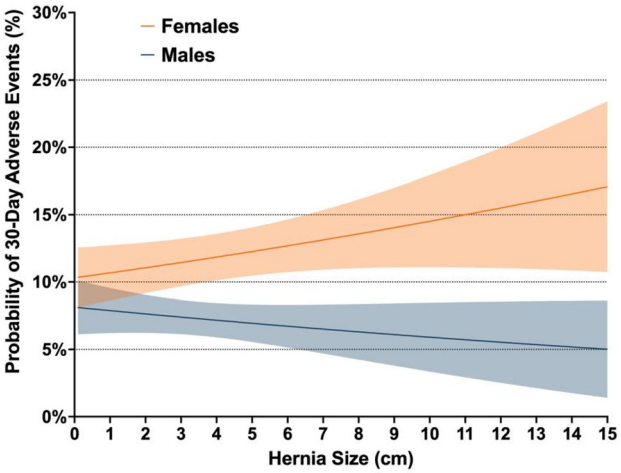
Introduction: Although females account for nearly half of ventral and incisional hernia repairs performed in the United States, shockingly little attention has been paid to sex disparities in hernia treatment and outcomes. Most hernia research investigates males and females in aggregate, despite the fact that females have been found to experience different outcomes after many surgical procedures. Therefore, we explored sex-based differences in operative approach and outcomes using a population-level hernia registry.

Methods: We performed a retrospective review of the Michigan Surgical Quality Collaborative Hernia Registry to identify patients undergoing elective, clean ventral and incisional hernia repair between January 1, 2020 and March 1, 2021. The primary outcomes for this study were risk-adjusted rates of minimally invasive approach, mesh use, and 30-day adverse events. 30-day adverse events were a composite of complications, emergency department visits, readmission, and reoperation. Risk adjustment between genders was performed using a multivariable logistic regression model that included patient characteristics (demographics, body mass index, comorbidities), clinical characteristics (surgical approach, admission status), and hernia characteristics (width, prior repair, location, mesh placement).

Results: 2,852 patients underwent ventral and incisional hernia repair, of whom 1,266 (44.4%) were female and 1,586 (55.6%) were male. Women tended to be younger (51.1 ± 15.6 vs. 55.2 ± 13.2 years, $p < 0.001$), had fewer comorbidities, and had larger hernias (3.6 ± 3.8 vs. 3.0 ± 3.4 cm, $p < 0.001$). After adjusting for these differences, female gender was associated with a slightly higher probability of undergoing minimally invasive repair (40.1% [95% CI 37.3%-42.9%] vs. 36.2% [95% CI 33.8%-38.6%], $p = 0.050$), a lower probability of mesh placement (73.6% [95% CI 71.4%-75.9%] vs. 78.5% [95% CI 76.9%-80.2%], $p = 0.001$), and a higher probability of 30-day adverse events (11.5% [95% CI 9.8%-13.3%] vs. 7.6% [95% CI 6.2%-8.9%], $p = 0.001$). Analysis of the interaction between sex and hernia size revealed that females with larger hernias had an increasing likelihood of adverse events whereas males did not (**Figure**).

Conclusions: Even after accounting for differences in clinical characteristics and hernia properties, there are sex-based differences in the treatment and outcomes of ventral and incisional hernias in women. Despite being younger and healthier, women were more likely to experience adverse events after surgery. Moreover, despite having larger hernias, women were less likely to have mesh placed. Additional work is needed to understand the factors that drive these disparities in ventral hernia treatment and outcomes.

Figure—Predicted probabilities of 30-day adverse events over hernia size stratified by sex.



S141

MIS approach for small ventral hernias associated with diastasis of the rectus abdominis muscle

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Purpose: To present our minimally invasive approach for symptomatic ventral hernias < 5 cm with associated Diastasis of the Rectus Abdominus Muscles (DRAM).

Methods: Retrospective analysis of patients with symptomatic ventral hernias < 5 cm in size and associated DRAM undergoing hernia repair and plication of DRAM from July 2018-March 2021 was conducted. Patients with BMI < 30 were selected for an Endoscopic Onlay Repair (ENDOR) vrs a Robotic Extended Totally Extraperitoneal Ventral Repair (R-eTEP) if BMI > 30. An endoscopic approach was selected for patients with lower BMI due the higher incidence of SSO with this technique in our practice with BMI > 30.

Results: We performed a R-eTEP in fifty-seven patients and an ENDOR in twenty-four patients. In the R-eTEP group, 37 (65%) patients were female, the mean age was 54.8 (± 10.6), and the mean BMI was 32 (± 4.8). 23 patients (40.4%) had a recurrent hernia and 26 (45.6%) presented a Swiss cheese defect, classified as M3 hernias. 50 patients (87.7%) had multiple defects classified as M2 or M3 hernias. The mean operative time was 200 (± 62.4) minutes, with two cases requiring a hybrid approach. The median length of stay was one day (0–12), and the median follow-up was 103 days.24 patients underwent an ENDOR. Patients were also predominantly females (79.2%), mean age was 45.7 years (± 11.7), with a mean BMI of 28 (± 3.6). 13 patients had isolated umbilical or epigastric hernias (M2/M3 hernias).The mean operative time was 146.2 min (± 51.1). Mesh was was fixated with a fibrin sealant or suture with both techniques and there was no conversion to open surgery.

Most patients on both groups underwent ambulatory surgery. Five patients developed post-operative seromas, one requiring drainage due to infection. The Median follow-up was 48.5 days (10–523), with two reported hernia recurrences.

Conclusions: R-eTEP and Endoscopic Onlay Repairs are safe and effective techniques with adequate patient selection for the treatmet of small ventral hernias with associated DRAM.

S142

Outcomes of biologic versus synthetic mesh in CDC 3&4 open abdominal wall reconstruction (AWR)

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Objectives: AWR in a contaminated field is associated with an increased risk of wound complications and hernia recurrence. Mesh choice is a topic of heavy debate in contemporary AWR. The aim of this study is to compare outcomes of patients who underwent hernia repair with biologic versus synthetic mesh in a contaminated setting.
Methods: A prospective, single institution hernia database was queried for patients with CDC Class 3 and 4 wounds undergoing open AWR. The primary and secondary outcomes were hernia recurrence and wound complication rates between mesh types, respectively. Standard statistical methods were used in uni- and multivariate analysis.
Results: A total of 386 patients met criteria: 221 patients had CDC Class 3 wounds and 165 CDC Class 4. There were 335 hernias repaired with biologic mesh and 51 with synthetic mesh. A greater percentage of biologic mesh patients had CDC Class 4 wounds (47.8% biologic vs 9.8% synthetic, $p = 0.01$). Biologic mesh patients had an increased BMI (33.2 ± 7.4 vs 32.2 ± 5.6 kg/m^2, $p = 0.01$) but were similar in terms of smoking history (34.0% vs 20.4%, $p = 0.07$) and diabetes (32.7%vs22.0%, $p = 0.14$). Hernia defect size (297.9 ± 232.9 vs 208.2 ± 154.8 cm2) was larger for biologic mesh patients but mesh size was smaller (587.3 ± 321.9 vs 975.6 ± 336.9 cm2). Strattice (74.8%) and MTF (11.6%) were the most common biologics. Ventralight(39.2%), UltraPro(17.7%), Proceed(13.7%), and Prolene (13.3%) were the most common synthetics. Preperitoneal mesh placement was performed in most cases (74.2% vs 87.2%, $p = 0.36$) and inlay mesh placement, while not as frequent overall, was more commonly used with biologic (9.4% vs 2.1%, $p = 0.36$). Operative time was over three and a half hours for both groups ($p = 0.32$). Overall hernia recurrence was equivalent (10.4% vs 17.6%, $p = 0.14$) even after excluding bridging mesh (9.5%vs17.6%; $p = 0.06$). Mean follow-up was 25.4 ± 28.0 vs 41.9 ± 48.1 months ($p < 0.01$). Overall wound complication rate was comparable (36.0% vs 32.6%, $p = 0.74$) between the two groups. Delayed primary closure was used more commonly with biologic mesh (45.1% vs 2.0%; $p < 0.01$). By four months, 12% of the synthetic mesh patients developed a mesh infection, with 66% requiring a mesh excision. In logistic regression, wound complications and bridging mesh were predictive of recurrence (OR 6.0 and 13.1; $p < 0.05$). Wound complications remained independently associated with recurrence even after excluding bridging mesh (OR 5.8).
Conclusions: Biologic mesh may be used in contaminated, complex open ventral hernia repair with similar hernia recurrence and wound complication rates as synthetic mesh, albeit with less mesh-related infection.

S143

The impact of frailty on outcomes in ventral hernia repair in a statewide database

Quintin P Solano[1]; Ryan Howard, MD[2]; Anne Ehlers, MD[2]; Lia Delaney, MS[1]; Brian Fry, MD[2]; Mary Shen, MD, MS[2]; Michael Englesbe, MD[2]; Justin Dimick, MD, MPH[2]; Dana Telem, MD, MPH[2]; [1]University of Michigan Medical School; [2]Michigan Medicine

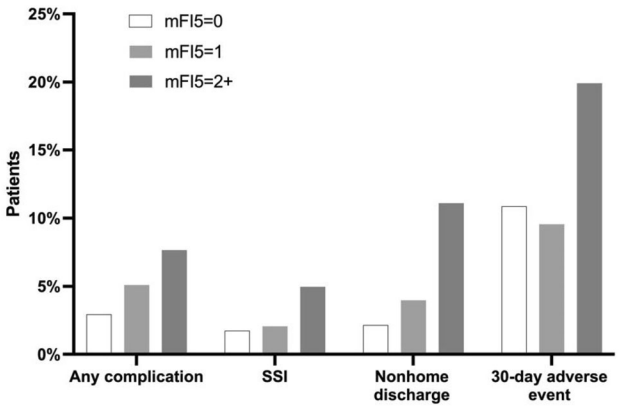
Introduction: Preoperative frailty is a strong predictor of postoperative morbidity in the general surgery population. Although ventral hernia repair (VHR) is one of the most common operations performed in the United States, there is a paucity of research examining the impact of frailty on outcomes after VHR. Moreover, existing studies lack crucial hernia variables, such as hernia size and location, that are known to affect patient outcomes. Within this context, we investigated the association between preoperative frailty and clinical outcomes among adults undergoing VHR using a hernia-rich database.

Methods: Using a clinically nuanced, population-level hernia registry, the Michigan Surgery Quality Collaborative Hernia Registry, we performed an analysis of adult patients undergoing VHR between January 1, 2020, and July 1, 2021. Patients were stratified into three groups by a validated 5-factor Modified Frailty Index (mFI-5 = 0, mFI-5 = 1, mFI-5 $\geq$ 2). The co-primary outcomes were any and serious 30-day postoperative complications, surgical site infection (SSI), non-home discharge, and a composite of any post-discharge adverse event (emergency department visit, readmission, or reoperation). Multivariable analyses were performed to account for patient characteristics, hernia characteristics (size, location, mesh use), and operative characteristics.

Results: A total of 1,634 patients underwent VHR with a mean age of 54 + 15 years, 798 (49%) female patients, and a mean BMI of 33 + 8 kg/m^2. In this cohort, 745 (46%) patients had an mFI-5 score = 0, 628 (38%) had an mFI-5 score = 1, and 261 (16%) had an mFI-5 score $\geq$ 2. The overall rates of complication, SSI, non-home discharge, and post-discharge adverse events are shown in the Figure. Compared to patients with an mFI-5 score > 2 were more likely to have a serious postoperative complication (OR 4.30 [95% CI 1.35–13.68]) or SSI (OR 4.47 [95% CI 1.56–12.83]). An mFI-5 score > 2 was not associated with non-home discharge (OR 1.85 [95% CI 0.79–4.33]) or post-discharge adverse events (OR 1.59 [95% CI 0.99–2.58).

Conclusion: In a cohort of patients undergoing VHR, an mFI-5 score $\geq$ 2 was associated with worse postoperative outcomes. These findings contribute to the growing literature highlighting the importance of patient frailty in operative selection and counseling. Addressing frailty in the preoperative setting has the potential to improve surgical outcomes. Future work should examine longer-term outcomes, especially hernia recurrence, in this population.

Figure. Clinical Outcomes Stratified by mFI-5 Score.



S144

Glycosylated hemoglobin is a poor predictor of postoperative complications in diabetic patients undergoing ventral hernia repair. An ACHQC study

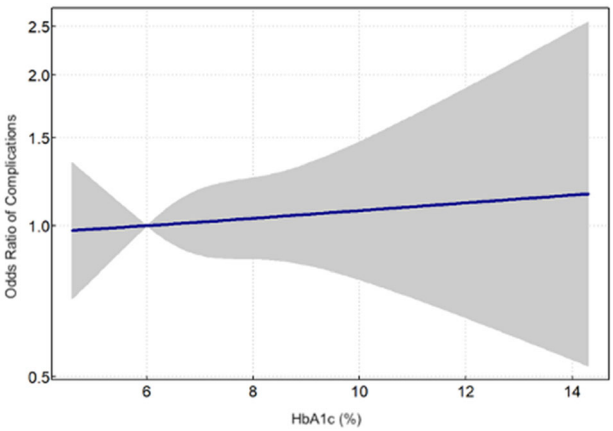
Mazen R Al-Mansour, MD[1]; Melanie Vargas[1]; Thomas Stewart[2]; Anand Gupta[3]; [1]University of Florida College of Medicine; [2]Vanderbilt University School of Medicine; [3]Ohio State University College of Medicine

Introduction: Elevated preoperative glycosylated hemoglobin (HbA1c) is believed to predict postoperative complications in diabetic patients undergoing ventral hernia repair (VHR). An expert panel recommended deferring elective VHR in patients with HbA1c > = 8% (Liang et al. Ann Surg. 2016). However, they acknowledge that data specific to VHR is lacking. Our objective was to assess the association between HbA1c and postoperative complications following VHR in diabetic patients.

Methods: We conducted a retrospective cohort study using the Abdominal Core Health Quality Collaborative (ACHQC) database. We included adult diabetic patients who underwent elective VHR with an available HbA1c result. As a descriptive analysis, the patients were divided into two groups (group A = HbA1c < 8%; group B = HbA1c > = 8%). Patient demographics, comorbidities, hernia characteristics, operative details and surgical outcomes were compared. The primary analysis was a multivariable logistic regression model of postoperative complications. In addition to several covariates related to baseline disease severity and complication risk, HbA1c was included in the model as a restricted cubic spline to estimate its potentially nonlinear relationship with the complication risk.

Results: 2,739 patients met the inclusion criteria (2,234 in group A and 505 in group B). The results below pertain to groups A and B respectively. Median age was 62 vs. 59 years, 46% vs. 50% were male and median body mass index was 34 vs. 35 kg/m^2. The median HbA1c was 6.5% vs. 8.7%. 78% vs 75% were incisional hernia, 39% vs 36% of those were recurrent, and median hernia width was 7 vs. 6 cm. Open approach was used in 64% vs. 63% and myofascial release was performed in 53% vs. 51%. Descriptively, there was no clinically significant difference in the rates of postoperative complications (26% vs 25%), SSI (6% vs 6%), surgical site occurrence (18% vs 19%), reoperation, readmission, or median length of stay between both groups. There was no statistically significant difference in the recurrence rate (8% vs 11%, $p = 0.2$) in the 622 (23%) patients who completed one-year follow up. The primary, multivariable analysis, did not identify an association between HbA1c and the rate of postoperative complications.

Conclusion: HbA1c is a poor predictor of postoperative complications in diabetic patients undergoing elective VHR. No difference was detected in recurrence rate in the high HbA1c group; however, the low follow up rate does not allow for adequate assessment of recurrence.



S145

Long-term outcomes of the RIVAL trial: 1- and 2-year outcomes of a prospective, randomized clinical trial comparing laparoscopic versus robotic inguinal hernia repair

Benjamin T Miller, MD[1]; Ajita S Prabhu, MD[1]; Chao Tu, MS[1]; David M Krpata, MD[1]; Clayton C Petro, MD[1]; Lucas R Beffa, MD[1]; Alfredo M Carbonell, DO[2]; William W Hope, MD[3]; Jeremy A Warren, MD[2]; Rana M Higgins, MD[4]; Brian P Jacob, MD[5]; Jeffrey Blatnik, MD[6]; Michael J Rosen, MD[1]; [1]Cleveland Clinic Foundation; [2]Prisma Health—Upstate; [3]New Hanover Regional Medical Center; [4]Medical College of Wisconsin; [5]Mount Sinai—New York; [6]Washington University

Objective: Robotic inguinal hernia repair is growing in popularity among general surgeons despite little high-quality evidence supporting short- or long-term advantages over traditional laparoscopic inguinal hernia repair. The original RIVAL trial reported increased cost and surgeon frustration with the robotic approach with no clinical differences. The 1- and 2-year patient-reported and clinical outcomes of the two techniques are reported in this exploratory analysis.

Methods: This is a multi-center, single-blinded, prospective randomized clinical study conducted at six sites from 2016 to 2019, comparing laparoscopic versus robotic transabdominal preperitoneal (TAPP) inguinal hernia repair with follow-up at 1 and 2 years. Patient-reported outcomes measured include pain (Visual Analog Scale), health-related quality of life (36-Item Short-Form Health Survey), physical activity (Physical Activity Assessment Tool), neuropathic pain (Leeds Assessment of Neuropathic Symptoms and Signs Pain Scale), and surgical scar cosmesis (Stony Brook Scar Evaluation Scale). Clinical outcomes measured are wound morbidity and composite hernia recurrence (patient-reported and clinical exam).

Results: Early trial participation included 102 patients, 83 (81%) completed 1-year follow-up (45 laparoscopic vs 38 robotic) and 77 (75%) completed 2-year follow-up (43 laparoscopic vs 34 robotic). At 1 and 2 years, there were no differences between the two groups with regards to pain, neuropathic pain, or health-related quality of life. At 1 year, the robotic group had greater vigorous activity (minutes per week) compared to the laparoscopic group (90.0 vs 74.3; $p = 0.03$), but there was no difference at 2 years (63.8 vs 70.3; $p = 0.50$). No other differences were found in physical activity. Surgical scar cosmesis outcomes were similar at 2 years. No long-term wound morbidity was found in either group. At 2 years, there was no difference in hernia recurrence (1 laparoscopic vs 1 robotic; $p = 1.0$).

Conclusions: In this exploratory analysis, no major differences were found in patient pain, health-related quality of life, physical activity, or hernia recurrence at 1 and 2 years between TAPP laparoscopic and robotic inguinal hernia repairs. Future prospective studies should focus on robust long-term follow-up to confirm the clinical and patient-reported outcomes between these two surgical techniques.

S146

Portable neuroimaging differentiates novices and experts in the FLS suturing task

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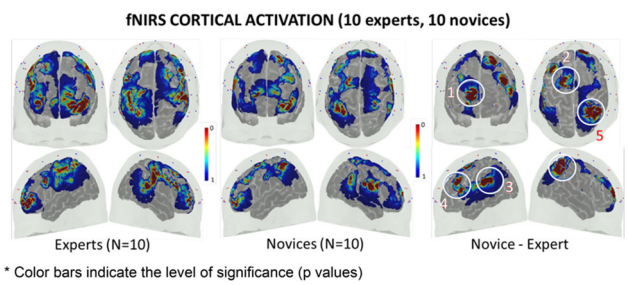
Introduction: The goal of this study was to compare the brain activation patterns of experienced and novice individuals when performing a complex surgical skills task. Recent studies have shown that novices have elevated prefrontal cortex (PFC) activation compared to experts when performing the Fundamentals of Laparoscopic Surgery (FLS) pattern cutting task [1]. This study aimed to evaluate whether similar differences between experts and novices would be observed for the FLS suture with intracorporeal knot tying task, which requires bimanual motor control.

Methods And Procedures: Ten experienced, and ten novice participants completed one experimental session. During the session, participants performed the FLS suture with intracorporeal knot tying task in a standard FLS box trainer for three repetitions, each separated by two minutes. Functional near infrared spectroscopy (fNIRS) data was recorded using an optode montage that covered the prefrontal and sensorimotor brain areas throughout the task. Data processing was conducted using the HOMER3 and AtlasViewer toolboxes to determine the oxy-hemoglobin (HbO) and deoxyhemoglobin (HbR) concentrations. The hemodynamic response function based on HbO changes during the task relative to the resting state was averaged for the first minutes of each repetition and across the repetitions per participant. Group-level differences were evaluated using a general linear model of the HbO changes with significance set at $p < 0.05$.

Results: The average performance score for the experienced group was significantly higher than the novice group ($p < 0.01$). The figure shows the significant cortical activations ($p < 0.05$) in the prefrontal and sensorimotor areas for the expert (left) and novice (middle) groups. The rightmost panel shows the contrast between the average activation in the novices and experts. The numbered areas are those with statistically significant differences, where the novices showed greater activation than the experts – 1. right dorsolateral prefrontal cortex (PFC), 2. left supplementary area, 3. left supramarginal gyrus, 4. left inferior frontal gyrus, and 5. right parietal cortex. For the experts, the significant activation included medial PFC, which is an area related to internal performance monitoring. When compared to experts (see figure: Novice-Expert), the novices showed significant left lateralization of the cortical activation, consistent with the regions for complex motor control.

Conclusions: Portable neuroimaging allowed for the differentiation of the brain regions activated by experienced and novice participants for a complex surgical motor task. This information can be used to support the objective evaluation of expertise during surgical skills training and assessment.



* Color bars indicate the level of significance (p values)

S147

The American board of surgery flexible endoscopy curriculum prepares individuals to pass the fundamentals of endoscopic surgery manual skills test

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Objective: To determine if completion of the Flexible Endoscopy Curriculum (FEC) prepares individuals to pass the Fundamentals of Endoscopic Surgery (FES) manual skills test.

Background: FES certification has been required by the ABS for general surgery applicants since 2018. The ABS recommends completion of the FEC prior to taking the FES manual skills test. FEC measured components include meeting case log requirements for upper and lower endoscopy, achieving a Global Assessment of Gastrointestinal Endoscopic Skills (GAGES) score > 18, and completing a dedicated endoscopy rotation. We hypothesized that completion of the FEC would result in improved performance on the FES manual skills test.

Methods: Participants included first-attempt FES manual skills examinees between June of 2014 and February of 2019. De-identified data were reviewed, and 970 unique participants reporting FEC data were identified. Self-reported data included gender, PGY level, glove size, upper (UE) and lower (LE) endoscopy experience, simulation training time, and participation in an endoscopy rotation (ER). Final FES skills exam scores and pass/fail designations for each participant were reported by FES program staff. The performance of those completing or not completing the FEC were compared.

Results: Participants were similar with respect to age, height, glove size, hand dominance, and time spent on a simulator. Men and candidates taking FES exam later in residency were more likely to have completed all FEC requirements ($p = 0.002$, $p < 0.001$). There was a statistically discernible difference in FES first time pass rates between those reporting completion of all components of FEC compared to those who completed no components of FEC (88.4% vs 72.4%, $p < 0.001$). On logistic regression analysis, completion of all FEC components (OR = 2.3, 95% CI 1.5 – 3.7, $p < 0.001$) and male gender (OR = 3.1, 95% CI 1.7 – 5.7, $p < 0.001$) were predictors of pass rate, while glove size (OR = 1.5, 95% CI 1.0 – 2.5, $p = 0.08$), simulator training time (OR = 1.1, 95% CI 0.9 – 1.4, $p = 0.37$) and resident PGY level were not (OR = 1.1, 95% CI 0.9 – 1.4, $p = 0.38$). Of the FEC components, LE was the strongest predictor of passing (OR = 2.4, 95% CI 1.3 – 4.3, $p = 0.005$).

Conclusions: Completion of FEC is strongly associated with passing the FES skills test. FEC is an effective strategy for developing endoscopic skills and this study supports the ABS recommendation for completion of FEC prior to taking the FES skills test.

S148

Community distress as a predictor of early hernia recurrence for older adults undergoing ventral hernia repair (VHR)

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Background: Social cohesion and neighborhood support have been linked to improved health in a variety of fields, but is not well-studied among the elderly population. This is particularly evident in surgical populations. Therefore, this study sought to assess the potential role of community distress in predicting early hernia recurrence among older adults.

Methods: The Abdominal Core Health Quality Collaborative (ACHQC) was used to identify patients aged 65 or older undergoing ventral hernia repair with zip code data available. Patients were linked to the Distressed Communities Index (DCI), which is a national database that assigns a score of 0–100 to each zip code based on 7 measures of neighborhood prosperity. Quintiles were used to compare groups: distressed (0–20), at-risk (21–40), moderate (41–60), comfortable (61–80), and prosperous (81–100). Time to recurrence for neighborhood distress quintiles was examined using a Cox proportional hazards model.

Results: In total, 10,216 patients were included in the study, including 3175 (31.1%) prosperous, 2392 (23.4%) comfortable, 1854 (18.1%) moderate, 1444 (14.1%) at-risk, and 1351 (13.2%) distressed. Distressed communities had lower mean age and greater proportion of racial minorities ($p < 0.001$). Open repairs were significantly more common among the distressed group (66.7%), as were all comorbidities ($p < 0.001$). The recurrence-free survival was shorter for the distressed communities compared to the prosperous after adjusting for baseline characteristics (HR: 1.3; 95% CI: 1.04–1.62; $p = 0.019$). Mean time to recurrence was lowest for patients living in distressed communities, indicating the worst recurrence rates, while mean time to recurrence was greatest for those in prosperous zip codes ($p < 0.001$).

Conclusions: Older VHR patients presenting from distressed zip codes, as identified by the Distressed Communities Index, experience hernia recurrence significantly sooner as compared to patients from prosperous zip codes. This study may provide evidence of the role of neighborhood and environmental factors in caring for older patients following VHR.

S149

Bowel stimulation before loop ileostomy closure to reduce postoperative ileus: a multicenter, single-blinded, randomized controlled trial

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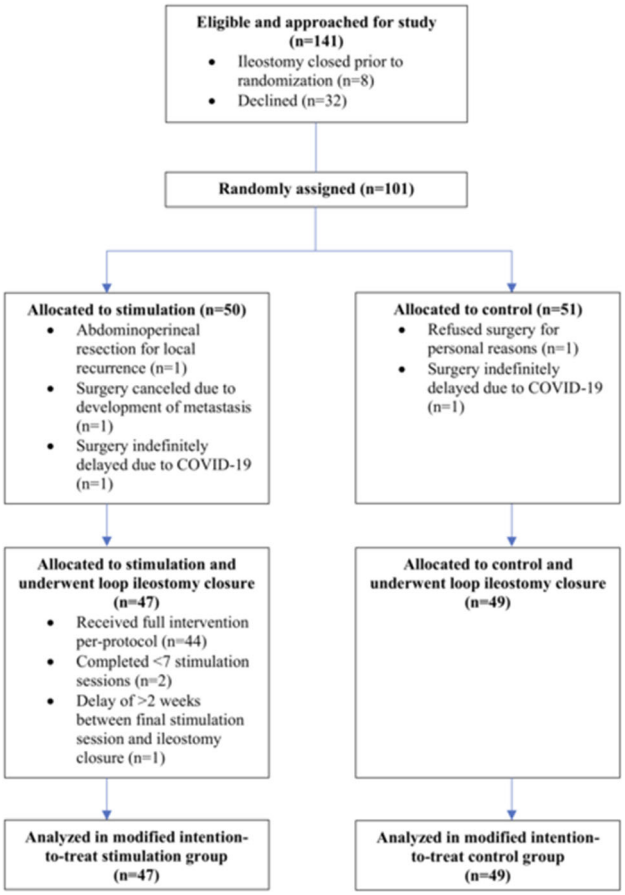
Introduction: Postoperative ileus (POI) is the most common morbidity following loop ileostomy closure and is a major impediment to early discharge protocols. The objective of this study was to evaluate the impact of preoperative bowel stimulation on the development of POI after loop ileostomy closure.

Methods and procedures: This was a multicenter, randomized controlled trial (NCT025596350) including adult (≥ 18 years-old) patients who underwent elective loop ileostomy closure at 7 participating hospitals. Participants were randomly assigned (1:1) using a centralized computer-generated sequence with block randomization to either preoperative bowel stimulation or no stimulation (control group). Bowel stimulation consisted of 10 outpatient sessions within 3 weeks prior to ileostomy closure and was performed by trained Enterostomal Therapy nurses. During each session, the efferent limb of the ileostomy was canalized with an 18 Fr Foley catheter and infused with 500 mL of normal saline mixed with 30 g of a thickening-agent (Nestle Thicken-UpÓ). The primary outcome was POI, defined as intolerance to oral food in the absence of clinical or radiological signs of obstruction, on or after post-operative day 3, that either a) required nasogastric tube insertion; or b) was associated with 2 of the following: nausea/vomiting, abdominal distension, or the absence of flatus. Assessment of POI was performed by a blinded trained research team member. Enhanced Recovery Protocols were used at all hospitals.

Results: Between January 2017 and November 2020, 101 patients were randomized, and 5 patients never underwent ileostomy closure; thus, 96 patients (47 stimulated vs. 49 control) were analyzed according to a modified intention-to-treat protocol (Figure 1). Baseline characteristics were well balanced, including median age (62.0 (55.5–71.0) vs. 64.0 (53.0–71.0), $p = 0.85$), proportion of patients with an American Society of Anesthesiologist score > 2 (31.9% vs. 22.4%, $p = 0.41$), and median time between ileostomy creation and closure (6.7 months (5.0–11.0) vs. 7.3 months (5.4–10.1), $p = 0.55$). The incidence of POI was lower among patients randomized to stimulation (6.4% vs. 24.5%, $p = 0.034$; unadjusted RR: 0.26, 95% CI 0.078–0.87). Stimulated patients also had earlier median time to first flatus (2.0 days (1.0–2.0) vs. 2.0 days (2.0–3.0), $p = 0.025$), were more likely to pass flatus on postoperative day 1 (46.8% vs. 22.4%, $p = 0.022$), and had a shorter median postoperative hospital stay (3.0 days (2.0–3.5) vs. 4.0 days (2.0–6.0), $p = 0.003$). Overall 30-day morbidity was similar in both groups (12.8% vs. 30.6%, $p = 0.062$).

Conlusion(s): Preoperative bowel stimulation via the efferent limb of the ileostomy reduced POI after elective loop ileostomy closure.

Figure 1 CONSORT flow diagram of randomized patients



S156

Comparing outcomes of per-oral pyloromyotomy and pyloroplasty for the treatment of gastroparesis

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Background: Gastroparesis is characterized by delayed gastric emptying without a significant obstructive pathology and is estimated to effect more than 5 million adults in the United States. Therapies for this condition are divided into two categories: gastric electrical stimulation or pyloric therapies to facilitate gastric emptying. Pyloric procedures include pyloroplasty, a well-documented procedure, and per oral endoscopic myotomy (POP), a relatively novel endoscopic procedure that disrupts the pyloric muscles endoscopically. There is a paucity of literature comparing the two procedures. The aim of this study is to compare the outcomes of these two techniques.

Methods: Under an IRB protocol, data was collected prospectively from September 2018 through April 2021 at our institution for patients undergoing POP ($n = 63$ patients) or robotic pyloroplasty (RP) ($n = 48$). Preoperative and postoperative data including sex, race, age, BMI, and Gastroparesis Cardinal Symptom Index (GCSI) score were analyzed using univariate and multivariate analysis.

Results: There was no significant difference in sex, age, and BMI for both cohorts. Patients who underwent POP had significantly shorter operative time compared to RP (27 min vs 90 $p < 0.001$). The change between preoperative and postoperative GCSI scores for POP versus RP (22.6 versus 17.6 units) was significantly decreased for both interventions ($p < 0.001$). However, comparing both data, RP has significantly better improvement in postoperative GCSI score than POP ($p = 0.034$). This was reflected in the individual symptoms with nausea ($p < 0.001$), ability to finish meal ($p = 0.037$), belly visibly larger ($p = 0.037$) and bloating ($p = 0.022$) all showing improvement in both groups, but with RP having a more significant decrease in the scoring of these symptoms. There was no significant difference in the number of postoperative complications (12 vs. 6 $p = 0.440$).

Conclusion: Even though both interventions are significantly associated with improvement of symptoms in patients with gastroparesis, our data demonstrates that robotic pyloroplasty has a superior response in comparison to per-oral endoscopic myotomy for the management of these symptoms. Per-oral pyloromyotomy has a similar complication rate to robotic pyloroplasty with a shorter operative time.

S157

Abnormal response after multiple rapid swallow provocation is not predictive of early post-operative dysphagia following fundoplication

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Introduction: The aim was to evaluate the clinical significance of multiple rapid swallows (MRS) during high resolution manometry (HRM) prior to fundoplication. Despite pre-operative HRM, 10–24% of patients report post-fundoplication dysphagia. Some suggest MRS may be a better predictor of dysphagia risk after surgery than standard HRM metrics. We hypothesize response to MRS is not predictive of dysphagia post-fundoplication.

Methods: Retrospective review of a prospectively collected database was performed on patients undergoing HRM evaluation with MRS provocation testing between July 2019 and August 2020 at a single institution. Patients with prior esophageal or hiatal surgery, peptic stricture, or achalasia were excluded. After performing standard 10 swallow HRM, MRS provocation was performed and recorded (2 mls of liquid swallowed every 2 s for 5 swallows while upright). Patient reported dysphagia scores were collected at the time of and prior to HRM, at initial consultation, and at 1-month post-operative follow-up, using a 5-point scale incorporating frequency and severity of symptoms (scale 0–4). Scores ≥ 2 (weekly or daily symptoms) were considered clinically significant. MRS was defined as recovery contraction DCI > 450 mmHg*sec*cm. Antireflux surgery was tailored based on standard HRM values, not MRS (partial fundoplication for ineffective motility).

Results: 570 patients underwent HRM during the 13-month study period. 287 patients met inclusion criteria. Average patient age was 59.5 years-old, with 66% of patients being female. 217 (38%) patients reported clinically significant dysphagia at the time of HRM. As expected, there is a correlation between MRS recovery and standard study DCI, contraction amplitude and % peristalsis. However, none of these values correlated with preoperative dysphagia scores. Neither MRS nor MRS:SS DCI were associated with clinically significant dysphagia at the time of pre-operative HRM ($p = 0.11$ and $p = 0.40$, respectively).

148 patients underwent fundoplication during the study period, (66 complete, 82 partial). There was no statistical difference in the proportion of patients undergoing complete versus partial fundoplication by dysphagia outcome ($p = 0.28$). Sixty-six patients had available post-operative dysphagia scores (pre-operative: 21 dysphagia, 45 no-dysphagia). Post-operatively, 1/45 reported new onset dysphagia > 2. Of those with pre-operative dysphagia, 19 improved, 1 was stable, and 1 reported worsening dysphagia.

Conclusions: The risk of early dysphagia post- fundoplication following a tailored traditional approach based on standard HRM metrics, is very low. The additional data provided by multiple rapid swallows does not add to the surgical decision making process using the investigated approach.

	Improved(n=24)	Unchanged (n=21)	Worsened (n=18)	p-value
Age	66.7 (13.4)	64.1 (14.5)	53.8 (16.7)	0.017
Sex (%Female)	61.11	52.38	62.50	0.76
IRP	9(4.5-13.5)	7 (2-12)	5(3.75-7.25)	0.078
DCI_nl	40(0-80)	20 (0-65)	30(5-55)	0.86
DCI_mean	385(26-744)	306 (0-641.8)	494 (198.5-789.5)	0.945
DECA	46.8(25.4)	50.7(32.1)	49.5 (30)	0.9
Peristaltic swallows (%)	90 (70-100)	80 (60-100)	80(50-100)	0.778
Failed swallows (%)	15 (0-40)	40 (10-70)	30(0-50)	0.985
Abnormal MRS recovery (%)	60.0	45.5	36.8	0.76
MRS_DCI	398.5 (0-1015)	301 (0-738)	291 (0-802.5)	0.28
MRS:SS	1.23 (0.89-2.12)	0.88 (0.25-1.51)	0.84 (0.05-1.63)	0.98
Complete Fundoplication	7 (29.2)	6 (28.5)	9 (50)	
Partial Fundoplication	17(70.8)	15 (71.4)	9(50)	0.28

S158

Novel ”starburst“ mesh configuration for paraesophageal and recurrent hiatal hernia repair: comparison with keyhole mesh configuration

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Introduction: Controversy exists over the use of mesh, its type and configuration in repair of hiatal hernia. Our practice is to limit biological mesh usage to large or recurrent hiatal hernias, and we have evolved our mesh configuration from the U-shape to the keyhole configuration. However, a better understanding of the forces attacking upon the hiatus has led us to develop a novel configuration of the keyhole pattern by folding the mesh over the edges of the approximated hiatus – entitled the “starburst” configuration. We report our experience with the starburst configuration, comparing it to our results with the keyhole configuration.

Methods: The medical records of all patients undergoing either the keyhole or starburst mesh configuration hiatal hernia repair were reviewed between 2017 and 2021. Data gathered included age, sex, type of hernia (sliding, paraesophageal, or recurrent), fundoplication type (none, Nissen, Toupet, Collis-Toupet, or magnetic sphincter augmentation [MSA]), in-hospital complications, and postoperative outcomes (hiatal hernia recurrence, reflux-symptom recurrence, dysphagia, dilations, reoperations).

Results: From 7/2017 to 8/2019, 48 cases using the keyhole mesh configuration were completed. The average age was 67 + 11 years, and 88% were female. Paraesophageal hernia (PEH) comprised 65% and recurrent hiatal hernia (RHH) 35% of cases. Distribution of fundoplication type: 4% none, 44% Nissen, 38% Toupet, 8% Dor, 6% Collis-Toupet. Postoperative complication occurred in 21% of these patients. Clinical outcomes: Recurrent hiatal hernia 8%, dysphagia 15%, dysphagia requiring dilation 8%, recurrent GERD symptoms 4%, and reoperation 8%. From 10/2020 to 8/2021, 58 cases using the starburst configuration were completed. For these patients, average age was 67 + 11 years and 79% were female. Sliding hiatal hernia comprised 5%, PEH 57%, and RHH 38%. Distribution of fundoplication type: 10% none, 40% Nissen, 43% Toupet, 5% MSA, 2% Collis-Toupet. Post-operative complication occurred in 10% of these patients. Clinical outcomes: Recurrent hiatal hernia 8%, dysphagia 8%, dilations 2%, recurrent GERD symptoms 2%, and reoperations 7%.

Conclusions: Our experience is that the starburst mesh configuration compares favorably with the keyhole configuration with respect to postoperative complications, dysphagia, need for esophageal dilation, and GERD symptom recurrence. However, as of yet, we have not noted a significant difference in hiatal hernia recurrence. We are continuing to further refine this technique and study the long-term outcomes of our patients.

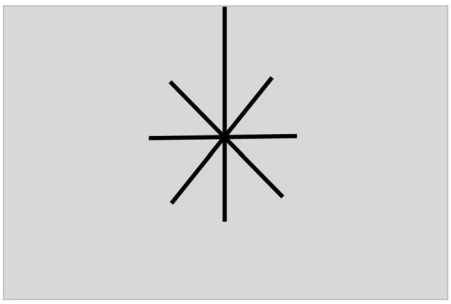
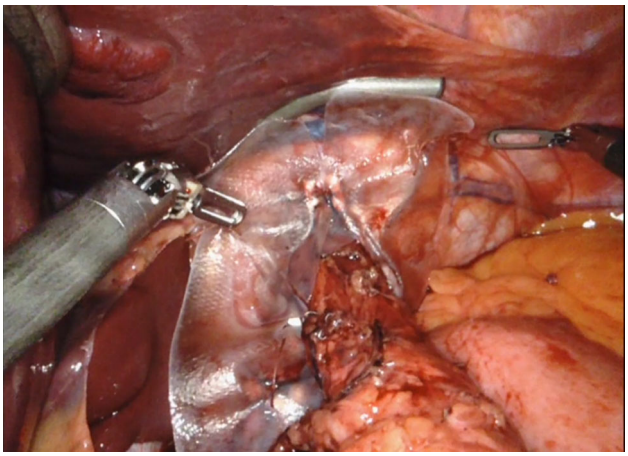


Figure 1. Startburst mesh pattern.

Figure 2. Starburst mesh placement at hiatus in robotic hiatal hernia repair.



S159

Esophagogastric junction compliance on impedance planimetry (EndoFLIP) following peroral endoscopic myotomy predicts improvement in postoperative Eckardt score

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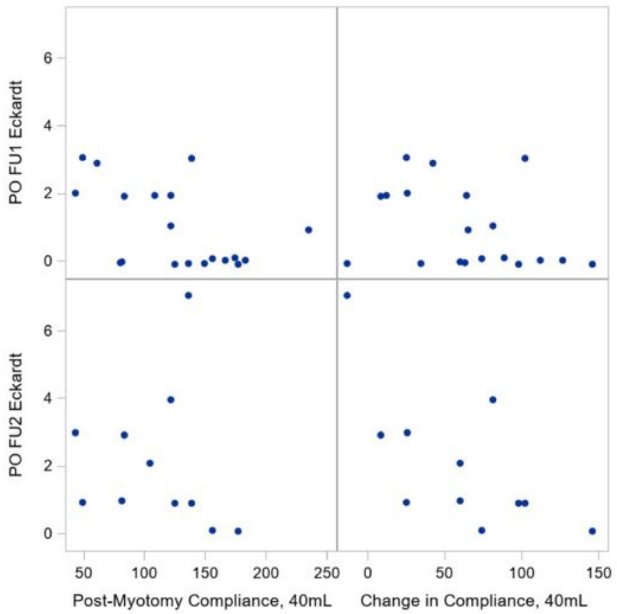
Introduction: Peroral endoscopic myotomy (POEM) is a mainstay of treatment for achalasia and other esophageal motility disorders. Tailored myotomy based on intra-operative compliance, as measured with impedance planimetry, has yet to be described. In this study, we describe the association between improvement in Eckardt score and post-myotomy compliance.

Methods: A retrospective review of a prospectively maintained gastroesophageal database was performed. Demographic and perioperative data of patients who underwent POEM between January 2019 and August 2021 were analyzed. Group comparisons were made using two-tailed Wilcoxon rank-sum and Fisher's exact tests. Spearman's correlation coefficients (r) were used to assess the relationship between compliance and outcomes, all with two-tailed statistical significance of $p < 0.05$.

Results: 36 patients underwent POEM and intraoperative evaluation with a functional lumen imaging probe (FLIP) for type 1 achalasia ($n = 6$, 16.7%), type 2 achalasia ($n = 17$, 47.2%), type 3 achalasia ($n = 8$, 22.2%), diffuse esophageal spasm ($n = 1$, 2.8%), esophagogastric junction outflow obstruction ($n = 1$, 2.8%), jackhammer esophagus ($n = 2$, 5.6%), or not otherwise classified ($n = 1$, 2.8%). There was significant improvement in all FLIP measurements at both 30 mL and 40 mL fill post-myotomy (all $p < 0.01$). With a 30 mL and 40 mL fill, respectively, compliance increased by 42% (142 ± 118%) and 66% (166 ± 133%) from pre to post-myotomy. Mean preoperative Eckardt score was 5.6 ± 2.5, while mean Eckard scores at first and second postoperative visit were 1.3 ± 1.8 and 2.3 ± 2.2, respectively. Median times to first and second follow up were 23 days (IQR 20–23) and 97 days (IQR 65–209). A higher compliance at 30 mL fill (r = -0.57, $p = 0.033$) and 40 mL fill (r = -0.52, $p = 0.022$) was moderately associated with lower Eckardt score at first follow up (Fig. 1). A post myotomy compliance of ≥ 140 mm^3/mmHg at 40 mL fill was associated with a lower Eckardt score at first (0.1 ± 0.4 vs 1.5 ± 1.2, $p = 0.019$) and second (0.0 ± 0.0, vs 2.6 ± 2.0, $p = 0.029$) postoperative visit.

Conclusions: A tailored lower esophageal myotomy based on intra-operative impedance planimetry can result in improved outcomes. A target post-myotomy compliance of at least 140 mm^3/mmHg at a 40 mL fill is associated with a normal Eckardt score at first and second post-operative visits.



S160

Comparative outcomes of laparoscopic and robotic approaches to gastrectomy

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Introduction: Gastric cancer(GC) is associated with significant mortality worldwide. Radical gastrectomy with lymphadenectomy is considered the only curative option for GC. Traditionally, these operations are associated with significant morbidity. Laparoscopic(LG) and more recently robotic(RG) techniques have been developed as a way to potentially decrease the perioperative morbidity. We sought to compare oncologic outcomes with laparoscopic and robotic techniques for gastrectomy.

Methods: Utilizing the National Cancer Database we identified patients with gastric cancer who underwent gastrectomy. We then stratified by technique Robotic or Laparoscopic. Mann–Whitney U and Kruskal were used to compare continuous variables and Pearson's Chi-square test was used to compare categorical variables. Unadjusted survival analyses were performed using the Kaplan–Meier method. Multivariate analysis (MVA) was performed to identify predictors of survival. All statistical tests were two-sided and $p < 0.05$ was considered significant.

Results: We identified 2,530 patients who underwent RG and 10,790 LG with median ages of 66 (20–90) and 66 (18–90) respectively, $p = 0.09$. Charleson/Deyo scores were comparable between the groups, $p = 0.06$. There were no differences in tumor histology, $p = 0.98$, grade $p = 0.63$, or tumor size $p = 0.72$. Neoadjuvant therapy was more often utilized in the robotic group at 40% compared to 29.9% in the LG, $p < 0.001$. The median lymph nodes removed was higher in the RG at 18 (11–26) compared to 17 (10–25) in the LG, $p < 0.001$. The mean number of lymph nodes positive were higher in the LG 2.6 ± 5.1 vs RG 2.2 ± 4.6, $p < 0.001$. The R0 resections were higher in the RG at 92.8% vs 89.9% in LG $p < 0.001$. Conversions to open were 7.2% in the RG and 15.2% in the LG groups, $p < 0.001$. The median length of hospitalization was 7 (4–10) in both groups. The readmission rates were 5.3% in the RG and 5.7% in the LG groups, $p = 0.49$. The 30 and 90-day mortality was 2.1% and 4% in the RG and 2.7% and 5.4% in the LG respectively, $p = 0.13$ and 0.004. The median and overall 5-year survival was 84.7mo and 61% in the RG and 90.3mo and 58% in the LG, $p = 0.04$. Multivariate analysis revealed that age, sex, Charlson/Deyo score, tumor location, histology, grade, stage, facility volume, and neoadjuvant therapy were all predictors of survival.

Conclusions: Robotic and laparoscopic techniques are both acceptable approaches to gastrectomy. However, conversions to open are higher, LN yield and R0 resections are lower in the laparoscopic group. Additionally, a survival benefit is demonstrated in those undergoing robotic gastrectomy.

S161

Clinical and financial outcomes of per oral endoscopic myotomy compared to laparoscopic Heller myotomy for treatment of achalasia

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Introduction: Peroral endoscopic myotomy (POEM) and laparoscopic Heller myotomy (LHM) are established highly effective treatments for achalasia with most studies demonstrating similar outcomes for the two procedures. Many payors have been slow to recognize POEM as a valid treatment option for achalasia despite it being less invasive and potentially an outpatient procedure. Several studies have directly compared its outcomes to LHM and some have compared the cost-effectiveness of the two procedures. However, no study has combined this with hospital reimbursement data. This study compares perioperative and long-term outcomes, cost-effectiveness, and reimbursement of POEM and LHM at a single institution.

Methods: Patients who underwent POEM or LHM between 2014 and 2021 were retrospectively analyzed using permutation t-tests to determine if there was a statistically significant difference between the average change in symptom scores pre- and post-surgery for the two procedure groups. Treatment success was defined by Eckardt ≤ 3 (Fisher's exact test). For median operative time, myotomy length, hospital cost and reimbursement, the Mann–Whitney U test was used and for length of hospital stay (LOS), a Chi-squared test was used. Cost and reimbursement data was available starting in 2018.

Results: A total of 58 patients who underwent either POEM ($n = 33$) or LHM ($n = 25$) at Geisinger Medical Center between 2014 and 2021 were included in the study. Treatment success (Eckardt ≤ 3) for POEM and LHM was achieved by 88% and 76% of patients, respectively ($p = 0.302$). POEM patients had a shorter operative time (median 106 min vs. 145 min, $p = 0.003$), shorter LOS (48.5% vs. 0% same day discharge, $p < 0.001$) and longer myotomy length (median 11 cm vs. 8 cm, $p < 0.001$). At an average follow-up time of 36.7 months for LHM and 28.6 for POEM, dysphagia alone had a significantly different mean change between the two groups ($p = 0.003$). Scored from 0 to 4, pre- and post-surgery mean dysphagia values were 2.20 and 1.08 for LHM and 2.88 and 0.58 for POEM. Outcomes of heartburn, regurgitation, Eckardt, GERD HRQL, RSI and medication use were not statistically different between groups; however, there was a trend toward a greater reduction in Eckardt score with POEM. Median hospital reimbursement was dramatically less for POEM ($952 vs. $12,600), despite hospital costs also being significantly lower than LHM ($17,000 vs. $64,000).

Conclusion: POEM is associated with a shorter operative time and LOS, a longer myotomy length, and greater resolution of dysphagia compared to LHM. POEM costs significantly less but is poorly reimbursed.

S162

Robotic median arcuate ligament release: Management algorithm and clinical outcomes from a large minimally invasive series

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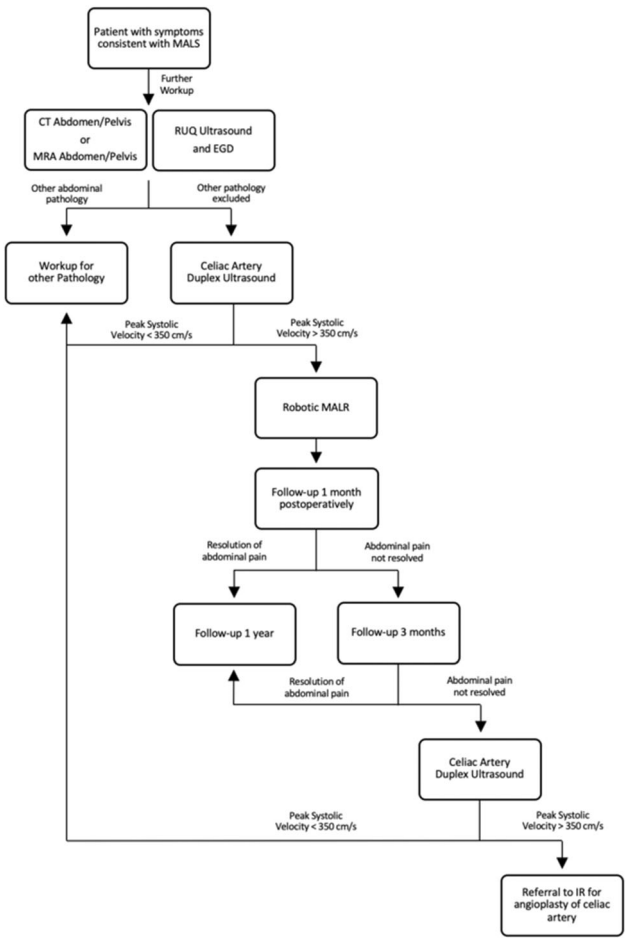
Introduction: Median arcuate ligament syndrome (MALS) is a rare and debilitating condition for which median arcuate ligament release (MALR) can offer appropriately selected patients significant relief. MALR can be difficult to perform laparoscopically, however, given the challenging exposure and potential for significant hemorrhage. The robotic approach may facilitate a minimally invasive MALR approach given the fine precision and dexterity of the instrumentation and stability of the camera platform. Here we describe the management algorithm we have developed as well as short- and long-term clinical outcomes for a large series of robotic MALR patients.

Methods and Procedures: This retrospective cohort study analyzed adult patients who underwent robotic MALR performed by a single surgeon at a tertiary academic hospital from 2014–2020. The diagnosis of MALS was made using objective criteria from celiac artery duplex ultrasound (DUS) with a peak systolic velocity (PSV) of > 350 cm/s combined with a right upper quadrant abdominal ultrasound, esophagogastroduodenoscopy, and computer tomography or magnetic resonance angiography to exclude other diagnoses. Information on patient demographics, perioperative factors, and patient reported symptoms up to 1-year post-operatively were collected.

Results: A total of 62 patients underwent robotic MALR during the study period. The mean age was 27.0 ± 12.1 years and the majority of patients were female ($n = 52/62$, 83.9%). The most common presenting symptoms were post-prandial abdominal pain ($n = 57/62$, 91.9%) and an epigastric location of pain ($n = 54/62$, 87.1%). The preoperative DUS expiratory PSV was 363.1 ± 47.5 cm/s. The mean operative time was 57.8 ± 14.2 min. There were no conversions to open surgery and minimal blood loss (mean = 14.1 ± 2.8 mL). At 3-months, 87.1% ($n = 54/62$) of patients had resolution of abdominal pain. The 8 patients that did not have complete resolution of abdominal pain underwent further testing; 4 of these 8 patients had persistently elevated DUS PSV and were referred for angioplasty. 2 of these 4 referred patients had resolution of abdominal pain after angioplasty. Of patients with 1-year follow up, 88% ($n = 42/48$) continued to have no abdominal pain.

Conclusion: Here we describe, to our knowledge, the largest series of minimally invasive (laparoscopic or robotic) MALR procedures published to date. The large majority of patients treated with robotic MALR had relief of abdominal pain, with durable outcomes at 1-year at a rate comparable to or better than published open or laparoscopic MALR series. With strict adherence to a management algorithm, the robotic approach to MALR is safe and feasible, with good patient outcomes.



S164

"Do What You Can, With What You Have, Where You Are."—Laparoscopic Common Bile Duct Exploration Using a Disposable Bronchoscope

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First introduced over thirty years ago, laparoscopic common bile duct exploration (LCBDE) is not a new technique. However, despite known advantages over open or endoscopic procedures, LCBDE has suffered from a lack of widespread adoption. Common barriers to performing LCBDE include lack of training and unavailability of dedicated choledochoscopes which limits direct visualization and basket retrieval. LCBDE can be done using other techniques, such as saline irrigation, Fogarty catheters, and basket grasping under fluoroscopic guidance. In the past, LCBDE has been performed at our institution with the previously mentioned "blind" techniques. During the covid-19 pandemic, disposable bronchoscopes have become widely available at our institution. Familiarity with this instrument raised the possibility of using one for direct vision of the biliary tract.

Case Report: A 61-year-old male with past medical history of obesity and Roux-en-Y gastric bypass presented to the emergency department with jaundice. Workup revealed a cholestatic pattern in liver function tests, with elevated direct bilirubin. Abdominal CT reported a dilatated common bile duct (CBD) and a 1-cm stone in the distal CBD. The patient was taken to the operating room for laparoscopic cholecystectomy with intraoperative cholangiogram (IOC) and LCBDE. IOC confirmed the presence of a filling defect in the distal CBD. Attempts were made to cannulate the cystic duct but were unsuccessful. A choledochotomy was performed and the bronchoscope (aScope, Ambu, Columbia, MD) was introduced. A large stone at the lower third of the CBD was seen. A basket was introduced through the working channel of the bronchoscope. This allowed mobilization, but not capture of the stone. Notably, visualization was impaired as the bronchoscope has only one working channel (i.e., simultaneous irrigation and basket manipulation was not possible). However, the stone was mobilized towards the mid portion of the CBD and was extracted through the choledochotomy. Stone clearance was confirmed by choledochoscoscopy. The choledochotomy was closed without a T-tube and an abdominal drain was placed.

The patient was discharged home with resolution of symptoms. No adverse events were found during or after surgery.

LCBDE under direct vision with a disposable bronchoscope is feasible and could provide an alternative to dedicated choledochoscopes, thus allowing more widespread adoption of LCBDE. In the words of Theodore Roosevelt, sometimes you must do what you can, with what you have, where you are.

S165

Relationship between the percentage of excess weight loss (%EWL) and HbA1c levels in patients with super obesity undergoing metabolic surgery: a prospective cohort study

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Introduction: Bariatric surgery is the standard treatment for obese and super-obese (SO) patients who suffer from comorbidities (e.g. type 2 diabetes mellitus [T2DM]) and have not reduced their weight by other means. One of the most used techniques is vertical gastrectomy (VG) due to its effectiveness in achieving adequate percentages of excess weight loss (%EWL) and because it is less technically demanding. However, very little has been described about the evolution of super-obese patients with T2DM undergoing VG. The aim of this study was to evaluate the relationship between %EWL and HbA1c in patients with SO and T2DM, with a 2-year follow-up.

Subjects and methods: Patients with SO and T2DM undergoing VG as a primary procedure between 2011 and 2017 at the National Medical Center (CMN) "20 de Noviembre" in Mexico were included. Patients were followed-up for two years. T2DM remission was defined as Hb1Ac level equal or less than 6.5%. A t-test was performed for paired samples, with a confidence interval determined at 95%.

Results: Twenty-three patients were evaluated. The mean BMI was 53.4 kg/m^2 (SD: $\pm$ 2.7 kg/m^2), and 17 (73.9%) were female. Hb1Ac level decreased from 7.7% before surgery to 6.7% and 5.8% at one and two years follow up, respectively. Those who achieved a complete remission of T2DM had a higher %EWL at two years of follow-up ($p < 0.001$); also at this point, 30.43% achieved partial remission and 56.62% achieved complete remission of T2DM.

Conclusion: VG is an effective procedure in terms of %EWL and impact on metabolic comorbidities such as T2DM, reaching remission. Hb1Ac showed a lower level at one and two years follow up.

Key words: morbid obesity, weight loss, glycated hemoglobin A, type 2 diabetes mellitus, gastrectomy.

S167

Initial experience in robotic surgery in a third level hospital in México

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Introduction: The evolution of conventional open surgery has changed with the introduction of laparoscopy in the last century. Ten years after this development, its subsequent progression to the robotic system was considered "the second revolution in surgery". This sophisticated robotic system provides a stable camera platform, third-dimensional imaging, adequate ergonomics, instruments with a high range of motion, and the ability to modulate the surgeon's tremor. In México there are only 18 robotic surgery equiped hospitals. Hospital Angeles Puebla is the newest site.

The objective of this study is to statistically report a series of initial cases and procedures performed with the Da Vinci robotic system at the Hospital Angeles Puebla, in Puebla, Mexico.

Methods and procedures: An observational, descriptive, and retrospective study was conducted in a population undergoing surgical procedures with the Da Vinci robotic system during the period January–September 2021. Variables such as surgical specialty, surgery performed, procedures per trimester, volume of surgeries performed by the surgeon, complications and re-intervention rates were analyzed.

Results: A total of 48 procedures were performed in this medical center, 52% (25) by the gynecology service, 32% (15) by the general surgery and advance surgical services, 14% (7) by urology, and 2%(1) by thoracic surgery. There were a total of 9 (18.7%) procedures during the months of January to March, 22 (45.8%) in the second trimester April-June and July–September, 17 (35.4%). There was an average productivity per surgeon of 3.25 surgeries in its first 90 days. Rates of major complications were 0% with its use and 2% of reintervention. This reintervention was associated to a Nissen fundoplication due to stenosis of the esophagus.

Conclusions: The initial experience with the da Vinci system (Intuitive Surgical, Sunnyvale, CA) at the Hospital Angeles Puebla showed that its use as minimally invasive surgery is feasible in a third level facillity after adequate training, with a low probability of major complications or re-intervention. This allows us to suggest the importance of the integrations of this new technologies in the surgical approach of patients, as well as the realization of further studies including clinical trials to verify the integral performance of the robotic system.

S168

Elipse intragastric balloon, an option for type i-ii morbid obesity. initial experience in a bariatric clinic in Colombia

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Introduction: The use of temporary restrictive methods such as the intragastric balloon has been useful in the management of obesity and the balloons have been traditionally placed with endoscopy. In March 2020, a new method arrives in Colombia, which does not require endoscopy, where the patient ingests the balloon and after 4 months removes it by natural methods. This new method avoids using anesthesia and endoscopic procedures yet still yields the same results as the endoscopic balloon.

Objetive: to describe the initial experience in the first year of using the ellipse balloon in the management of obesity I-II at the OEclinic in Cali, Colombia.

Methods and Results: In October 2020, the implantation process of the ellipse balloon began in patients with overweight or type I -II obesity. 81% were women and 19% men, 54% were 30–40 years old, 36% were over 40 years old and 18% were between the ages of 20 and 30 years. All were managed with an interdisciplinary group, hypocaloric diet and previous endoscopic evaluation of the stomach. The procedure consists of the patient swallowing a capsule with water, then with the help of abdomen radiography, the position of the capsule in the stomach is verified, it is inflated with 500 cc of sterile solution from the laboratory and then it is verified that it is well positioned, the probe and the procedure ends. Average procedure time in 98% of cases was 10 min and in 2% of cases 15 min. Adverse effects in the first 24 h of insertion were mainly nausea.

The average weight loss in 4 months was 10 kg for 18% of participants,13 kg among 63% and 16 kg in 27% of participants. 80% reached target weight and 20% who had a BMI 37 reached 30 BMI. No patient has required endoscopic removal of the device. In patients with type II obesity who become overweight, treatment with GLP-1 analogs is complemented for 6 more months.

Conclusion: The ellipse balloon is an effective option for the management of type I and II obesity, it is non-invasive, allows the patient to participate in the procedure, is well tolerated and is eliminated by natural means. The weight lost in patients adhering to the guidelines is 60% of excess weight, reaching a healthy weight in patients with type I obesity. Post-balloon evacuation regain in initial cases is 0% at 1 year.

S169

GLP-1 analogs are an option to the management of regain weight after bariatrica surgery? experience in a Bariatric Clinic in Colombia

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Introduction: weigth regain after bariatric surgery is widely described, 2 years ago, GLP-1 analogs are an option to manage it and avoid revisional surgery.

Aim: o show how the use of GLP-1 analogues together with changes in habits have a favorable effect in patients with regain weight after bariatric surgery.

Materials and methods: 40 patients between the ages of 22 and 63 with a diagnosis of overweight and obesity after bariatric surgery, consulted for management at the Obesity Clinic between June 2018 and March 2021. All patients underwent interdisciplinary management,body composition measurement by impedance analysis, and Liraglutide was started at a dose of 0.6 to 3 mg sequentially. Monthly follow-up was done to evaluate results, adherence to guidelines and presence of adverse symptoms.

Results: Patients were distributed according to their BMI overweight 17% Obesity type I 64% and obesity type II 17%, 5 of them had previous bariatric surgery 38 patients sleeve gastrectomy and 3 patients gastric bypass. 29% (10) reached a top dose of 3 mg daily, 58% (24) used doses between 0.6 and 1.2 and 13% doses between 1.8 and 2.4 g. The most frequent adverse effects were constipation, diarrhea, skin reaction and rashes. The treatment lasted between 6 to 12 months. The weight loss was 58% of the patients 10 kg and 39% up to 15 kg and 3% > 20 kg. The percentage of visceral fat lost throughout the group was 10 to 20 cm and body fat between 3 to 7 kg. The follow up until now is 18 months without reganancy in which the medication is discontinued. In patients with weight reganance after bariatric surgery, emphasis was placed on alimetary measures and the loss was 15% of excess weight and it was not necessary to resort to revision of the surgery. The improvement in the metabolic profile was 90% in the first 3 months of follow-up. follow up at 18 months without increase weight.

Conclusion: The use of pharmacological measures associated with changes in alimetary habits, exercise and behavioral management of eating habits has been shown to be very effective in weight loss, the benefits of liraglutide in coadjuvant management have been evident compared to other pharmacological measures. This treatment must be performed with medical supervision and in a period of no more than 12 months.

S170

Non-operative management of uncomplicated appendicitis during pregnancy fails frequently leading to higher rates of maternal and fetal complications

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Introduction: Recent randomized trials have reinvigorated interest in non-operative management of appendicitis. However, the evidence yielded in these trials excludes pregnant women with uncomplicated appendicitis. Consensus guidelines continue to recommend appendectomy as the treatment for this population. This study's purpose is to compare operative and non-operative management of uncomplicated appendicitis during pregnancy.

Methods and procedures: The National Inpatient Sample database was queried for all cases of uncomplicated appendicitis during pregnancy between October 2015 and December 2017. After dividing patients based on pregnancy trimester, management of uncomplicated appendicitis was categorized into three groups: immediate operative intervention, successful non-operative intervention, and unsuccessful non-operative management followed by delayed appendectomy (defined as surgical intervention > 1 day after admission). Univariable analysis compared baseline patient and hospital characteristics. Multivariable regression analyses adjusted for differences in baseline characteristics to quantify the impact of management strategy on maternal and fetal outcomes within each trimester.

Results: A total of 3,600 hospital discharges associated with uncomplicated appendicitis during pregnancy satisfied inclusion criteria; 29%, 43%, and 28% of discharges fell within the first, second, and third trimesters, respectively. The median age of all patients was 27 years, 49% were White, and 1% had at least two comorbidities. Immediate surgery was performed in 58% of discharges. Of the 42% of patients who trialed non-operative therapy, 31% were successful but 69% failed and required delayed surgery. Multivariable analyses showed that maternal and fetal complication rates following successful non-operative management did not significantly differ from immediate surgery during the first (odds ratio [OR] 1.043, 95% confidence interval [CI] 0.364–9.986, $p = 0.937$), second (OR 1.828, 95% CI 0.653–5.121, $p = 0.251$), or third (OR 1.349, 95% CI 0.772–2.357, $p = 0.293$) trimester. However, when non-operative management failed and required delayed surgical intervention, rates of maternal and fetal complications were significantly higher in the first (OR 2.710, 9% CI 1.420–5.173, $p = 0.002$) and third (OR 2.621, 95% CI 1.171–4.001, $p < 0.001$) trimesters. Although a similar trend was seen in the second trimester (OR 1.281, 95% CI 0.636–2.582, $p = 0.488$), it was not statistically significant.

Conclusions: Despite consensus recommendations advocating for surgery to treat uncomplicated appendicitis during pregnancy, 42% of these patients trialed non-operative management, which frequently failed. When successful, non-operative management was not associated with a significantly higher rate of maternal and fetal complications. However, unsuccessful non-operative management with delayed appendectomy was associated with significantly higher complication rates during the first and third trimesters. These results reaffirm surgery for uncomplicated appendicitis during pregnancy.

S171

Roux-en-Y Gastric Bypass is Non-Inferior to Fundoplication for Gastroesophageal Reflux Disease (GERD) in Patients with BMI > / = 35

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Objective: This study compares Roux-en-Y gastric bypass (RYGB) to fundoplication on GERD-specific quality of life (QOL) outcomes in adults with morbid obesity (BMI $\geq$ 35) who present with GERD. We hypothesize that RYGB is non-inferior to fundoplication at improving GERD-specific QOL measures while also providing the additional benefit of weight loss.

Methods: We conducted a retrospective review of a prospectively maintained surgical quality database. We included patients with BMI $\geq$ 35 who presented for symptomatic GERD and subsequently underwent Roux-en-Y gastric bypass or fundoplication (Nissen or Toupet) at a single institution between 2009 and 2021. Patient-reported outcomes tracked symptom improvement using validated questionnaires at time of pre-operative consult and routine post-operative follow-up visits. Data was analyzed using the Wilcoxon rank-sum test.

Results: A total of 105 patients (87.6% female, mean BMI 39.5 $\pm$ 5.3) were identified with available questionnaire data at any time point. Of these, 73 (69.5%) received fundoplication and 32 (30.5%) received RYGB. Compared to patients who underwent fundoplication, patients who underwent RYGB were significantly younger (mean age 55 $\pm$ 9 years vs 63 $\pm$ 12, $p < 0.001$) with higher pre-operative BMI (43.1 $\pm$ 7.6 vs 38.0 $\pm$ 2.7, $p < 0.001$). There were no significant differences in 30-day complications, emergency department visits, or readmissions. All patients reported improvement in GERD symptoms and overall QOL. There were no significant differences in GERD Health-Related Quality of Life (GERD-HRQL), Reflux Symptom Index (RSI), or Dysphagia Score between RYGB and fundoplication at 5-year follow-up (Fig. 1). RYGB patients reported transiently more pain and difficulty swallowing at 2-year follow-up, resulting in a significantly higher total GERD-HRQL score (10.2 $\pm$ 11.2 vs 5.1 $\pm$ 7.4, $p = 0.045$).

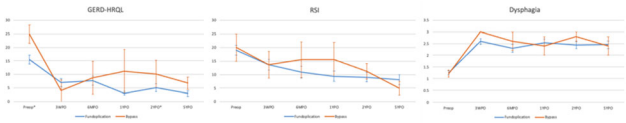

Figure 1. GERD-specific quality of life scores over time. * $p < 0.05$.

Conclusions: Roux-en-Y gastric bypass is an effective treatment for GERD. This study demonstrates that RYGB is not inferior to traditional fundoplication in patients with BMI $\geq$ 35 in achieving sustained improvement in GERD symptoms at 5-year follow-up without increasing 30-day complications, emergency department visits, or readmissions. Given the additional proven benefit of durable weight-loss after RYGB, serious consideration should be given to RYGB as the new standard-of-care operation in the treatment of GERD in patients with BMI $\geq$ 35. Future investigation is recommended with direct comparison in randomized controlled studies.

S172

Ambulatory Bariatric Surgery: A Pilot Study on Laparoscopic Sleeve Gastrectomy as Day Surgery

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Introduction: Access to bariatric surgery remains poor and has only worsened during the COVID-19 pandemic. As a result, there is a growing interest in delivering safe bariatric surgery in an out-patient setting. Despite some reports on the topic, most studies on same-day laparoscopic sleeve gastrectomy (LSG) include an over-night stay at a medical facility and up to 24 h after surgery. In a pilot study, we aimed to assess the feasibility and safety of LSG in an ambulatory setting.

Methods: In a single-center prospective study, since February 2021, patients planned for LSG that met the inclusion criteria were offered, and if consented, scheduled for an ambulatory procedure. The study was performed at an academic institution with a dedicated multidisciplinary bariatric program that provides extensive perioperative patient education and uses standardized enhanced recovery pathways (ERPs) for bariatric procedures. After surgery, the patients were discharged home from the recovery room once all the pre-determined criteria in the respective ERP were met. Once discharged, patients received two phone follow-ups by the surgical team (same night and on day-1) to screen for alarming symptoms. Feasibility and early (90-day) postoperative morbidity including failure of the planned ambulatory approach (need for admission), emergency department (ED) visits and readmissions were tracked. Data is reported as count (percentage) and median (interquartile range).

Results: During February-August 2021, a total of 25 patients were planned and successfully underwent LSG as an ambulatory procedure. The median age was 42 (16) years and 21 (84%) were females. Baseline BMI was 45.0 (6.0) kg/m^2. The median procedure time was 75 (14) minutes. There were no intraoperative complications. All patients were discharged home as planned, with a median stay in the recovery room of 6.0 (0.6) hours. One patient required an in-and-out foley catheterization for urinary retention prior to discharge. No patient was asked to present to ED based on the two planned phone follow-ups. Follow-up rate for the study cohort was complete. Early postoperative morbidity was 8% ($N = 2$). One patient required readmission at day-35 for dehydration causing acute kidney injury; another patient presented to ED for vague abdominal pain on day-13 and was discharged after a negative workup.

Conclusion: Ambulatory LSG is feasible and appears to be safe in carefully selected patients. Perioperative multidisciplinary patient education, care and implementation of standardized ERPs are fundamental elements for success. Larger studies with established/standardized protocols are needed to guide the safe use of ambulatory bariatric surgery.

S173

Preoperative malnutrition markers and their effect on postoperative outcomes following lysis of adhesions

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Introduction: Lysis of adhesions remains the standard surgical care for obstruction following the failure of conservative management. Preoperative nutrition can have a major effect on postoperative outcomes due to the physiologic demands of healing. Here we examine the impact of clinical and laboratory markers of nutrition on postoperative outcomes of patients undergoing lysis of adhesions (LOA).
Methods: Patients who underwent LOA were identified from the ACS-NSQIP database (2015–2019) using appropriate CPT codes. Patients were then split into four groups based on their preoperative nutritional findings. Patients were grouped based on combination of history of preoperative weight loss (> 10% loss in the last 6 months, WL) and preoperative albumin level less than 3.5 g/dL (HA). Fishers exact test and Kruskal–Wallis were used to compare surgical characteristics and outcomes including major complications, length of procedure and readmission. Factors with $p < 0.05$ were included in the multivariable model for each outcome.
Results: There were 18,135 LOA procedures identified. Within this group patients were divided into four groups: neither WL nor HA, HA only, WL only, and both WL and HA. A majority of the patients fell into the group without either WL or HA (54.3%) and served as the reference group. Multiple preoperative variables and surgical characteristics were found to be statistically significant including but not limited to BMI, ASA class, history of COPD, preoperative renal failure, approach to surgery and disseminated cancer. Multiple outcomes were also statistically significant including but not limited to organ space infection, failure to wean from ventilator, postoperative DVT, postoperative septic shock, return to OR and mortality. On multivariable model only comparing neither WL or HA to the group with both factors (WL + HA), total hospital stays (RRR 1.02), operative time (RRR 1.002), organ space infection (RRR 2.21), postoperative DVT (RRR 2.66), post-operative septic shock (RRR 2.01), and readmission (RRR 1.84) were significantly higher.
Conclusions: When examining the impact of nutrition on the outcomes of lysis of adhesions both a history of weight loss and a low albumin represent an increased risk compared to those without either. The complicated pathophysiology of nutrition within patients and their individual physiology makes it difficult to examine outcomes based on nutrition status. However, here we present significant evidence of its impact on surgical outcomes.

S174

Cost effectiveness of a dedicated feeding tube clinic

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Introduction: Feeding tube (FT) complications are a costly burden on healthcare systems. Patients with FTs often rely on the Emergency Department (ED) for management due to inconsistent post-procedural care. We established a dedicated FT clinic to provide longitudinal care for patients with FTs, including prophylactic tube exchanges and regular nutritional evaluation and management. We hypothesized that a dedicated clinic would reduce costs related to FT management.
Methods: A retrospective review of patients who underwent FT placement at a tertiary Veterans Affairs hospital from January 2010 to September 2021 was completed, including FT clinic enrollment and ED utilization for complications. For analysis, $1200 was used as the average ED visit cost for FT dislodgement (ED visit, surgical consultation, replacement FT, and radiographic confirmation) and $350 was used for outpatient clinic cost (office visit and replacement FT).
Results: A total of 104 patients underwent FT placement during the study period, including 18 (17%) patients enrolled in the FT clinic. The majority were male (100, 96%) with an average age of 65 (27–90). The most common indication for placement was head and neck malignancy (52, 50%), followed by malnutrition (15, 14.4%) and neuromuscular disorders (15, 14.4%). There were 21 ED visits in the FT clinic group and 134 ED visits in the standard-of-care (SOC) group. Grossly, the SOC group accrued $160,800 in ED costs over the study period compared to $25,200 for the FT clinic group. The cost of ED visits for the FT clinic group was approximately $1400 per patient, compared to $1870 per patient for the SOC group, a 25% difference.
Conclusions: A dedicated feeding tube clinic resulted in a 25% reduction in ED costs per patient. Two years of FT clinic visits with prophylactic FT exchanges is equivalent to the cost of 1 ED visit. Hospital systems that care for these complex patients should consider a dedicated FT clinic in order to reduce ED utilization and costs related to FTs.

S176

Relation between gastric pouch volume and excess weight loss and regain after laparoscopic sleeve gastrectomy

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Objective: This study aimed to evaluate Laparoscopic Sleeve Gastrectomy in the treatment of morbidly obese patients pre and post-operatively after 3 months, 6 months, and 1-year follow-up and assess the volumetric changes of the gastric reservoir 1 year after LSG using multi-slice computer tomography.
Methods: A prospective observational study was carried on 30 morbidly obese patients aged between 18–60 years with BMI of > 40 kg/m 2 or > 35 kg/m^2, who underwent a highly restrictive primary LSG at the Department of general surgery, Kafrelsheikh university hospital, during the period from November 2018 to November 2020.
Results: There was a statistically significant difference throughout the whole follow-up period (P-value = 0.05) regarding weight loss, BMI reduction, percentage of excess weight loss, and percentage of excess body mass index loss (%EBMIL). Using multi-slice computer tomography, the gastric volume of 30 patients were assessed. Gastric volume within 1 month of surgery ranged from 60.0 – 107.0 ml with a mean 82.93 $\pm$ 11.45 ml. After one 1 year postoperatively, gastric volume ranged from 135.0 – 260.0 ml with a mean of 175.8 $\pm$ 23.68 ml. There was a statistically significant increase in gastric volume after 1 year (P-value = 0.05). However, our results showed no significant correlation (r = 0.131, $p = 0.491$) between the percentage of excess weight loss and the increase of gastric reservoir volume after 1 year of surgery.
Conclusion: MSCT with modern post-processing algorithms can describe more comprehensively and quantitatively the gastric pouch volume and leaking of anastomoses.

S177

Diffusion of Robotic Surgery into Bariatric Fellowships: Trends in Utilization from the Decade before the COVID-19 Pandemic

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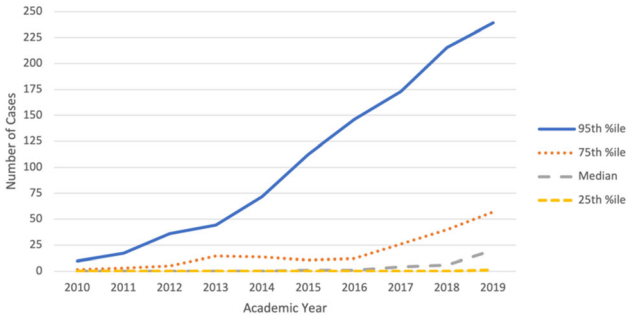
Introduction: In the first decade following daVinci Surgical FDA approval, robotics was used primarily by urologists and gynecologists. However, beginning in 2011, there was an exponential increase in the volume of robotic general surgery, and by 2017, general surgery surpassed gynecology to become the highest volume category of robotic procedures performed worldwide. The aim of our study was to characterize the diffusion of robotic surgery throughout Bariatric fellowship programs from 2009 to 2019.
Methods: We reviewed de-identified Fellowship Council (FC) case logs for all Bariatric accredited programs from 2010 through 2019 academic year. Fellows who performed fewer than 100 procedures (all case types and approaches) were excluded from analysis as they represent non-clinical fellows. We compared mean volumes of robotic cases across academic years using ANOVA. We then tracked percentile benchmarks over time to determine whether utilization of robotics was widespread or isolated to a few programs. Finally, we calculated the share of index bariatric cases that were performed robotically over time and used regression analysis to model a line of best fit.
Results: Our analysis included 822 fellows and 298,017 procedures. The mean volume of robotic cases per fellow increased significantly from 4.4 to 50.7 cases/fellow from the 2010 to the 2019 academic year ($p < 0.0001$). For the first seven years analyzed, growth was driven almost entirely by a small number of high-volume programs with the 95th percentile of robotic volume growing by > 130 cases, while the 75th percentile grew by only 10 cases and the 50th percentile increased by only 1 case. Over the final three years of analysis there was diffusion of meaningful robotic case volumes to a larger number of programs with the 95th percentile growing by 93 cases, the 75th percentile growing by 45 cases, and the 50th percentile growing by 19 cases (Figure 1). Regarding index bariatric procedures, the percentage of cases performed robotically grew significantly from 2.4% in 2010 to 13.5% in 2019. Based in regression analysis, this growth follows an exponential growth pattern with the share of cases performed robotically doubling every four years.
Conclusions: Laparoscopic surgery remains the dominant approach in Bariatric fellowships. However, robotic case volumes have grown exponentially, and our data suggest that the market share of robotics will continue to increase. In the future, it may be important to consider establishing minimum criteria for robotic cases within Bariatric fellowships to ensure that fellows receive exposure to this technique.

Figure 1: Benchmarks for Robotic Case Volume by Year



S178

Outcomes of Partial fundoplication after lung transplantation for GERD-related decline in allograft function

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Introduction: Gastroesophageal reflux disease (GERD) is known to contribute to progressive allograft decline secondary to bronchiolitis obliterans (BO) after lung transplantation. Other centers have evaluated antireflux surgery as way to slow the decline in lung function as related to GERD. Most centers have used Nissen fundoplication with selective use of partial fundoplication in cases of esophageal dysmotility. Previous research has indicated that partial fundoplication is as effective at controlling reflux with lower rates of postoperative dysphagia. We sought to explore lung function and reflux outcomes in a cohort of lung transplant patients whom all underwent partial fundoplication for control of GERD.
Methods: Data from a prospectively maintained institutional lung transplant registry was retrospectively reviewed for all patients between 2013–2020 who underwent fundoplication after lung transplant. Lung transplant patients underwent routine pulmonary function testing with FEV1 monitoring. Patients with FEV1 values within 180 days pre-fundoplication and two years post-fundoplication were included in the analysis. All patients referred for fundoplication underwent esophageal pH testing, manometry, UGI, and EGD. A 270°posterior Toupet fundoplication or a 180° anterior Dorr fundoplication was performed depending on the presence of significant dysmotility.
Results: 53 patients were included in the final analysis. FEV1 values were averaged for each patient over 4 time periods 180–90 days pre-fundoplication, 90–0 days pre-fundoplication, 0–90 post-fundoplication, and 90–180 days post-fundoplication. There was no significant effect of fundoplication on lung function as measured by FEV1 values over this time period. Average FEV1 values in each time period were 2.5–2.55L. A Linear Mixed Effect Model was used to test for a change in FEV1 trajectory up to two years post-fundoplication with an auto-regressive correlation structure. A significant effect of time ($p = 0.0017$) was identified with FEV values decreasing by 9 mL every month post-transplant on average, with a trend towards a slow in that decline by 2 mL per months that was not statistically significant ($p = 0.8$). In the patients for whom postoperative Demeester scores were available ($n = 19$), there was a decline in acid exposure from a mean of 48.17 to 7.37 ($p = 0.0003$).
Conclusion: Although our results did not reach statistical significance, there was a trend towards a decrease in the rate of decline of allograft function after partial fundoplication. In the patients whom results were available, there was appropriate control of acid exposure as measured by Demeester scores.

S180

Readability of sages patient information brochures

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Introduction: Appropriate education and information are the cornerstone of patient autonomy. Clinicians aim to achieve this goal through use of brochures and educational material, however, many of these sources do not provide the appropriate level of readability for the average patient. The average US resident reads at an 8th grade level, with the average Medicare beneficiary reading at a 5th grade level. Further, the Joint Commission has recommended that such materials should be written at or below a 5th grade reading level to provide an appropriate level of readability. We therefore aimed to evaluate the readability of patient information brochures provided by SAGES.
Methods: English language patient information brochures that were collected from the SAGES Healthy Sooner webpage (https://www.sages.org/healthy-sooner/patient-information/) on 9/20/2021 and evaluated for readability. Microsoft Office Professional 2019 was utilized to calculate Flesch Reading Ease (FRE) and Flesch-Kincaid Grade Level (FKGL) scores. The FRE is a score from 0 to 100, with higher scores equating to easier reading (90 or higher equates to a 5th grade reading level). The FKGL rates text on a U.S. grade school level. Qualitative and univariate analyses were performed.
Results: Thirteen patient information brochures were evaluated (Table). None of the 13 brochures achieved a FRE score of 90 or a FKGL of a 5th grade reading level. The average FRE score was 47.8 with a range of 33.8 to 68.5. The average FKGL score was 10.4 with a range of 7.1 to 13.1. The brochure with the highest FRE and lowest FKGL (best readability) was that for endoscopic retrograde cholangiopancreatography. The brochure with the lowest FRE and highest FKGL (worst readability) was that for anti-reflux/GERD surgery.
Conclusions: Although the SAGES patient information brochures are a useful tool with images for patient education and counseling, none of the 13 available English language brochures met the recommended criteria for patient readability. Further refinement of the phrasing utilized in these brochures will be needed to provide the appropriate level education for the average U.S. patient.

Table: SAGES Patient Information Brochures and Calculated Readability Scores

	Words	Flesch Reading Ease	Flesch-Kincaid Grade Level
Adrenal Gland Removal (Adrenalectomy)	2163	60.7	7.9
Anti-Reflux (GERD) Surgery	1934	33.8	13.1
Appendix Removal (Appendectomy)	1494	58.3	8.1
Colon Reseection Surgery	1511	41.0	11.7
Colonoscopy	1067	45.2	10.7
Diagnostic Laparoscopy	1857	40.6	11.7
ERCP (Endoscopic Retrograde Cholangio-Pancreatography)	1374	68.5	7.1
Gallbladder Removal Surgery (Cholecystectomy)	2018	61.4	7.7
Inguinal hernia repair	1891	44.7	10.8
Obesity Surgery	2588	36.1	12.4
Spleen Removal (Splenectomy)	1903	46.4	11.2
Upper endoscopy	975	44.3	10.7
Ventral hernia repair	1960	40.1	11.9
Average	1749	47.8	10.4
Min	975	33.8	7.1
Max	2588	68.5	13.1

S181

Extensive esophageal mobilization in PEHR: how protective is it?

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Background: Attainment of adequate intra-abdominal esophageal length (3 cm) is considered a key step in laparoscopic paraesophageal hernia repair (PEHR) but there is little evidence of how much length is sufficient to minimize recurrence and no consensus about when esophageal lengthening procedures may be required. This study explores how protective esophageal length is against recurrent hiatal hernias (HH).
Methods: We performed extensive mediastinal esophageal mobilization to maximize esophageal length and documented this length in consecutive patients undergoing PEHR at our institution between 2015 and 2019. Recurrence was evaluated by barium esophagram in patients who completed minimum 6-month follow up.
Results: One hundred three of 176 patients (59%) completed 6-month follow-up (median 8.5 months). Most patients (93%) had at least 3 cm of intraabdominal esophagus after mobilization. Seventy-four patients (71%) had more than 3 cm of esophagus. Of those with < 3 cm length, two (19%) received a short (2–2.5 cm) fundoplication, two (1.9%) had a gastropexy without fundoplication, and four (3.9%) underwent a Collis gastroplasty with fundoplication. The anatomic HH recurrence rate was 24.2% (25/103). There was no difference in average esophageal length between patients with and without recurrence (3.8 cm vs. 3.8 cm, $p = 0.93$). We compared the extremes and found no difference in recurrence between those with a long (> 5 cm) versus "short" esophagus (< 3 cm) (25% vs 33%, $p = 0.69$).
Discussion: With extensive esophageal mobilization we almost always obtain at least 3 cm of esophagus, and rarely required a Collis gastroplasty. There does not appear to be any protective influence of attaining > 3 cm intra-abdominal esophageal length, and therefore the mechanism of recurrence does not appear to depend on this factor.

S182

Hiatal hernia recurrence and bariatric outcomes comparing simultaneous hiatal hernia repair with sleeve gastrectomy versus Roux-en-y gastric bypass

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Background: Morbidly obese patients are at increased risk of gastroesophageal reflux disease (GERD) and hiatal hernias (HH). Concomitant HH repair at the time of bariatric surgery is a safe and effective way to decrease the risk of provoking or exacerbating GERD symptoms and may also decrease HH recurrence. This study aims to determine whether there is a difference in HH recurrence, GERD symptoms, and bariatric outcomes following sleeve gastrectomy (SG) versus roux-en-y gastric bypass (RNYGB) performed at the time of HH repair (HHR).
Methods: A retrospective chart review of patients undergoing concomitant bariatric surgery and hiatal hernia repair at a single tertiary bariatric center of excellence between 2012 and 2016 was performed. Only those undergoing laparoscopic sleeve gastrectomy or laparoscopic roux-en-y gastric bypass were included. The primary outcome was hiatal hernia recurrence demonstrated by radiographic or procedural findings. Secondary outcomes included the time to recurrence, recurrence of GERD symptoms, and bariatric outcomes. Statistical analysis was completed using Microsoft Excel with a statistical significance of $p < 0.05$.
Results: We identified 164 patients undergoing simultaneous bariatric surgery and hiatal hernia repair: 153 sleeve gastrectomy and 11 RNYGB. HH recurrence was not significantly different for sleeve gastrectomy (9.80%) and RNYGB (18.18%) ($p = 0.40$), although recurrence following RNYGB occurred earlier at 17.2 months vs 39 months for SG ($p = 0.004$). GERD symptom recurrence was not statistically different (28.1% for SG vs 36.4% for RNYGB; $p = 0.62$) nor was time to GERD symptoms 37.6 months vs 33 months ($p = 0.82$). Overall bariatric weight loss outcomes were not significantly different at 2 weeks, 3 months, 6 months, and 12 months. However, patients who recurred following RNYGB lost significantly more weight than those who recurred following sleeve gastrectomy with an average weight loss of 16.7%, 33.7%, 44.6%, and 47.5% for SG versus 24.9%, 49.5%, 70.7%, and 86% for RNYGB at 2 weeks ($p = 0.006$), 3 months ($p = 0.03$), 6 months ($p = 0.18$), and 12 months ($p < 0.001$) respectively.
Conclusion: The rate of hiatal hernia recurrence was similar between sleeve gastrectomy and roux-en-y gastric bypass although patients undergoing RNYGB recurred earlier and lost more weight than patients who recurred following sleve gastrectomy. None of our other secondary outcomes were statistically different including presence and time to GERD symptoms and overall bariatric outcomes.

S183

Predictors of difficulty in minimally invasive liver surgery: a multi-center retrospective comparison and validation of difficulty scoring systems

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Background: Uptake of minimally invasive liver surgery (MILS) has been limited by development and education of surgical skills. As surgeons adopt this new skill set, difficulty scoring systems are valuable to determine the safety profile for the use of MILS. Four scoring systems for MILS have been developed from Japan, Korea, France and Europe: Ban/IWATE/Difficulty Scoring System, Halls/Southampton, Hasegawa, and Kawaguchi. While there is overlap between scoring systems, 2 have gained further recognition: Halls/Southampton and Ban/IWATE/Difficulty Scoring System. The aim of this study was to assess intraoperative and post-operative outcomes for different MILS as ranked by the Southampton and IWATE scoring systems.

Methods: A retrospective review of a multicentered North American MILS database was performed. A total of 1776 cases were identified. Cases that did not include hepatic resection were removed resulting in 1051 cases. Each case was scored based on the Southampton and IWATE MILS difficulty scoring systems. Statistical analysis was performed using SPSS software (version 23, Chicago, IL).

Results: A total of 1051 patients were identified who underwent hepatic resections for benign or malignant lesions. Using the Southampton scoring system, there were 183 low difficulty, 579 moderate difficulty, 287 high difficulty, and 2 extremely high difficulty cases. The Southampton difficulty scoring system did correlate with operative outcomes such as estimated blood loss for low 343 mL, moderate 499 mL, and high 681 mL ($p < 0.001$). Similarly operative time (166 min, 225 min, and 265 min, $p < 0.001$) and length of stay (3.53 days, 6.30 days, 7.05 days, $p < 0.05$) were higher with higher difficulty cases. Need for conversion to open ($p = 0.182$) and post-operative complication rate ($p = 0.118$) were not statistically significant between the low and moderate difficulty groups; however, the rate of post-operative complications was significantly higher in the moderate versus high difficulty groups (19.69% vs 30.31%, $p < 0.05$). Using the IWATE difficulty scoring system, there were 117 low, 357 moderate, and 577 high difficulty cases; there were no significant differences in operative or clinical patient outcomes (operative time, estimated blood loss, length of stay, conversion rate, or post-operative complication rate) between the groups.

Conclusion: The Southampton difficulty scoring system was predictive of operative and post-operative outcomes within the low, moderate, and high difficulty groups. Using the IWATE difficulty scoring system, there were no discernable clinical outcome differences as difficulty increased. This data suggests that the Southampton scoring system was better able to predict operative and post-operative outcomes based on difficulty ranking.

S184

Comparing weight loss outcomes after conversion to Roux-en-Y gastric bypass vs duodenal switch from sleeve gastrectomy in a community hospital

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Background: Laparoscopic sleeve gastrectomy (SG) is currently the most commonly performed bariatric procedure. However, sustained long-term weight loss remains limited. Revisional surgery to convert SG to Roux-en-Y gastric bypass (RYGB) or duodenal switch (DS), whether classic biliopancreatic or single-anastomosis, is often sought after to obtain additional weight loss. The optimal revisional procedure is still under investigation. This study aims to compare the outcomes after conversion of SG to RYGB or DS.

Methods: A retrospective single institution review was conducted from a database of patients undergoing bariatric procedures from May 2015—August 2021. 75 patients were identified who underwent conversion from prior SG to either RYGB (40) or DS (35). Mean excess body weight loss (EBWL) at 3, 6, 12, and 24 months were assessed. Secondary measures such as length of stay (LOS), length of procedure, and 30-day readmission rate were also reviewed. Unpaired T-tests were utilized to compare EBWL of those with RYGB to those with DS, while paired T-tests were used to evaluate subgroup weight loss over 3, 6, 12, and 24 months. Statistical analysis was performed using SPSS version 26.0.

Results: Percentage of EBWL for RYGB vs DS was 24.0% vs 18.8% at 3 months ($N = 36$ vs 26; $p < 0.0491$), 34.8% vs 29.0% at 6 months ($N = 29$ vs 17; $p < 0.2192$), 41.8% vs 40.1% at 12 months ($N = 29$ vs 12; $p < 0.8088$), and 37.2% vs 41.7% at 24 months ($N = 26$ vs 7; $p < 0.6281$). Average LOS was 2.6 days ± 1.4 for RYGB and 2.8 days ± 1.3 for DS ($p < 0.3016$). Average length of procedure was 134.4 min for RYGB and 189.8 min for DS ($p < 1.33E-7$). 30-day readmission rate was 22.5% ($N = 9$) for RYGB and 14.3% ($N = 5$) for DS. Significant weight loss was observed in both subgroups up to 12 months, with no significant weight loss between 12 and 24 months (RYGB $N = 21$, $p < 0.1481$; DS $N = 6$, $p < 0.2990$).

Conclusions: Patients with previous SG saw a significant difference in weight loss after undergoing revisional RYGB when compared to revisional DS after 3 months but saw no additional differences in weight loss afterwards up to 24 months. Both revisional bariatric procedures were effective for sustained weight loss in the first 12 months, with no significant weight loss reversal seen at 24 months. Additionally, the length of operating time was significantly longer for DS compared to RYGB, though the hospital LOS was not significantly different, and the 30-day readmission rate was higher for RYGB than for DS.

S185

Feasibility of expanding an ambulatory colectomy protocol: A retrospective analysis of early discharge following minimally-invasive colectomy in an enhanced recovery pathway

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Introduction: There is increasing evidence to support discharge prior to gastrointestinal recovery following colorectal surgery, which may improve value by decreasing length of stay(LOS) and hospital resource utilization. Furthermore, many patients are discharged early despite being excluded from an ambulatory colectomy pathway. Therefore, the objective of this study was to determine the outcomes of patients discharged early following laparoscopic colectomy in an enhanced recovery pathway (ERP).
Methods: A retrospective review of all adult patients undergoing elective laparoscopic colectomy at a single university-affiliated colorectal referral center (08/2017–06/2021) was performed. Patients were included if they had undergone elective laparoscopic colectomy (without creation of a new stoma or ileostomy closure) and excluded if they had been enrolled as ambulatory colectomy pathway. Remaining patients were then divided into three groups: LOS = 1 day, LOS 2–3 days, and LOS 4 + days. The main outcome was 30-day emergency room(ER) visits, and readmissions. Reasons for inpatient stay per post-operative day(POD) were also recorded.
Results: A total of 497 patients were included (LOS1 $n = 63$ (13%), LOS2-3 $n = 284$ (57%), and LOS4 + $n = 150$ (30%)). There were no differences in patient characteristics, indication for surgery, or operation performed between the groups. Patients were discharged with gastrointestinal recovery (tolerating diet and passage of flatus or stool) in 54% LOS1 vs. 98% LOS2-3 vs. 100% LOS4 + ($p < 0.001$). Shorter procedure duration, transversus abdominus plane block, and lower opioid requirements were associated with lower LOS ($p < 0.001$). Absence of flatus was the most common reason to keep patients hospitalized: 61% on POD1, 21% on POD2, and 8% on POD3 ($p < 0.001$). There were no differences in the number or timing of 30-day ER visits, or readmission between the three groups (Table). In the LOS1 group, there were no differences in outcomes between patients with full return of bowel function at discharge compared to those without.
Conclusion: Discharge on POD1 was not associated with increased emergency department use, complications or readmissions. Importantly, full return of bowel function at discharge did not affect outcomes. These findings suggest that early discharge without full return of bowel function is safe and should be considered to improve efficient use of inpatient resources. There may be potential to expand eligibility criteria for ambulatory colectomy protocol.

	LOS = 1 day	LOS = 2–3 days	LOS = 4 + days	p-value
Overall 30-day complications	7(11%)	34(12%)	81(54%)	< 0.001
30-day ER visit	7(11%)	23(8%)	15(10%)	0.750
Median ED timing, POD[IQR]	7[7–15]	9.5[5–18]	11[8–17]	0.505
30-day readmit	4(6%)	9(3%)	8(5%)	0.322

S186

Comparison of postoperative pancreatic fistula rates of laparoscopic versus robotic pancreaticojejunostomy in pancreaticoduodenectomy for soft pancreas with small pancreatic duct; A multicenter study with a propensity score matching analysis

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Objective: Soft pancreatic texture and small pancreatic duct were well known risk factors of postoperative pancreatic fistula (POPF) after pancreaticoduodenectomy (PD). Pancreatic reconstruction is the most technical challenge in minimally invasive PD. This study aims to compare the surgical outcomes of laparoscopic versus robotic pancreaticojejunostomy(PJ) in risky pancreas.
Method: Between October 2012 to June 2020, total of 429 cases of minimally invasive PD were performed by three surgeons in three different institutions. Among those patients, 201 patients with soft pancreas and small pancreatic duct less than 3 mm were included based on preoperative image study and the operative record. Propensity score matching analysis based on the patients' age, sex, BMI, ASA score, diagnosis, and pancreatic duct size was performed to compare the surgical outcomes of laparoscopic and robotic PJ.
Result: 118 totally laparoscopic PD, 49 totally robotic PD, and 34 hybrid PD (laparoscopic resection and robotic anastomosis) were performed. 69 patients underwent laparoscopic PJ and 69 patients underwent robotic PJ were selected after propensity score matching. Demographics of the patients were comparable. Pancreatic duct diameter was similar in both groups (1.8 ± 0.4 mm vs 1.8 ± 0.5 mm, $p = 1.00$). Operative time was shorter in RPJ group (456.1 ± 83.2 vs 405.1 ± 75.4, $p = < 0.01$). Incidence of clinically relevant POPF greater than grade B was comparable in laparoscopic and robotic PJ group (14.5% vs 11.6%, $p = 0.80$). Biochemical leakage, grade B, and grade C pancreatic fistulas were 46.4%, 14.5% and 0.0% in laparoscopic PJ group, respectively, and 31.9%, 11.6% and 0.0% in robotic PJ group.
Conclusion: Risk of POPF of laparoscopic or robotic PJ in soft texture and small duct was comparable by experienced surgeons. Robotic approach may be beneficial to save the operative time.

S187

Automatic task segmentation of robotic pancreaticojejunostomy videos using deep learning

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Introduction: A critical step in analyzing surgical video is workflow analysis. Segmentation/annotation of robotic surgery videos is accomplished manually. Deep learning has been used for automated surgical analysis. Robotic Pancreaticoduodenectomy (RPD) is complex and a surgeon's performance during the pancreaticojejunostomy (PJ) reconstruction is associated with leak. In this work, we utilize deep learning algorithms to automatically segment PJ videos from RPD for future performance analysis.
Methods: This was a review of robotic PJ videos from 2012 to 2015. Each frame of the PJ video was categorized based on procedural tasks. We adopted a deep Convolutional Neural Network (CNN) for frame-level visual feature extraction and classification. Each PJ video was annotated into 12 tasks (Table 1). Training included measuring the model's error with respect to the ground-truth and optimizing it using back-propagation. The architecture was Resnet50.
Results: Of the 56 videos included, 40 were used for training and 16 for validating performance. All frames were extracted (24 frames/second) and annotated. The accuracy and per-class F1-score were 71.15% and 55.75% (Table 1). Processing time of each frame was < 0.01 (s), making it suitable for real-time applications.
Conclusion: Our results show that deep learning can be used reliably for task segmentation of robotic PJ videos. Future applications include skills assessment, real-time feedback, and outcome prediction.

Task	Precision	Recall	F-1Score	# Frames
Superior mattress	0.78	0.72	0.75	1818
Middle mattress	0.57	0.62	0.59	2239
Inferior mattress	0.68	0.65	0.66	2110
Grasp superior stitch	0.19	0.11	0.14	353
Patency of pancreatic duct	0.37	0.34	0.35	384
Enterotomy	0.91	0.82	0.87	1045
Posterior duct-to-mucosa suture	0.73	0.83	0.78	3271
Anterior duct-to-mucosa suture	0.84	0.88	0.86	8292
Stent placement	0.8	0.44	0.57	588
Superior buttress	0.42	0.45	0.43	912
Middle buttress	0.53	0.43	0.48	912
Inferior buttress	0.74	0.43	0.54	808
Other tasks/events	0.16	0.22	0.19	532

S189

Outcomes of surgical management of cholangiocarcinoma, early institution experience

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Background and Aim: Cholangiocarcinoma is a primary cancer of the bile ducts that arises from malignant transformation of the epithelial cells that line the biliary tree. It is a relatively rare malignancy that accounts for 3% of gastrointestinal cancers. Radical surgical resection offers the only chance of long-term survival but unfortunately $< 20\%$ of presenting patients are suitable for surgery. The aim of any proposed surgical procedure is to achieve complete tumor removal together with clear resection margins. The aim of this study was to evaluate the feasibility and the outcomes of surgical management of cholangicarcinoma.
Patients and Methods: This prospective study involved 40 patients who underwent surgery for cholangiocarcinoma. This study was conducted in the General Surgery Department in Tanta University Hospitals from June 2017 to June 2020. Hepatectomy with caudate lobectomy and biliary enteric anastomosis was done for patients with hilar cholangiocarinoma, in distal cholangiocarinoma Whipple procedure was performed while in intrahepatic cholangiocarcinoma, hepatic resection was done. Perioperative outcomes, histopathological data, pattern and treatment, recurrence and overall survival were recorded.
Results: The mean age of the patients was 52.9 years. 60% of the patients were males. Jaundice was the commonest symptom in 34 patients (85%). Preoperative biliary drainage was done for 19 patients (47.5%). Hilar cholangiocarcinoma (CCA) was the most common type in 24 patients (60%) followed by distal CCA in 11 patients (27.5%) and intrahepatic CCA in 5 patients (12.5%). In hilar cholangiocarcinoma, right hepatectomy done in 12 patients (30%), left hepatectomy in 9 patients (22.5%). In patients with distal CCA, 10 Whipple procedures were done and 1case was locally advanced. In intrahepatic CCA, 5 hepatic resection was done. The most frequent complication was bile leak in 5 patients (12.5%), Intra-abdominal collection in 3 patients (7.5%) and portal vein thrombosis in 1 patient (2.5%). As regard overall survival, 22 cases (55%) survived till the end of follow up, the median overall survival was 14 months, During the follow up period 11 patients (27.5%) developed recurrence.
Conclusion: Surgery remains the only line of treatment offering the possibility of cure. At univariate analysis, surgical margins, lymph node status, perineural invasion and microvascular invasion had significant impact on survival and curative resection is mandatory for long-term survival.
Keywords: Cholangiocarcinoma, Surgery, Complication, Survival.

S190

Do endoscopic findings predict clinical response to pop (per oral pyloromyotomy) for gastroparesis?

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Introduction: Gastroparesis is a life-altering diagnosis caused by the inability of the stomach to function within usual physiologic parameters. The primary causes are idiopathic, diabetes, postoperative, and autoimmune. Our first-line treatment for medically refractory gastroparesis is disruption of the pyloric muscle with an endoscopic Per-Oral Pyloromyotomy (POP), but predicting clinical response in a cost-effective way remains elusive. It is our hypothesis that the endoscopic presence of bile in the stomach is a negative predictor and the evidence of pylorospasm is a positive predictor of clinical improvement after POP.

Methods: This is the first known study relating findings on endoscopy during their POP procedure to the patient's outcomes after at least one year. All patients with medical-refractory gastroparesis over age 18 who underwent a POP procedure from January 1, 2019 to June 30, 2020 were included (n = 202). Preoperative and endoscopic data were collected prospectively with a subsequent phone survey to collect relevant postoperative data including Gastroparesis Cardinal Symptom Index (GCSI) and solid Gastric Emptying Studies. The primary outcome was a change in total GCSI score at the time of the phone survey.

Results: Postoperative data for 65 patients was obtained via phone survey. The average phone survey follow-up was 688 ± 139 days after POP procedure. Of these patients, the median age was 44, 82% were female, 63% were idiopathic, 17% diabetic, 19% postoperative, and 1% autoimmune. Endoscopic findings consisted of 30% with bile in the stomach and 72% had some degree of pylorospasm. Within the pylorospasm group, 27% were classified as "very tight" and difficult to traverse with a standard gastroscope. The median improvement in total GCSI score was -14 points. Forty-nine patients had postoperative solid Gastric Emptying Studies, of which 55% normalized. Within this preliminary data, neither the presence of bile (p = 0.422) nor signs of pylorospasm (p = 0.455) showed a correlation with total GCSI score change in multiple regression. Though the presence of a "very tight" pylorus did show a trend toward significant improvement (p = 0.085).

Conclusion: These preliminary results suggest neither the presence of bile in the stomach nor subjective evidence of pylorospasm during endoscopic evaluation predict symptom improvement after POP. An additional 137 patients are actively being contacted to develop a more robust data set for further evaluation.

S191

Treating recurrent dysphagia after myotomy: poem or pneumatic dilation?

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Introduction: Myotomy is the gold standard treatment for achalasia, yet the long-term failure rate approaches 15%. Treatment options for recurrent dysphagia include pneumatic dilation (PD), laparoscopic redo myotomy, per oral endoscopic myotomy (POEM), or esophagectomy. We employ both PD and POEM as first-line treatment for recurrent dysphagia after previous myotomy. The objective of this study was to evaluate operative success and patient reported outcomes for patients who underwent PD or POEM for recurrent dysphagia after myotomy.

Methods: We identified patients with achalasia who underwent PD or POEM for recurrent dysphagia after previous myotomy within a foregut database at our institution between 2013 and 2021. GERD HRQL, Eckart scores, and overall change in Eckart scores were compared across PD and POEM groups using a two-sample t-test in SAS Studio. Successful treatment of dysphagia was defined by an Eckart score < = 3.

Results: Two-hundred fifty-two patients underwent myotomy for achalasia. Of these, 21 patients (8%) had either PD or POEM for recurrent dysphagia. Mean follow-up was 11 months. Ten patients (48%) were treated with PD and eleven (52%) with POEM. Median length of stay was 0 days after PD and 1 day after POEM. There was one adverse event after PD (perforation, treated with endoscopic stenting). There were two adverse events after POEM (tunnel leak/bleed, treated with endoscopic washout). The preop median Eckart score were 4 and 5 in the PD and POEM groups, respectively. The postop median Eckart score was 3 in both groups. Change in Eckart score after procedure was not different between the groups (0.9 ± 4.4 for PD, 1.7 ± 1.7 for POEM, p 0.6). Postop satisfaction was 30% in the PD group and 60% in the POEM group. After PD, seven patients (70%) went on to have additional procedures (repeat PD, POEM, or esophagectomy). After POEM, two patients (18%) went on to have additional procedures (PD).

Conclusion: Patients undergoing PD or POEM for recurrent dysphagia after myotomy have similar rates of dysphagia resolution. Patients undergoing PD enjoy a shorter length of stay but require more subsequent procedures and have a lower satisfaction with their outcome as compared to patients undergoing POEM.

S192

Enhanced gastric decompression for palliation of malignant bowel obstruction

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Introduction: Malignant bowel obstruction (MBO) is a sequela of advanced intraabdominal cancer and can have a profound impact on quality of life. Common therapy is endoscopic gastrostomy tube placement for decompression. Standard gastrostomy tubes are poorly designed to evacuate the dependent portions of the stomach due to their location on the anterior gastric wall. In our institution we have therefore begun placing the ASPIRE Assist gastrostomy tube (ASPIRE Bariatrics, Exton, PA) which includes a 15 cm, 30Fr fenestrated gastric tube for enhanced decompression of the entire stomach. This tube is FDA indicated for gastric decompression but marketed for endoscopic weight loss. The purpose of this study was to review our experience with management of MBO utilizing the ASPIRE Assist tube.

Methods: This is a retrospective analysis of outcomes at a single institution. All decompressive endoscopic gastrostomy tube placements performed by two surgeons between November 2019 and July 2021 were reviewed. Decompressive gastrostomy tube placement was performed utilizing standard safe tract and Ponsky pull technique. Preoperative imaging was reviewed when available to confirm a safe window for gastric access prior to placement.

Results: Fourteen patients were identified (10F:4 M), mean age 70 (range 35–89). Initial cancer diagnoses included gynecologic (8), colorectal (3), bladder (1), small bowel (1), peritoneal serous (1). During the 12 months before decompressive gastrostomy tube placement, mean number of hospital admissions for MBO were 1.6 (range 1–3). Following placement of the decompressive gastrostomy tube, twelve patients had no further hospital admissions for MBO over their lifespan of mean 270 days (range 8–679 days) and two patients had a total of 4 hospital admissions for MBO. One patient had 1 admission for MBO in the 12 months before decompressive gastrostomy tube placement and 3 admissions in the 4 months after placement. A second patient had 2 admissions in the 12 months before decompressive gastrostomy tube placement and 1 admission in their 54-day lifespan after placement. There were no major complications from endoscopic gastrostomy tube placement. One patient required repeat endoscopy for tube repositioning when the extension retracted into the esophagus and had no further complications.

Conclusions: Endoscopic placement of the ASPIRE Assist gastrostomy tube is safe for the palliation of symptoms from MBO. Enhanced decompression has the potential to improve symptom management, reduce hospital encounters, and improve quality of life when compared with decompression with standard gastrostomy tubes. Further study is needed however initial data from our study appears promising.

S193

Per oral cricopharyngeal myotomy for management of zenker's diverticulum in the hands of a general surgeon

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Introduction: Zenker's diverticulum is an outpouching of the mucosa and submucosa at the posterior aspect of the pharynx that presents with dysphagia, regurgitation, and halitosis. It is an acquired condition of the elderly with a reported prevalence of 0.01—0.10%. Though rare, its effects are life-altering. Treatment has shifted from open cricopharyngeal myotomy and rigid endoscopy to the use of flexible endoscopy, mostly utilized by gastroenterologists. Few studies evaluate general surgeons' performance of flexible endoscopic management of Zenker's diverticulum. The objective of our case series is to show that general surgeons trained in surgical endoscopy can perform this procedure with favorable outcomes.

Methods and procedures: We conducted a retrospective review of per oral cricopharyngeal myotomies in patients over 18 years old performed at a single institution by a single surgical endoscopist between 2017 and 2021. Our primary outcome was symptom improvement with oral intake. We also evaluated intraprocedural complications, postprocedural complications, hospital length of stay, time to oral intake, and recurrence rate. We abstracted age, sex, body mass index, diverticulum size, and procedure time. We used ranges and frequencies (percentages) to describe the patient population and outcomes.

Results: Forty patients met inclusion criteria. The median age was 74 years old (60–95) and mostly male (n = 27, 67.5%). Median BMI was 28 kg/m^2 (18–43), average total procedure length of 64 min (41–119), diverticulum size of 28 mm (19–90), and average length of stay of 0.9 days (0–8). There were no intraoperative complications. All patients had a post-procedural barium esophagram. 100% of our patients noted improvement of symptoms. 70% of patients had their diets resumed on the same day of their procedure (n = 27), and 92.5% of patients had their diets resumed by post-procedure day (PPD) 1. Nineteen patients were discharged on PPD 0, and 92.5% of patients were discharged by PPD 1. Esophageal leak was the only post-procedural complication (n = 5). Three patients had radiographic leaks without clinical sequelae that resolved independently (two within 24 h, one within 72 h). Two patients required nasojejunal tube placement and home tube feeding for two weeks. Both leaks resolved without surgical intervention. Recurrence rate was 17.5% (n = 7) and was not influenced by size of diverticulum.

Conclusion—Our study demonstrates that general surgeons trained in endoscopy can perform myotomies on a wide range of sizes, with favorable patient outcomes and few complications.

S194

Imaging through scattering media by 3D spatial filtering embedded into micro-endoscope

Arkady Rudnitsky; Amihai Meiri; Asaf Shahmoon; Zeev Zalevsky; Zsquare Medical

Objective of the technology: The main objective is related to the capability of integrating into minimally invasive and ultra-thin disposable micro-endoscopic tool, a modality of realizing high resolution imaging through scattering medium such as blood while performing medical procedure. In this research we aim for the first time to present a time-multiplexing super-resolving approach exhibiting enhanced focus sensitivity, generated by 3D spatial filtering, for significant contrast increase in images collected through scattering medium and right after improving their resolution by applying time-multiplexing super-resolving approach.
Description of the technology: Our innovative method of imaging through scattering media provides imaging of only one specific object plane in scattering medium's volume while suppressing the noise coming from all other planes. The method should be assisted with axial scanning to perform imaging of the entire 3D object's volume. In our developed optical system noise suppression is achieved by 3D spatial filtering approach while at least 3 orders of suppression is experimentally demonstrated. The sensitivity to defocus and noise suppression is dramatically enhanced by placing an array of microlenses combined with pinholes raster positioned between two modules of telecentric lenses. Further enhancement of performance is obtained by developing special diffractive optical element replacing the microlenses and pinholes raster.
Preliminary Results: We will present our novel conceptual designs for the enhanced signal to noise ratio when imaging through scattering medium and present preliminary experimental results demonstrating signal to noise enhancement of about 3 orders of magnitude. In addition, we will present the experimental combination of this proposed concept together with time multiplexing super resolution approach involving usage of laser-based illumination of the inspected object through the scattering medium and via that projecting time-changing primary speckle patterns and using those patterns to super-resolve the final image quality.
Conclusions: Here we present, to the best of our knowledge, the first ever design of time multiplexing based approach for super-resolved imaging through scattering medium. The approach includes a time multiplexing optical design significantly increasing the depth of focus sensitivity and after performing axial scanning yielding a significant enhancement of the signal to noise ratio of the 3D object that is being imaged through the scattering medium. Right after the contrast enhancement we use time multiplexing super-resolved concept based upon illuminating the object with a laser and by that projecting random time changing speckle patterns on it while using those patterns to enhance our imaging resolution.

S195

Gastrojejunostomy vs. endoscopic stenting for the treatment of gastric outlet obstruction: a systematic review and meta-analysis

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Background: The aim of this systematic review and meta-analysis is to perform a comprehensive evaluation of endoscopic stenting (ES) versus gastrojejunostomy (GJ) for the palliation of gastric outlet obstruction (GOO). Though GJ has been a standard palliative procedure for GOO, ES has shown to provide benefits due to its non-invasive approach. Previous systematic reviews exist; however, they analyzed a limited number of outcomes and did not include all available studies.
Methods: A comprehensive search in MEDLINE, Embase, and CENTRAL from database inception to January 2021 was performed. Articles were eligible for inclusion if they were 1) randomized controlled trials or cohort studies; 2) comparing patients over 18 years with benign or malignant GOO and 3) comparing patients who received ES with those who received GJ. Conference abstracts were included. The primary outcome was mean survival time. Secondary outcomes included technical success, clinical success, reinterventions, time until oral food tolerance, mortality, post-procedure adjuvant palliative chemotherapy, postoperative morbidities, length of stay (LOS) and costs. Inverse variance random effect meta-analyses were used to pool effect estimates.
Results: 2,222 citations were initially obtained of which 39 studies fit inclusion criteria. In total, 3,128 patients undergoing ES (41.4% female, age: 68.0 years) and 2,116 patients undergoing GJ (40.4% female, age: 66.8 years) were included. Patients undergoing ES experienced a shorter mean survival time (mean difference (MD): -24.77 days, 95% Cl: -45.11 to -4.43, $p = 0.02$) and less patients were likely to make it to palliative chemotherapy (risk ratio (RR): 0.81, 95% Cl: 0.70 to 0.93, $p = 0.004$). The ES group had a shorter time to oral intake of liquids and solids. Surgical site infections were less common in ES patients (RR: 0.30, 95% Cl: 0.12 to 0.75, $p = 0.01$); however, they also had a greater risk of undergoing reinterventions (RR: 2.60, 95% Cl: 1.87 to 3.63, $p < 0.00001$). LOS was shorter in the ES group (MD: -8.43 days, 95% Cl: -10.15 to -6.70, $p < 0.00001$), especially upon subgroup analysis when compared with open GJ alone.
Conclusions: ES results in less postoperative morbidity and shorter LOS when compared to GJ for palliation of GOO; however, this may be at the cost of decreased overall survival and initiation of palliative chemotherapy. Both techniques are likely appropriate in select clinical scenarios. Further comparative studies between ES and laparoscopic GJ are warranted as minimally invasive expertise increases in prevalence.

S196

Assessment of pyloric sphincter physiology after IL-esophagectomy using endoluminal functional lumen imaging probe (EndoflipTM)

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Objective for the Study: The most common functional complication after Ivor-Lewis Esophagectomy is the delayed emptying of the gastric conduit (DGCE). The purpose of this study is to present pyloric distensibility measured with EndoFlipTM in patients after Esophagectomy. We state that using EndoFlipTM, DGCE can be distinguished from the postoperative physiology of the pylorus.

Methods and Procedures: 39 patients after Esophagectomy were included retrospectively from May 2021 to September 2021 at University Hospital Cologne, Germany. 26 patients showed a normal postoperative course whereas 13 patients suffered from DGCE. The EndoFlipTM was positioned under endoscopic control. Distensibility was measured at 40 ml, 45 ml and 50 ml balloon filling. The statistical analysis was performed using SPSS. The Student t test and Chi Square test were used. All tests were two-sided, with statistical significance set at $P \leq 0.05$.

Results: EndoFlipTM measurement was feasible in all patients and no complications during measurements were recorded. Distensibility proofed to be smaller in patients with symptoms of DGCE compared to asymptomatic patients. For 40 ml, 45 ml and 50 ml the mean distensibility was 9.92 vs 6.42, 7.67 vs 5.10 and 5.65 vs 3.98 mm2/mmHg for non-DGCE vs DGCE patients, respectively. The differences were significant in all three balloon fillings.

Conclusion: To our knowledge we can present the largest cohort after esophagectomy measured with EndoFlipTM. This device is relatively new and has mostly been used for the assessment of the lower esophageal sphincter (EGJ). With this presented study we can certainly show, that the use of EndoFlipTM can be expanded to the measurement of the pylorus. Furthermore, our study could demonstrate that the distensibility in asymptomatic patients after esophagectomy is significantly higher than in patients suffering from DGCE. In conclusion, EndoFlipTM can be used as an additional diagnostic tool in patients who suffer from DGCE.

S198

The Lapp training network: from a sages grant to an eight-country remote laparoscopic simulation training program

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Introduction: Important limitations in surgical simulation training include lack of access to validated basic/advanced training programs with continuous year-round training and experts available for feedback during practice sessions. With the support of a SAGES research grant, a digital-platform called LAPP was developed to train surgeons remotely in basic/advanced laparoscopic skills using simulation training. LAPP was conceptualized to use a network of trained instructors to remotely review practice by enrolled trainees, providing objective multimedia-feedback within 72-h. LAPP has been successfully validated in remote simulation-based training curricula at two Chilean training centers. We describe our experience scaling the use of LAPP from those two centers to training programs in 14 cities across eight countries.

Methods and procedures: Outside institutions with surgical training programs that lacked a robust simulation curriculum were identified. These became target sites for expansion of the LAPP program.They were equipped with box-trainers and the supplies necessary ready to implement the LAPP system. Training-sessions were held at each institution for administrators/faculty involved in the simulation curriculum. The sessions taught how to manage trainees' practice schedules, set up training-stations, and how to record/upload the training via LAPP. A Train-The-Trainers(TTT) program was created to establish a network of trained instructors that could remotely provide objective feedback to trainees through LAPP in an asynchronous manner using personal digital devices. Trainees underwent basic/advanced laparoscopic simulation-training in four-steps: Trainees watch instructional videos. They practice and upload a video of their practice to LAPP. A trained instructor evaluates the recording, providing objective multi-media feedback, and assesses performance using validated rating scales and procedural time. Finally, trainees receive personalized feedback within 72-h, incorporating it into ongoing training.

Results: Between 2019–2021, seven institutions in Chile and one in each of the USA, Bolivia, Brazil, Ecuador, El Salvador, Paraguay, and Peru have implemented a remote simulation curriculum using LAPP. Most administrators involved in simulation are not physicians(13/14). Over 12 instructors were trained with the TTT and are active proctors in the platform. LAPP has been used by 462-learners, who uploaded a total of 5,562 videos, receiving 23,990-feedback communications (Fig.0.1).

Conclusion: LAPP has been successfully used in the creation of a robust network of continuous year-round simulation-based training in basic/advanced laparoscopy. Training centers were successfully run with administrators to assist in setup, and no other on-site staff were necessary. LAPP may be used to further expand simulation-training without the constraints of traditional in-person simulation.

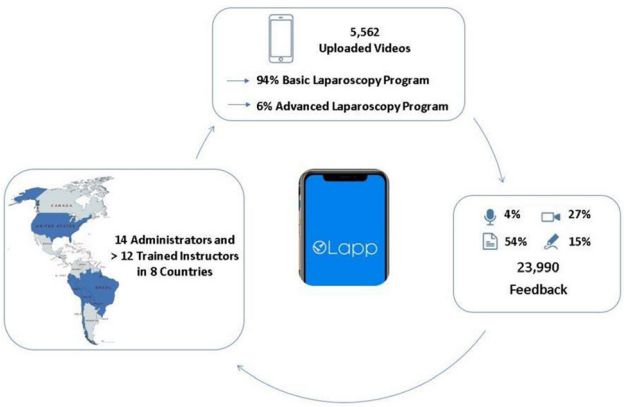

Figure 1. Results of using LAPP training network during 2019-2021

S199

Validation of an artificial intelligence platform for the guidance of safe laparoscopic cholecystectomy

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Introduction: Many surgical adverse events, such as bile duct injury during laparoscopic cholecystectomy (LC), occur due to errors in visual perception and judgment leading to misinterpretation of anatomy. Artificial intelligence (AI) has shown promise as a potential tool to improve the quality and safety of LC, such as through real-time intraoperative support. While novel AI models have recently been developed to accurately identify anatomic structures on videos of LC, it is unknown whether these models can replicate the mental model of expert surgeons. The purpose of this study was to evaluate the performance of AI models compared to expert surgeons in the identification of safe and dangerous zones of dissection during LC.

Methods: A deep learning AI model (GoNoGoNet) was previously developed and trained to identify the safe (Go) and dangerous (No-Go) zones of dissection during LC. A panel of six high-volume surgeons from the SAGES Safe Cholecystectomy Task Force (experts) performed free-hand annotations on frames of prospectively collected videos of LC to identify the Go and No-Go zones. Expert consensus ("ground truth") on the location of Go and No-Go zones was established using > 50% pixel agreement (Fig. 1). Identification of Go and No-Go zones by GoNoGoNet (Fig. 2) was compared to expert-derived ground truth using mean F1 Dice Score (validated spatial overlap index), and pixel accuracy, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

Results:A total of 47 frames from 25 LC videos, procured from 3 countries and 9 surgeons, were annotated by the expert panel and GoNoGoNet. Fourteen (56%) had acute or chronic cholecystitis, 7 (28%) required lysis of adhesions, and 1 (4%) required subtotal cholecystectomy. Mean (± standard deviation) F1 Dice score were 0.58 (0.22) and 0.80 (0.12) for Go and No-Go zones, respectively. Mean (± standard deviation) accuracy, sensitivity, specificity, PPV and NPV for the AI to identify Go zones were 0.92 (0.05), 0.52 (0.24), 0.97 (0.03), 0.70 (0.21), and 0.94 (0.04) respectively. For No-Go zones, these metrics were 0.92 (0.05), 0.80 (0.17), 0.95 (0.04), 0.84 (0.13) and 0.95 (0.05) respectively.

Conclusions: AI can be used to identify safe and dangerous zones of dissection within the surgical field, with high specificity/PPV for Go zones and high sensitivity/NPV for No-Go zones. Overall, model prediction was better for No-Go zones compared to Go zones. This technology may eventually be used to provide real-time guidance and minimize the risk of adverse events.

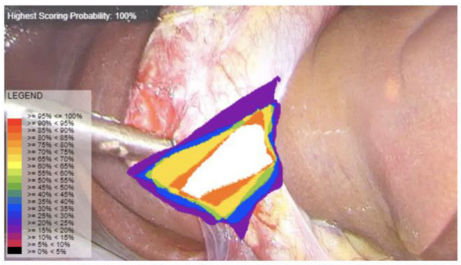

Fig 1. Example of annotations by the expert panel for the Go zone. Data is shown using a topographical representation based on how many experts annotated each pixel.

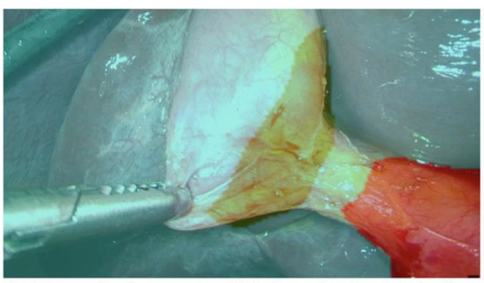

Fig 2. Example of annotation of Go (green) and No-Go (red) zones by GoNoGoNet

S200

Real-time administration of indocyanine green in combination with computer vision and artificial intelligence for the identification and delineation of colorectal liver metastases

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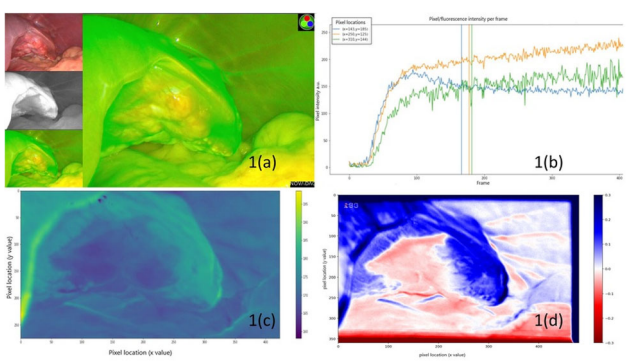
Introduction: Fluorescence guided surgery for the identification and resection of liver lesions in its present form is problematic. Whilst the pre-emptive administration of Indocyanine Green, a fluorescent albumin-bound fluorophore, has been shown to assist in the detection and resection of colorectal liver metastases, specificity rates with this point-in-time discrimination method are low. Furthermore, this technique provides logistic and scheduling challenges necessitating administration of the fluorophore hours/days in advance of surgery. We looked at the feasibility of intra-operative administration of indocyanine green for the demonstration and characterisation of liver lesions based on their dynamic signalling profiles.
Methods: Ten patients with CLM undergoing open and laparoscopic procedures were included. Indocyanine green (0.05 mg/kg) was administered intravenously with subsequent recording of liver fluorescence inflow and outflow (Fig. 1(a)) using the Stryker/Pinpoint near-infrared imaging system. Once captured, video motion (camera movement and tissue deformation) was compensated by estimating the movement of pixels between frames and applying the estimated motion in reverse. Estimation was achieved by identifying recognizable landmarks in each pair of frames, matching them, computing the relative motion between the matched pairs, and interpolating the motion of all other pixels by a so-called thin-plate spline. The accuracy of this stabilization procedure was judged visually. Tissue classification (benign vs malignant) was performed and 2D heat maps were created for all lesions based on their dynamic fluorescence properties.
Results: All ten CLM were correctly classified by the machine learning algorithm. One benign lesion (liver cyst) was correctly identified as a benign entity. Time-fluorescence plots were extracted for each pixel in all lesions (Fig. 1(b)) and 2D image representations created using plot centre of mass (Fig. 1(c)) and diverging colour plots of fluorescence outflow (Fig. 1(d)). In one sample lesion, unsupervised machine learning, in the form of clustering, was performed to create an alternative 2D representation.
Conclusion: Single feature machine learning can accurately identify colorectal liver metastases from surrounding liver tissue as well as from benign liver lesions. Representative 2D maps of such lesions can subsequently be created through exploitation of their dynamic fluorescence perfusion patterns in real time using advanced computer vision and artificial intelligence methods. This may assist in reducing the positive margin rate at time of metastatectomy as well as assist in identifying unexpected occult malignancies.



S201

Automated identification of bleeding and bile leakage in laparoscopic cholecystectomy videos using deep learning

Niyenth Iyengar; Babak Namazi, PhD; Shruti Hegde, MD; Heidi Mahnken, MD; Ryan Dumas, MD; Ganesh Sankaranarayanan, PhD; University of Texas Southwestern Medical Center

Introduction: During laparoscopic cholecystectomy (LC) operations, bleeding events and bile spillage may occur because of injuries caused by sudden or inadvertent movements of instruments. Early identification and control of bleeding and bile spillage is essential in preventing adverse outcomes. Currently, to evaluate operative performance, videos must be manually reviewed for bleeding or bile spillage events, which can be time consuming and unproductive. The objective of this work is to use deep learning for automated identification of bleeding and bile spillage during LC.

Methods: A publicly available dataset of 80 recorded videos of LC called Cholec80 was manually annotated for bleeding and bile spillage by three reviewers. The annotation involved visual identification and subsequent time-stamping from the exact moment of the event to the time when the event was controlled using cautery or suction/irrigation. A deep Convolutional Neural Network (CNN) was trained to classify the current frame of the video based on the presence (labeled as 1) and absence (labeled as 0) of the events. Frames were extracted at 1 fps (Frame-Per-Second). The occurrence and duration of these events are significantly less than the absence of them and have a ratio of 1:20. To tackle such a high imbalance in our dataset, which could negatively affect the overall performance, frames were sampled at 0.1 fps for class 0 and 2 fps for class 1. Resnet50 was used as our CNN architecture.

Results: The CNN was trained using 40 videos. The remaining 40 videos were used for validating the trained model. After applying the balancing method, approximately 8 k frames with the presence and another 8 k frames with the absence of adverse events were chosen to train the model. The training was performed with Stochastic Gradient Descent (SGD) optimizer with a learning rate of 0.001. The current accuracy of the model is 94.5% with F1-score (harmonic mean of sensitivity and precision) of 69.32%. The overall run-time is less than 0.01 s. Examples of the model's prediction are shown in Fig. 1.

Conclusion: We showed that real-time identification of adverse events can be successfully accomplished by applying a deep learning-based model LC videos. Post-operatively, segmenting the bleeding/bile spillage control in a recorded video could be used for operative performance assessment and other educational applications. The obtained results can be further improved in the future by utilizing the temporal coherence in multiple consecutive frames.

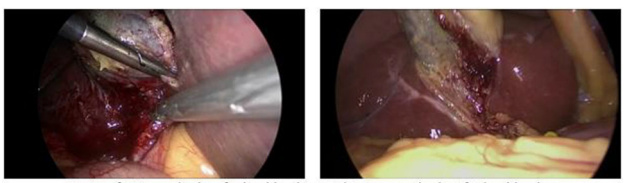


Fig. 1 Left: Correctly classified as bleeding, Right: Incorrectly classified as bleeding

S202

Weight loss outcomes for patients undergoing conversion to Roux-en-y-gastric bypass after sleeve gastrectomy

Eileen Roach; Simon LaPlante; Shannon Stogryn; Azusa Maeda; Timothy Jackson; Allan Okrainec; University of Toronto

Introduction: Laparoscopic sleeve gastrectomy (LSG) is the most performed bariatric surgical procedure worldwide. Despite excellent reported outcomes after LSG, a proportion of patients go on to have an additional bariatric surgical procedure. These conversion procedures are most commonly done to manage side effects of LSG or insufficient weight loss or weight regain after LSG. Reported weight-loss outcomes for patients undergoing laparoscopic Roux-en-Y gastric bypass (LRYGB) after previous LSG vary widely in the literature. We sought to determine the weight-loss outcomes of patients undergoing LRYGB after LSG in the largest bariatric surgical network in Canada and to determine whether outcomes differ according to indication for conversion.

Methods and procedures: The Bariatric Registry is a multi-center database with prospectively collected standardized data on all patients undergoing bariatric surgery at the seven Bariatric Centers of Excellence comprising the Ontario Bariatric Network in Ontario, Canada. A retrospective analysis was performed of all patients who underwent LRYGB after previous LSG between 2012–2019. Weight-loss outcomes were compared between patients who underwent LRYGB for insufficient weight loss/weight regain (IWL) and those who underwent conversion to LRYGB for other reasons (OTHER). Patients undergoing multiple conversions or revisional procedures were excluded.

Results: Of the 90 patients initially identified, 36 (40%) were excluded for loss of follow-up after LRYGB. Of the remaining 54 patients, 39 (72.2%) were converted for IWL and 15 (27.8%) were converted for other reasons, primarily nausea/vomiting and GERD symptoms. Median BMI in the IWL and OTHER groups was, respectively, 60.1 kg/m^2 and 48 kg/m^2 prior to LSG ($p = 0.011$); 46.7 kg/m^2 and 36.5 kg/m^2 prior to LRYGB ($p = 0.003$), and 43 kg/m^2 and 39 kg/m^2 at last follow-up ($p = 0.003$). At final follow-up, patients undergoing LRYGB for IWL had lost a median total of 47% excess weight (EWL) compared to 67.5% EWL in those converted for other reasons ($p = 0.014$). Median length of follow-up did not differ between the two groups.

Conclusions: This study demonstrates that weight-loss outcomes after conversion from LSG to LRYGB differ by indication for conversion. Patients undergoing conversion for IWL lose fewer BMI points and lose less excess weight after LRYGB than those undergoing conversion for other reasons. These findings can help surgeons appropriately counsel patients considering additional surgery after LSG.

S203

Robotic vs laparoscopic duodenal switch

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Introduction: Robotic surgery is currently applied in all bariatric surgical procedures. Improved visualization and additional degrees of freedom makes it a perfect tool for complex operations especially those involving intracorporeal anastomosis such as Biliopancreatic Diversion with Duodenal Switch (BPD-DS). BPD-DS was considered technically difficult since it was first described. The procedure underwent several modifications until the first robotic BPD-DS (R-BPD-DS) was first performed more than 20 years ago. Application of R-BPD-DS is increasing, however differences in outcomes remain unclear when compared to laparoscopy (L-BPD-DS). To our knowledge there is currently no study that addresses the differences between robotic and laparoscopic BPD-DS.

Methods: Information obtained from Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) Database over a 4-year period (2015–2018). A total of 5592 patients who underwent BPD- DS were divided into two groups (R-BPD-DS; 1119 vs L-BPD-DS; 4473) and 30-day outcomes were analyzed.

Results: Most patients in both groups were young (42.6 vs 43.6 years old; $p < 0.01$), female (64% vs 71%; $p < 0.01$) and white (74% vs 82%; $p < 0.01$) in both groups. The R-BPD-DS group had less comorbidities and risk factors ($p < 0.05$); HTN (36% vs 52%), preop reflux (22% vs 31%), history of cardiac catheterization (1% vs 1.9%), prior bariatric/foregut surgery (0.4% vs 4%), active smoking (8% vs 10%), chronic obstructive pulmonary disease (1.4% vs 2.5%), American Society of Anesthesiologist score of 3 or 4 (84 vs 88%). Conversely, patients subjected to R-BPD-DS had higher Body Mass index (BMI 53 vs 51.9; $p < 0.01$); unplanned ICU admissions (0.6 vs 1.6%; $p = 0.01$) and 30-day mortality (0.3 vs 1%; $p = 0.02$). Finally, average operative times were longer for R-BPD-DS (216 vs 132 min; $p < 0.01$).

Conclusions: Patients subjected to R-BPD-DS overall had better outcomes, but operative time was longer in R-BPD-DS group. The laparoscopic group had more comorbidities and more unplanned ICU admissions. Randomized controlled trials in the future are needed to further exhibit the utility of robotic assisted BDP-DS.

S204

The avoidable delay in weight loss surgery for the super morbidly obese: a cross-sectional study

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Introduction: Many insurance companies mandate a minimum of a 6-month preoperative medical intervention prior to bariatric surgery. It has been conventional experience that this does not make a difference in BMI prior to surgery. This cross-sectional study is an effort towards elucidating whether or not a 6-month preoperative medical intervention makes any difference in preoperative BMI.

Methods: All adult patients with bariatric consultation at any time at the New York University Langone Health campuses during the period 2015 to 2021 were evaluated via electronic medical records. Only patients with > BMI 50 on initial visit and those without previous bariatric surgeries at other institutions were included. Along with BMI and weight, baseline characteristics were obtained during this perioperative period. A paired t-test was performed on the difference in BMI and percent-weight loss among the subjects at least 6 months before surgery and the same subjects right before surgery. Additionally, sub-group analysis was performed on those that had > 5% weight loss.

Results: Of the 130 super-morbidly obese patients undergoing preoperative medical intervention, by the time of surgery there was a statistically significant mean difference in BMI of -1.51, standard deviation 3.26 with a p-value of < 0.01. There was also a statistically significant mean difference in percent-weight loss of 0.048, standard deviation 0.11 with a p-value of < 0.01. Furthermore, there were no observed intraoperative complications nor 30-day mortality.

Conclusions: We found that BMI and percent-weight loss is present and is statistically significant, but these small differences have little clinical significance given that the goal target of medical preoperative weight-loss is typically 5–10% body weight. This study provides additional data to suggest that mandatory preoperative medical interventions in the super morbidly obese may make no difference in BMI nor operative outcomes, and warrants further study in the form of cohort design.

Table I. All patient characteristics

		All samples (n=130)
Age (SD), years		41.43(~12.28)
Gender		
	Male	40(30.77%)
	Female	90(69.23%)
Program duration (SD), month		8.39(~7.83)
Diabetes		
	No	83(63.85%)
	Yes, Insulin	17(13.08%)
	Yes, Non-Insulin	30(23.08%)
Obstructive sleep apnea (OSA)		58(44.62%)
GERD		30(23.08%)
Number of Anti-Hypertensive Medications (SD)		0.94(~1.22)
Hyperlipidemia		23(17.69%)
ASA Classification		
	ASA II - Mild systemic disease	16(12.31%)
	ASA III - Severe systemic disease	107(82.31%)
	ASA IV - Severe systemic disease threat to life	7(5.38%)
Intraoperative complications		0
30-day mortality		0

Table II. Paired t-test result comparing BMI difference between initial visit and before procedure

N	Mean	SD	p-value
130	-1.51	3.26	<0.01

Table III. Paired t-test result comparing weight percentage change between initial visit and before procedure

N	Mean	SD	p-value
130	0.048	0.11	<0.01

Table V. Paired t-test result comparing difference of BMI change between patients with >=5% weight loss and <5% weight loss

Group	N	Mean (BMI Change)	SD	p-value
Weight loss>=5%	42	-4.55	1.91	<0.01
Weight loss<5%	88	-0.05	2.73	

S205

Sleeve gastrectomy morphology and long-term weight-loss and gastroesophageal reflux disease outcomes

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Objective: To explore the relationship between sleeve gastrectomy (SG) morphology and long-term weight-loss and gastroesophageal reflux disease (GERD) outcomes.

Methods: All patients (n = 268) undergoing SG performed by 3 surgeons at a single academic institution from January 1, 2010, to December 31, 2012, were included. Long-term weight-loss and GERD outcomes were available for 90 patients which were incorporated in analyses. SG morphology was determined from postoperative day 1 upper gastrointestinal series (UGIS) available from 50 patients. Images were independently categorized using previously published methodology as Dumbbell (38%), Lower Pouch (22%), Tubular (26%), or Upper Pouch (14%) by Radiologist and Surgeon. Radiologist categorization was used when disagreement occurred (8%). Univariable analyses were conducted to explore potential associations between SG morphology, weight-loss, and GERD outcomes.

Results: Follow-up was 8.2 ± 0.9 years. Population characteristics included age of 45.1 ± 10.8 years, female sex in 83.3%, and hiatal hernia repair (HHR) performed at index SG in 17.8%. Changes from preoperative obesity and associated diseases comprised body mass index (BMI) (49.5 ± 7.6 vs. 39.2 ± 9.4 kg/m^2; $p < 0.0001$), diabetes mellitus (30.0% vs. 12.2%; $p = 0.0006$), hypertension (70.0% vs. 54.4%; $p = 0.0028$), hyperlipidemia (42.2% vs. 24.2%; $p = 0.0017$), obstructive sleep apnea (41.1% vs. 15.6%; $p < 0.0001$), osteoarthritis (48.9% vs. 13.3%; $p < 0.0001$), back pain (46.5% vs. 28.9%; $p = 0.0035$), and medications (4.8 ± 3.3 vs. 3.7 ± 3.5; $p < 0.0001$). GERD was more prevalent at follow-up than baseline (67.8% vs. 47.8%; $p < 0.0001$). GERD-specific outcomes included de novo (51.1%), persistent (27.9%), worsened (60.5%), and resolved (14.0%) GERD. Ten patients underwent reoperation for refractory GERD with SG morphology corresponding to Dumbbell (n = 5) and Upper Pouch (n = 1) for those with available UGIS. Univariable analyses showed that, at follow-up, patients with GERD experienced a larger reduction in BMI compared with patients without GERD (-11.8 ± 7.7 vs. -7.0 ± 5.1 kg/m^2; $p = 0.0007$). Patient age and sex, surgeon, SG morphology category, and whether a HHR was done at index SG were not associated with the presence of any, de novo, or worsened GERD at follow-up. Dumbbell SG morphology was associated with lesser reduction in BMI at follow-up (-6.8 ± 7.2 vs. -11.2 ± 7.1 kg/m^2; $p = 0.0187$) while greater BMI change was appreciated with Lower Pouch SG shape (-16.9 ± 9.9 vs. -9.3 ± 6.4 kg/m^2; $p = 0.0309$).

Conclusions: This is the first study assessing the impact of SG morphology on long-term weight-loss and GERD. Our data suggest an association between SG morphology and long-term weight-loss but not with GERD outcomes. This information may help guide the technical optimization and standardization of SG. Interestingly, patients with GERD at follow-up showed a larger BMI reduction compared to patients without GERD.

S206

Rates of recurrent marginal ulcer in gastric bypass patients undergoing elective revisional surgery

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Introduction: The rate of marginal ulcer (MU) following primary Roux-en-Y Gastric Bypass (RYGB) is approximately 5–10%. Few studies have evaluated recurrence rates following surgical revision for MU. The primary aim of our study was to determine the rate of MU recurrence following revision. The secondary aim was to evaluate the impact of the type of revision on ulcer recurrence rates. We compared the recurrence rates for patients who underwent bilateral truncal vagotomy (BTV) versus those without BTV. We also examined the rate of MU in patients who had revision of the gastrojejunostomy (GJ) and those who underwent graham patch.

Methods and procedures: This was a retrospective cohort study examining data from multiple surgeons at a single tertiary academic medical center. Adult patients with a history of RYGB who underwent elective revision for recurrent MU between the years of 2003–2020 were included. Patients with graham patch repair (n = 9) or revision of GJ (n = 90) were included in the study. We sought to determine our overall rate of MU following revision for recurrent MU with and without BTV. We also examined recurrence following graham patch and after revision of GJ with and without BTV. Fisher's exact test was used to determine the statistical significance of recurrence rates between the groups.

Results: There were a total of 99 patients who underwent elective surgical revision for MU included in the study. Of the entire cohort 63 patients had at least one esophagogastroduodenoscopy following surgical revision for MU. Of the 99 patients, 35 (35.4%) patients underwent BTV at the time of revision. The overall recurrence rate for MU was 20.2%. The overall recurrence rate with BTV was lower than for those without BTV (14.3% vs 23.4%, $p = 0.310$). The overall recurrence rate in the group that underwent revision of GJ was 16.7%. The recurrence rate for GJ revision with BTV was less than for those without BTV (14.3% vs 18.2%, $p = 0.775$). Recurrence rate for patients who underwent graham patch without BTVwas 55.6%.

Conclusions: The rate of recurrence after revisional surgery for MU is high. The trend in our study showed that BTV decreased MU recurrence after revisional surgery. Our findings did not demonstrate statistical significance however, as our study would need approximately 300 patients for sufficient power to reach significance assuming the observed trend is valid.

S207

Safety of biliopancreatic diversion with duodenal switch in patients with body mass index less than 50 kg/m^2

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Introduction: Biliopancreatic diversion with duodenal switch (BPDDS) has advantages over other bariatric procedures such as has fewer marginal ulcers and less dumping syndrome compared to Roux en Y gastric bypass and improved weight loss compared to sleeve gastrectomy. However, BPDDS has often been reserved for patients with superobesity (BMI $>$ 50 kg/m^2) with total alimentary limb length of 250 cm (common channel (CC) length 50-100 cm and alimentary limb length 150-200 cm). The effects of limb lengths, however, are currently unclear in BPDDS. We aim to assess the safety of BPDDS in patients with morbid obesity (BMI $>$ 35 kg/m^2 and $<$ 50 kg/m^2) using a 150 cm CC and 150 cm alimentary limb.
Methods and procedures: After IRB approval, a retrospective review was performed on patients who underwent a BPDDS in 2016–2019 at a single institution. Only patients with a BMI $<$ 50 mg/k2 and $>$ 35 mg/k2 were included. Limb lengths were measured with a laparoscopic instrument with minimal tension. Postoperative short and long term follow up data were obtained via chart review and patient phone call. Variables were compared using paired t-test or repeated measures ANOVA where appropriate.
Results: There were 45 patients with morbid obesity who underwent BPDDS. CC lengths and alimentary limb lengths were 150-200 cm (158 $\pm$ 20 cm) and 110-200 cm (154 $\pm$ 18 cm), respectively. Average preoperative BMI was 44.9 $\pm$ 2.3 kg/m^2 and average follow up was 2.4 $\pm$ 1.4 years. There was 1 patient who required early reoperation and died from multiorgan failure and anastamotic leak. In the remaining patients, there were 2 ED visits (4.5%) and 1 (2.2%) readmission within 30 days. There were no marginal ulcers, limb length revisions or need for parental nutrition for protein calorie malnutrition. Percent excess weight loss at 1, 3, and 5 years were 71.5 $\pm$ 21.3%, 70.1 $\pm$ 16.6%, and 74.4 $\pm$ 17.2%, respectively. Postoperative weight was significantly lower than preoperative weight ($p < 0.0001$) without significant weight regain out to 5 years. At 1 year, there was resolution or improvement in 88.9% of diabetes mellitus type II, 80% of hypertension, 50% of OSA, 56% of hyperlipidemia and 50% of gastroesophageal reflux disease (GERD). De novo GERD was seen in 9.7% of patients.
Conclusions: BPDDS may be reasonable in patients with BMI $<$ 50 kg/m^2 and $>$ 35 kg/m^2 with 150 cm CC and 150 cm alimentary limb. BPDDS may be considered in select patients without severe obesity with careful measurements of limb lengths.