

MAY 3-4 2024
ANNUAL MEETING

THE LOFTON HOTEL • MINNEAPOLIS, MN



MINNESOTA SURGICAL SOCIETY
A Chapter of the American College of Surgeons



PODIUM ABSTRACTS

Surgical Bowel Preparation, But Not Bowel Resection, Mediates Dysbiosis After Colon And Rectal Surgery

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Introduction: The intestinal microbiota has been associated with alterations in colorectal surgery outcomes, including surgical infections and anastomotic leak; however, perioperative changes in its composition are poorly understood. This study characterizes the perioperative gut microbiome across multiple colorectal interventions. We anticipate the use of oral antibiotics prior to surgery will result in more substantial and persistent derangements in the intestinal microbiota composition compared to patients undergoing colonoscopy.

Methods: We assessed three cohorts (N=29, 26, 28): (S) colonoscopy with mechanical bowel preparation (MBP), (R) colon resection with MBP + oral antibiotics (SBP), and (N) non-resection colorectal surgery with SBP. Those receiving SBP also received perioperative IV antibiotics. Fecal microbiota were analyzed at 5 points from baseline to 180 days after surgery.

Results: The cohorts differed by age, sex, and comorbidity, expected due to differing procedural indications. Microbiota alpha diversity in both surgical groups was significantly diminished at T0 and T10, while colonoscopy patients retained near-baseline diversity across timepoints (Figure 1). Beta diversity demonstrated clustering of colonoscopy samples with relative enrichment of beneficial *Faecalibacterium* and *Alistipes*; *Streptococcus* was more abundant in the surgical cohorts.

Conclusion: Our data support the significant impact of MBP+OA on colon microbiota composition regardless of type of colorectal intervention with or without colorectal resection. This suggests future research into the benefits of restoring beneficial intestinal bacteria in the early postoperative period.

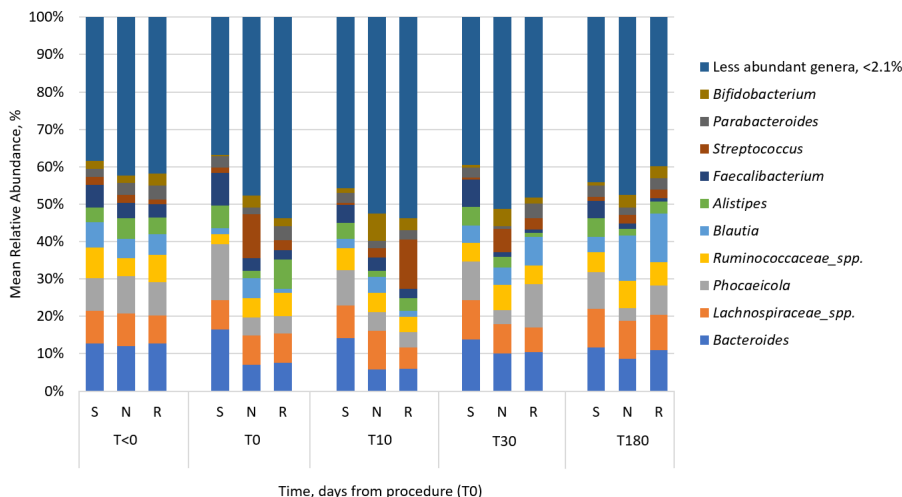


Figure 1. Mean relative abundance of fecal microbiota over study course from cohorts S (colonoscopy), R (resection), and N (non-resection). Predominant species are represented at the genus level.

Use of Autologous Blood Transfusion In Oncologic Resection is Not Associated With Cancer Recurrence or Survival

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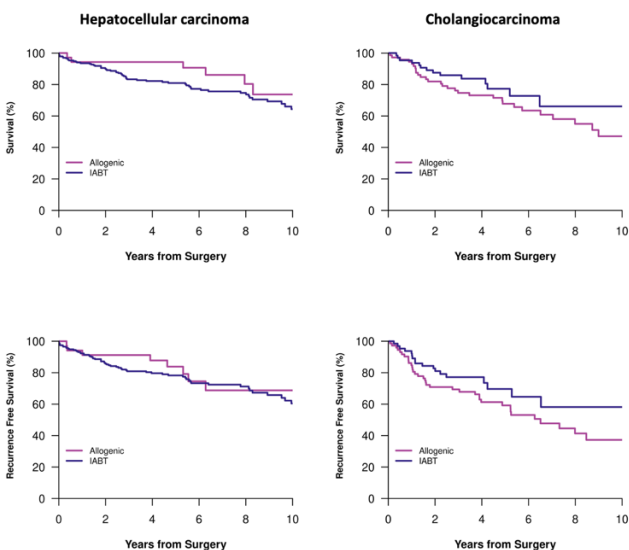
Introduction: Despite limited data, intraoperative autologous blood transfusion (IABT) has historically been contraindicated during oncologic resection due to concern for development of distant metastasis.

Methods: We identified all patients who underwent non-cardiac oncologic resection with IABT 2010-2021 at our institution to determine if receipt of IABT is associated with early metastasis. A subgroup analysis of patients who underwent liver transplant for malignancy was conducted using inverse probability of treatment weighting to compare survival between those who received autologous and allogeneic transfusions.

Results: Out of 444 patients, the most common diagnoses were hepatocellular carcinoma (52.9%), cholangiocarcinoma (15.3%), and renal cell carcinoma (4.1%). The median volume of autologous blood transfused was 661ml (IQR 337-1491ml). Seven patients (1.6%) experienced distant recurrence within 90 days, and 35 (7.9%) within one year. Three of the seven patients with early recurrence had unexpected findings on final pathology that would have precluded resection; two developed metastasis that was ultimately deemed present prior to surgery. In a subgroup analysis of patients undergoing liver transplant for malignancy, 299 patients who received IABT were compared with 107 patients who received allogeneic transfusion. Unadjusted Kaplan-Meier survival curves were compared (Figure 1). After adjusting for cancer type, age, sex, estimated blood loss, MELD score, stage, and allograft type, IABT was not associated with overall survival [HR 1.30 (95%CI 0.82-2.03), $p=0.241$] or recurrence-free survival [HR 1.15 (95%CI 0.77-1.73), $p=0.498$].

Conclusion: We did not observe an association between IABT and early recurrence. Autologous blood may be a safe alternative to allogeneic transfusion in oncologic resection.

Figure 1. Unadjusted Kaplan-Meier survival curves for patients who underwent liver transplant for malignancy.



Presidential Plenary Session with Discussants | Abstract | Clinical Research
Comparison of a Freehand Region-of-Interest Versus a Deep Learning Model for Skeletal Muscle Assessment to Predict Length of Stay Post Liver Transplantation
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Introduction: Computed Tomography (CT)-derived skeletal muscle measures are increasingly appreciated for their prognostic capabilities in clinical populations. In liver transplant populations, skeletal muscle measures of cross-sectional area and density have been shown to predict outcomes including length of stay (LOS). The purpose of this analysis is to compare two clinically feasible methods of skeletal muscle measurement at the level of the third lumbar vertebrae (L3) and their ability to predict LOS outcomes.

Methods: A total of 50 patients greater than 18 years old who underwent liver transplantation at the University of Minnesota from January 1, 2016 - May 30, 2021, were included in this single center analysis. Non-contrast CTs within 180 days of transplant were obtained and skeletal muscle (SM) measurements at L3 were calculated. The total healthcare LOS variable was created by adding hospital and rehab length of stay. Two previously established methods were utilized: (1) freehand region-of-interest (ROI, psoas muscle), and (2) total SM at the level of the L3 using automated software (AID-UTM, iAID Inc., Seoul, Korea), and variability was analyzed. Data are presented as mean (\pm SD)

Results: CT scans were obtained an average of 20.7 days (\pm 22.5) prior to transplantation. Mean age of the cohort was 55.8 years (\pm 10.2) and gender distribution was 40% female. Linear regression established that the automated software-derived muscle area variable could better predict LOS variables, including inpatient LOS (F (1,48) = 11.49, p=0.00 vs F (1,48) = 4.60, p=0.04), ICU LOS (F (1,48) = 4.17, p=0.05 vs F (1,48) = 0.94 p=0.34), and total healthcare LOS (F (1,48) = 12.90, p = 0.00 vs F(1,48) = 5.41, p=0.02). ROI-derived measures of skeletal muscle density, however, were a slightly better predictor of LOS variables. The automated software-derived area variables predicted ~20% of the variability of the LOS variables compared to the ROI area measures, which only predicted ~10% of variability of the LOS variables. Both automated software-derived and ROI Hounsfield unit variables predicted ~20% of the inpatient length of stay and healthcare LOS variables.

Conclusion: Our findings lend further support to the prognostic capacity of CT-derived skeletal muscle measures in liver transplant populations. Freehand ROI measures provide a potential sarcopenia measure easily obtained in a clinical setting, but new automated analysis software is capable of easily generating more comprehensive body composition measurements. Future analyses will assess the prognostic capacity of each method to quantify sarcopenia for better prediction of post-transplant outcomes to determine the clinical relevance of each approach in sarcopenia assessment.

Breakout Session I: Surgical Oncology | Abstract | Clinical Research

Lymph Node Metastases in Appendiceal Adenocarcinoma: An Analysis from the National Cancer Database

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Introduction: Right hemicolectomy represents the standard oncologic procedure for adenocarcinoma of the appendix, providing adequate lymph node yield for optimal staging. However, a significant proportion of patients have node negative disease on final pathology. Aims of the current study were to determine the rate of lymph node metastases in appendiceal adenocarcinoma and the associated risk factors from a national cohort of patients.

Methods: The National Cancer Database (2004-2018) was queried for adults with non-metastatic adenocarcinoma of the appendix who underwent right hemicolectomy colectomy with curative intent. All patients had a minimum of 12 lymph nodes examined and negative surgical margins. Additional exclusion criteria included missing chemotherapy data, radiotherapy, and unclear T and N staging.

Results: Of 3,185 patients identified, 76% were pN0; 21% were stage I, 55% stage II, and 24% stage III. On multivariable analysis, factors associated with lymph node metastasis were moderately (OR 2.1, 95% CI 1.6-2.8) and poorly differentiated grade (OR 4.7, 95% CI 3.3-6.6), non-mucinous (OR 1.5, 95% CI 1.2-1.8) and signet ring cell histology (OR 1.5, 95% CI 1.0-2.3), and T stage ($p < 0.01$). Size was not significant. At 60 months, overall survival was 79% for all patients. Age >70 , male sex, not insured, increasing Charlson-Deyo Score, pathologic T stage, and pathologic N status were independently associated with worse overall survival at 60 months ($p < 0.05$), whereas adjuvant chemotherapy was associated with better survival (single agent: HR 0.75, 95% CI 0.57-0.99; multi-agent: HR 0.73, 95% CI 0.59-0.91).

Conclusion: In this US based cohort, 1 out of 4 patients with appendiceal adenocarcinoma was found to have nodal disease at initial presentation. This observation in association with the increased survival associated with adjuvant chemotherapy, confirms the key role of segmental colectomy in the staging and treatment of these patients. While tumor grade, histology and T stage were associated with lymph node involvement, size was not, suggesting the lack of correlation between tumor biology and cancer dimensions.

Table 1. Multivariable logistic regression of factors associated with pathologic lymph node positivity.

Characteristic	Odds of pN+	
	Odds Ratio (95% CI)	P-value
Grade		<0.01
Well Differentiated	Reference	
Moderately Differentiated	1.87 (1.43-2.46)	
Poorly or Undifferentiated	3.70 (2.69-5.07)	
Histology		<0.01
Mucinous	Reference	
Non-Mucinous	1.43 (1.15-1.78)	
Signet Ring Cell	1.66 (1.12-2.45)	
Pathologic T		<0.01
1	Reference	
2	2.19 (1.07-4.49)	
3	4.99 (2.59-9.60)	
4A	6.42 (3.27-12.61)	
4B	9.96 (4.98-19.90)	
Tumor size (cm)	1.01 (0.98-1.03)	0.57

pN+, at least one lymph node positive on final pathology. Number of observations in the original data set = 3185. Number of observations used = 2395. Bold font indicates significance, $p < 0.05$.

Breakout Session I: Surgical Oncology | Abstract | Clinical Research

Risk of Lymph Node Metastases in Appendiceal Neuroendocrine Neoplasms: An Analysis from the National Cancer Database

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Introduction: Current NCCN guidelines recommend segmental colectomy for appendiceal neuroendocrine neoplasms >2.0cm given their propensity for nodal involvement, as opposed to appendectomy alone. However, the biologic behavior of neuroendocrine tumors is also determined by several factors besides size, including histology, lymphovascular invasion (LVI), and grade. We hypothesized that additional tumor characteristics would enhance prediction of LN metastases, supporting clinician decision-making regarding the optimal extent of surgical resection.

Methods: The National Cancer Database (2010-2017) was queried for adults with stage I-III appendiceal neuroendocrine neoplasms who underwent right colectomy. Five histologic subgroups including neuroendocrine tumor grade 1 (NET G1), NET G2-G3, neuroendocrine carcinoma (NEC), mixed neuroendocrine-non-neuroendocrine neoplasms (MiNEN), and goblet cell carcinoid (GCC) were independently analyzed.

Results: Of 3,541 patients (median age 51 years, 43% male, 88% white), 16% had positive LN. Overall, 40% had NET G1, 4% NET G2-G3, 10% NEC, 12% MiNEN, and 30% GCC. On multivariable analysis, factors associated with LN metastases included increasing depth of invasion, LVI, and increasing size, while GCC and MiNEN were not (Table 1). Five-year overall survival (OS) was 92%; 95% NET G1, 95% NET G2-G3, 91% NEC, 82% MiNEN, and 92% GCC. Age >70, increasing Charlson-Deyo score, MiNEN histology, involved LN, and T4 tumors were independently associated with worse OS (p<0.05).

Conclusion: In this national cohort, 1 in 6 patients with neuroendocrine neoplasms had positive LN, which was associated with increasing depth of invasion, LVI, and size >1cm. These findings suggest additional factors, rather than size alone, should be considered when determining the extent of surgical resection.

Table 1. Multivariable logistic regression of factors associated with lymph node positivity.

Patient and Tumor Characteristics		OR	95% CI	P-value
<i>Tumor Histology vs NET G1</i>	NET G2-3	1.10	0.51-2.38	<0.01
	NEC	1.22	0.77-1.93	
	MiNEN	0.31	0.18-0.55	
	Goblet cell	0.14	0.08-0.23	
<i>Depth of invasion vs submucosa</i>	Invades muscularis propria	1.93	1.06-3.48	<0.01
	Invades through muscularis propria	2.09	1.24-3.52	
	Penetrates visceral peritoneum	6.12	3.02-12.39	
<i>Lymphovascular invasion</i>	Present	4.54	3.24-6.37	<0.01
<i>Tumor size (cm)</i>	Per 1cm increase	1.44	1.31-1.58	<0.01
<i>Year of Diagnosis</i>	Per 1 year increase	0.81	0.73-0.90	<0.01

Breakout Session I: Surgical Oncology | Abstract | Clinical Research

Analyzing Population-Based Care Patterns in Patients with Asymptomatic Stage IV Colon Cancer

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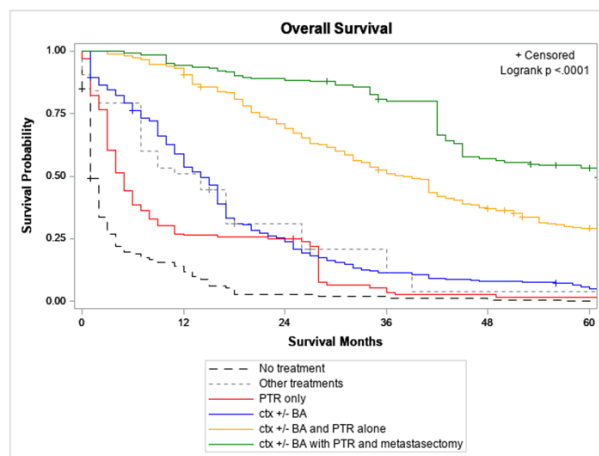
Introduction: Currents guidelines recommend chemotherapy+/-biologic agents (CTX+/-BA) for asymptomatic stage IV colon cancer, while primary tumor resection (PTR) is reserved for symptomatic tumors or resectable metastases. To date, real-world treatment patterns for metastatic colon cancer are understudied. The Surveillance, Epidemiology, and End Results Patterns of Care (SEER-POC) database provides a unique opportunity to study management approaches and outcomes in these patients.

Methods: Adults with asymptomatic metastatic colon cancer were identified in the 2014 SEER-POC study and categorized into 6 groups: CTX+/-BA, CTX+/-BA with PTR and metastasectomy, CTX+/-BA and PTR alone, PTR only, no treatment, or other treatments. Multinomial logistic regression model determined factors associated with receiving each management modality. Cox proportional hazard model assessed relationships between treatment modalities and all-cause mortality.

Results: Among 1,717 weighted cases, 28% received CTX+/-BA, 23% CTX+/-BA with PTR, 12% CTX+/-BA with PTR and metastasectomy, 12% PTR only, 23% no treatment, and 2% other treatments. Younger patients were more likely to undergo CTX+/-BA with PTR and metastasectomy than CTX+/-BA alone (OR=3.32, 95%CI 1.3-8.6) and less likely to receive no treatment (OR=0.05, 95%CI 0.02-0.17). Median follow-up for the entire cohort was 14 months [IQR:4-32]. Patients undergoing CTX+/-BA and PTR with metastasectomy had the best median survival at 61 months, while those with no treatment had the worst at 1 month.

Conclusion: Almost one-quarter of stage IV patients did not receive any treatment. Additionally, only 12% of these patients were completely resectable; this intervention was associated with a noteworthy median OS of 5 years, confirming the reported optimal outcomes of this approach. These data provide an important benchmark for any future population-based interventions of this group of patients.

Figure 1. Kaplan Meier curves comparing overall survival for patients with asymptomatic stage IV colon cancer.



Breakout Session I: Surgical Oncology | Abstract | Clinical Research

Patterns of Care and Outcomes of Primary Colonic Lymphoma: A Population-Based Analysis

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Introduction: Primary colorectal lymphoma (PCL) is a rare malignancy (~1%) with a rising incidence over the last three decades. Despite this increase, no standardized treatment regimen exists, and current management includes combinations of chemotherapy, surgery, and radiation. The aim of this study was to describe patterns of care and outcomes of PCL in a U.S. population-based cohort.

Methods: The Surveillance, Epidemiology, and End Results Database was queried to identify adults diagnosed with PCL, 2000-2017. Exclusion criteria were no documentation of treatment, more than one primary cancer, no histologic confirmation of lymphoma, lymphoma of the anal canal, and documentation reported only by nursing home, autopsy, or death certificate. Histology was grouped into diffuse large B cell (DLBCL), follicular, mantle cell, marginal zone, non-Hodgkin's, and Hodgkin's lymphoma + other. Treatment was categorized as: surgery (Sx), chemotherapy (CT), surgery + chemotherapy (Sx+CT), radiation + other (RT+other), or no treatment (NT). Tumor location was defined as proximal colon (appendix-transverse), distal colon (splenic flexure-sigmoid), or rectum. Multinomial logistic regression was conducted to identify factors associated with treatment. Cox proportional hazard and competing risk models were used to estimate the effect of treatment on overall (OS) and disease-specific survival (DSS).

Results: Of 4,069 patients, 50% were ≥65 years old, 63% male, and 82% white. Proximal lesions were more common (48%) and DLBCL was the most prevalent histologic subtype (42%). The largest proportion of patients underwent Sx alone (28%); 23% received CT only, 20% had Sx+CT, 24% were NT, and only 5% underwent RT+other. Multinomial analysis showed significant associations between treatment received and age, race, marital status, stage, histology, and lymphoma location. Compared to CT, patients ≥65 years old were less likely to receive any treatment and proximal lesions were more likely to undergo Sx+CT. CT was used at higher rates for more advanced stage disease (Table 1). OS and DSS were 63% and 70% for CT, 65% and 75% for Sx, 71% and 78% for Sx+CT, 72% and 78% for RT+other, and 64% and 74% for NT. After adjustment, factors associated with worse OS were age ≥65, male sex, Black race, rurality, higher stage, and histology, whereas proximal lymphoma was associated with improved OS. NT (hazard ratio [HR] 1.56, 95% confidence interval [CI] 1.35-1.81) and Sx alone (HR 1.34, CI 1.17-1.54) were associated with lower OS when compared to CT, while Sx+CT had better prognosis (HR 0.71, CI 0.61-0.83). For DSS, a similar prognostic role of clinicodemographic factors was observed. Particularly, NT (HR 1.36, CI 1.12-1.64) and Sx alone (HR 1.25, CI 1.05-1.49) had worse DSS than CT, while Sx+CT had better outcomes (HR 0.73, CI 0.61-0.87).

Conclusion: In this population-based cohort, one quarter of the patients did not receive any treatment, which was associated with increasing age, and worse survival. Patients with proximal lesions were more likely to undergo Sx+CT, with improved prognosis, possibly suggesting that localized disease amenable to surgical resection and systemic treatment may lead to better oncologic outcomes. As with other colorectal cancer, elderly, Black race, and rural setting had worse survival rates, suggesting potential disparities extending to this subset of patients.

Table 1: Multinomial model for predictors of treatment for PCL. Comparator group: treatment with chemotherapy alone.												
Characteristic	No treatment			Radiation + Other			Surgery			Surgery + Chemotherapy		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Age (ref: 18-64)												
65-74	1.58	1.18, 2.12	0.002	0.69	0.41, 1.16	0.2	1.37	1.03, 1.82	0.029	1.14	0.86, 1.51	0.4
75+	1.77	1.32, 2.37	<0.001	1.19	0.75, 1.88	0.5	1.93	1.47, 2.54	<0.001	0.85	0.63, 1.13	0.3
Female vs. Male	1.21	0.94, 1.55	0.15	0.94	0.63, 1.41	0.8	1.13	0.89, 1.43	0.3	1.02	0.79, 1.31	0.9
Race (ref: White)												
Black	0.76	0.49, 1.18	0.2	0.34	0.13, 0.89	0.028	0.91	0.60, 1.37	0.6	0.41	0.25, 0.67	<0.001
Other (American Indian/AK Native, Asian/Pacific Islander)	0.74	0.48, 1.13	0.2	0.63	0.34, 1.17	0.15	0.67	0.45, 1.00	0.049	0.8	0.54, 1.19	0.3
Income >\$70,000 vs. ≤\$70,000	0.95	0.73, 1.22	0.7	0.88	0.59, 1.33	0.5	0.89	0.70, 1.14	0.4	1.09	0.85, 1.40	0.5
Rural vs. Urban Residence	0.75	0.50, 1.11	0.2	0.47	0.22, 1.02	0.056	0.97	0.68, 1.40	0.9	0.96	0.66, 1.40	0.8
Unpartnered vs. Partnered	1.24	0.97, 1.60	0.086	0.45	0.30, 0.68	<0.001	0.88	0.69, 1.11	0.3	0.96	0.75, 1.23	0.8
Stage (ref: Localized)												
Distant	0.47	0.35, 0.62	<0.001	0.38	0.23, 0.62	<0.001	0.25	0.19, 0.33	<0.001	0.65	0.49, 0.86	0.003
Regional	0.52	0.36, 0.75	<0.001	0.45	0.25, 0.82	0.008	0.71	0.52, 0.97	0.031	1.14	0.83, 1.57	0.4
Unknown + Blank	5.36	3.43, 8.37	<0.001	1.47	0.73, 2.95	0.3	2.37	1.51, 3.72	<0.001	0.48	0.25, 0.94	0.031
Histology Group (ref: DLBCL)												
Follicular	6.27	4.10, 9.59	<0.001	1.32	0.65, 2.67	0.4	4.04	2.69, 6.05	<0.001	0.81	0.49, 1.33	0.4
Hodgkin's lymphoma+Other	2.01	1.39, 2.91	<0.001	0.48	0.22, 1.06	0.068	1.37	0.98, 1.93	0.067	1.25	0.91, 1.72	0.2
Mantle Cell	1.58	1.07, 2.31	0.02	0.46	0.21, 1.04	0.061	0.57	0.37, 0.86	0.007	0.49	0.33, 0.71	<0.001
Marginal zone lymphoma	8.63	5.75, 13.0	<0.001	3.6	2.09, 6.17	<0.001	5.34	3.63, 7.84	<0.001	0.35	0.19, 0.65	<0.001
Non-Hodgkin's lymphoma	2.89	1.76, 4.74	<0.001	1.24	0.58, 2.65	0.6	1.43	0.88, 2.34	0.2	0.7	0.41, 1.20	0.2
Lymphoma Location (ref: Proximal Colon)												
Distal Colon	0.81	0.59, 1.13	0.2	0.7	0.39, 1.26	0.2	0.51	0.38, 0.70	<0.001	0.48	0.34, 0.67	<0.001
Rectum	0.58	0.41, 0.83	0.003	2.64	1.68, 4.17	<0.001	0.3	0.21, 0.42	<0.001	0.21	0.13, 0.32	<0.001
Other	1.09	0.80, 1.49	0.6	0.49	0.24, 1.01	0.055	0.57	0.41, 0.77	<0.001	0.45	0.33, 0.62	<0.001

Primary colonic lymphoma (PCL), odds Ratio (OR), confidence Interval (CI), diffuse large B-cell lymphoma (DLBCL), bold indicates significant P-value <0.05.

Breakout Session II: Non-Oncologic Clinical Talks | Abstract | Clinical Research

Delineating the Sexual Dimorphism in Mid-Facial Bony Anatomy Using Advanced 3D Imaging Techniques

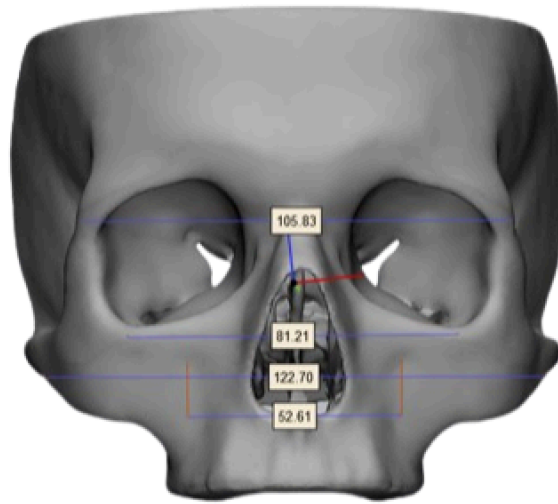
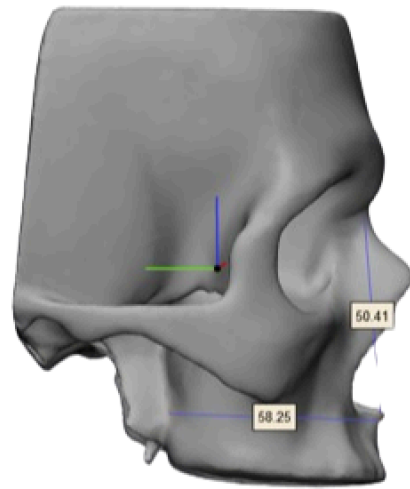
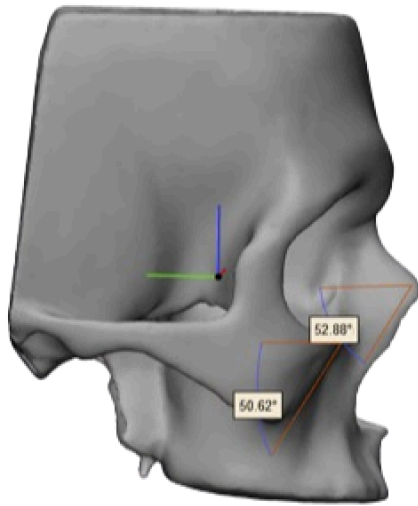
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Introduction: Facial shape is significantly influenced by the contours of the underlying facial bony skeleton. Gender dimorphisms in facial skeletal anatomy are of particular interest to facial plastic surgeons for planning craniofacial and aesthetic surgery. While the orbits and upper face have been previously investigated, dimorphic differences in the mid-face skeleton are not well understood. This study aims to elucidate the morphological differences in the midface region, focusing on the maxilla and zygomatic bones in male and female subjects through the analysis of high-resolution facial computed tomography (CT).

Methods: A retrospective review of facial CT scans in our institution's patient database was conducted. Data were extracted for 100 white patients aged between 20 and 79 years. Inclusion criteria were limited to scans with a resolution of 1 mm or finer. Scans indicating a history of facial trauma, tumors, orthognathic surgery, or orthodontic interventions were excluded. Segmentation and 3D volumetric reconstruction were performed using Materialise Mimics (version 25.0, Materialise NV, Belgium). Reformatted 3D CTs were transferred to 3-Matics software and manual measurements of the mid-facial skeleton, specifically the maxillary and zygomatic bones were performed. Measurements included bizygomatic width distance (Measured between the most lateral points on the zygomatic bones), frontozygomatic sutures distance, orbitale distance, infraorbital foramen distance, vertical distance (from the nasal spine to the posterior border of the nasion), depth (from the nasal spine to the posterior border of the maxilla), pyriform angle, and maxillary angle (Figure 1). Relevant demographic information was summarized as mean (standard deviation, SD) and analyzed using unpaired Student's t-tests or Wilcoxon signed-rank tests, with a 95% confidence interval, contingent upon the normality of population-level distribution

Results: Out of total 100 patients, 46 were females and 52 were males. Patients were subdivided based on age into three groups; young (20-39 years), middle-aged (40-59 years) and elderly (60-79 years) with a mean age of 51 years in females and 50 years in males. Statistical analysis showed significant differences all the measured aspects of the mid-facial region between males and females, except for the maxillary angle, where the difference was not significant (P value > 0.05). The average measurements where women differed from men included the bizygomatic width by -6.8 mm, the frontozygomatic suture by -5.5 mm, the orbital distance by -3.3 mm, and the vertical distance by -4.2 mm, all with a P value of less than 0.01. The distance of the infraorbital foramen differed by -2.2 mm (P value 0.05), the facial depth by -1.7 mm (P value 0.015), and the pyriform angle by 3.01 mm (P value 0.045). Notably, when evaluating differences within subdivided age groups, the pyriform angle was the only measurement to show a statistically significant difference (P = 0.012).

Conclusion: Our analysis of mid-facial skeletal anatomy utilizing 3D imaging techniques has revealed significant sexual dimorphism. Measured parameters including zygion distance, frontozygomatic sutures distance, orbitale distance, and vertical distance showed significant differences (p-values less than 0.01).



Breakout Session II: Non-Oncologic Clinical Talks | Abstract | Clinical Research
The Analysis of the Readability of Extracorporeal Membrane Oxygenation (ECMO) Patient Education Materials from ELSO Platinum Level Centers of Excellence and Top Web Search Results

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Introduction: Patients with lower levels of health literacy tend to have worse health outcomes. The NIH recommends education material be written at a 6th to 7th grade reading level. Few studies have investigated the readability level of ECMO educational materials.

Methods: ECMO educational material published by ELSO’s platinum centers of excellence in the US were included in the study. Each educational material was analyzed for content related to the function, indication, complications, weaning, and support of someone on ECMO. These topics were also used in a Google™ search and the top 20 results were analyzed for their level of readability. Readability was measured using the Measure of Gobbledygook Readability Formula (SMOG), Coleman–Liau index, and Flesch–Kincaid grade level (FKGL). Data was analyzed using descriptive statistics.

Results: There were 21 out of the 29 (72%) platinum centers of excellence in the United States that had educational material for ECMO. The average reading level for the ECMO educational material from the platinum centers was 8.54 for SMOG, 11.38 for Coleman-Liau, and 9.44 for FKGL. The average reading level for the ECMO educational material from the internet search results was 9.11 for SMOG, 10.92 for Coleman-Liau, and 9.77 for FKGL. The platinum centers had significantly lower reading levels ($p < 0.03$) when describing complications of ECMO compared to the internet search results.

Conclusion: ECMO education material published by platinum centers of excellence and the top 20 internet search results have readability levels above the NIH’s recommendation.

	SMOG		Coleman-Liau Index		Flesch-Kincaid		Mean of All Algorithms	
	Mean	p-value	Mean	p-value	Mean	p-value	Mean	p-value
Overall Information		0.39		0.51		0.70		0.89
Platinum ELSO (n=21)	8.54		11.38		9.44		9.79	
Internet	9.11		10.92		9.77		10.89	
How ECMO Works		0.74		0.65		0.87		0.91
Platinum ELSO (n=19)	8.50		10.05		9.79		9.45	
Internet	8.77		9.74		9.62		9.38	
Indications for ECMO		0.88		0.02		0.13		0.48
Platinum ELSO (n=20)	7.71		13.02		10.30		10.34	
Internet	7.83		10.50		8.64		8.99	
Complications of ECMO		0.04		0.04		0.04		0.03
Platinum ELSO (n=7)	5.34		7.81		5.07		6.07	
Internet	8.56		10.65		9.29		9.5	
Prognosis & Weaning		0.23		0.36		0.22		0.08
Platinum ELSO (n=10)	7.44		9.02		8.38		8.28	
Internet	8.93		9.98		10.27		9.73	
Family Support & Perspective		0.47		0.71		0.56		0.19
Platinum ELSO (n=11)	7.81		8.90		7.95		8.22	
Internet	8.53		9.34		8.75		8.87	

Bold denotes statistical significance, with $p < 0.05$
 A total of *** ELSO Platinum Centers provided no information.

Breakout Session II: Non-Oncologic Clinical Talks | Abstract | Clinical Research
Risk factors for postoperative venous thromboembolism after bariatric surgery: A comprehensive analysis from the national MBSAQIP data registry

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Introduction: Deep vein thrombosis (DVT) and pulmonary embolus (PE) account for significant morbidity and mortality after bariatric surgery. This analysis comprehensively investigated risk factors for 30-day venous thromboembolism (VTE).

Methods: MBSAQIP individual datasets from 2015-2022 were aggregated. Patient demographics, comorbidities, perioperative factors, and 30-day complication outcomes were used as covariates to identify risk factors for postoperative VTE after primary, minimally-invasive gastric bypass or sleeve gastrectomy. The data was split into 20-80 training-test sets and a multivariable regression model was used to determine factors for 30-day postoperative VTE. Python 3.12 and appropriate libraries were used.

Results: A cohort of 1,166,716 patients without prior VTE history was identified. Comprehensive 30-day complication rates in the cohort were summarized (Table 1). Patients with 30-day VTE (n=3,125; 0.27%) were older (P<0.001), of higher BMI (P<0.001), and were more commonly male (P< 0.001). Patients with 30-day VTE had higher rates of gastroesophageal reflux disease (GERD; P<0.001), dialysis dependence (P<0.001), chronic steroid use (P<0.001), venous stasis (P<0.001), sleep apnea (P<0.001), and hypoalbuminemia (P<0.001). Upon multivariable analysis, factors associated (P<0.05) with increased risk of 30-day VTE were black race (odds ratio 1.3; 95% confidence interval [1.2-1.3]), operation length (1.2 [1.1-1.2]), male gender (1.2 [1.1-1.2]), more recent year (temporal analysis; 1.1 [1.04-1.1]), advanced age (1.07 [1.02-1.1]), GERD (1.06 [1.02-1.1]) and sleeve gastrectomy (ref: gastric bypass; 1.06 [1.006-1.1]). Notably, IVC filters (1.03 [0.997-1.05]) and preoperative anticoagulation (1.02; [0.999-1.1]) were not associated with postoperative VTE (P>0.05), while diabetes (0.9 [0.9-0.96]) and hypertension (0.95 [0.9-0.992]) were protective (P<0.05).

Conclusion: Among other factors, black race, male gender, and prolonged operative times conferred increased risk of postoperative VTE after primary sleeve gastrectomy and gastric bypass. These data may help inform the bariatrician and patient about postoperative thromboembolism risk, and posit mitigation strategies such as prophylactic enoxaparin, as appropriate.

Key 30-Day Postoperative Complication	Prevalence (total n=1,166,716)
Mortality	807 (0.07%)
Acute Renal Failure	621 (0.05%)
Urinary Tract Infection	1202 (0.1%)
Unplanned Intubation	3938 (0.34%)
Pneumonia	1956 (0.17%)
Superficial Surgical Site Infection	4236 (0.36%)
Deep Surgical Site Infection	569 (0.05%)
Organ Space Surgical Site Infection/Staple Line Leak	2656 (0.23%)
Sepsis	1145 (0.1%)
Transfusion Requirement	7388 (0.63%)
Reoperation	12450 (1.1%)
Readmission	37911 (3.3%)
DVT	2134 (0.18%)
PE	1198 (0.10%)
VTE (DVT or PE)	3125 (0.27%)

Breakout Session II: Non-Oncologic Clinical Talks | Abstract | Clinical Research

Optimizing Readability and Clarity of Plastic Surgery Education Materials through AI: A ChatGPT Intervention Study

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Introduction:

Health literacy is an independent predictor of population health status and treatment outcomes and is directly related to the readability of available patient education materials (PEMs). The National Institutes of Health (NIH) and the American Medical Association (AMA) have recommended that PEMs be written at a level lower than the 8th-grade education level. Our Objective is to assess the readability of online PEMs about the most common plastic surgery procedures published by several academic institutions across the US. We then evaluated the utility of ChatGPT (OpenAI Inc., San Francisco, CA) to improve the readability while maintaining the comprehensibility of those materials.

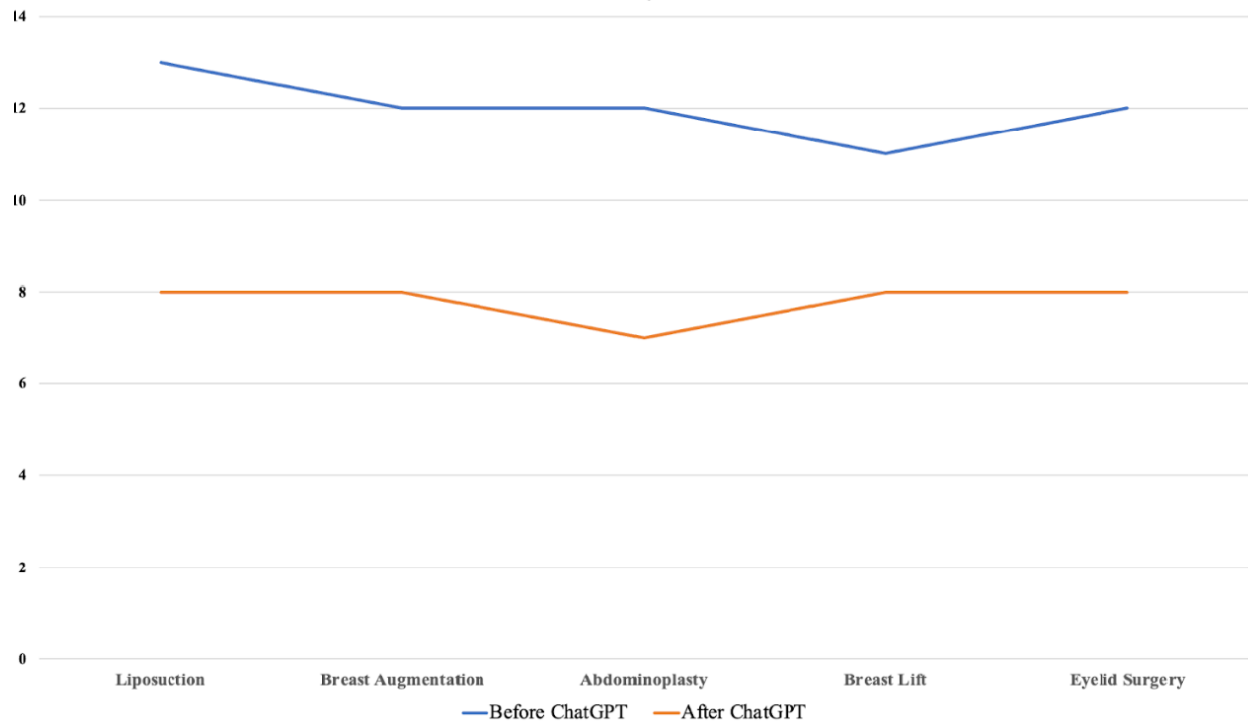
Methods: Online PEMs regarding five common plastic surgery procedures (according to the American Society of Plastic Surgeons), including liposuction, breast augmentation, abdominoplasty, breast lift, and eyelid surgery, were collected from the websites of 20 top institutions in plastic surgery (according to the Plastic Surgery Research Council). The materials were assessed using six readability scales. ChatGPT was then used for the same original texts to create improved and lower readability scores within the recommended NIH/AMA range. Grammarly (Grammarly Inc., San Francisco, CA) was used to assess the comprehensibility of the text before and after the use of ChatGPT. Statistical analysis for both results was performed using SPSS 28.0 (IBM Inc., Armonk, NY).

Results: None of the PEMs were written at or below the AMA/NIH's recommended reading level. The average educational level required to comprehend the texts across all institutions, as assessed by the readability scales, was at the 12th-grade level, with no significant difference between institutions. Some materials required a college-level education or higher. The level of comprehensibility of the text was 84.8 out of 100. After using ChatGPT, the average readability grade improved to the 7th-8th grade level, with a mean difference of 4.2 compared to the original text ($p < 0.001$) (Figure 1). The level of comprehensibility also significantly improved to 87.6 ($p < 0.001$).

Conclusion: Online PEMs help improve healthcare utilization, preventative care, patient-physician communication, and patient satisfaction. However, current materials related to plastic surgery procedures are not written at or below the AMA/NIH's recommended education level, which could impact the utility of those PEMs for the general public. ChatGPT is an innovative AI tool that is increasingly utilized in healthcare. In this study, we showed that the utility of AI can help improve the readability of PEMs while also enhancing the comprehensibility of the materials.

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Readability Level



Trauma Paper Competition | Abstract | Clinical Research

Renal Dysfunction in Acute Compartment Syndrome

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Introduction: Acute kidney injury (AKI) is a common comorbidity associated with trauma, and is independently associated with poor outcomes and increased mortality rates. Renal damage due to compartment syndrome has been observed in cases of “found down”, or atraumatic compartment syndrome. No literature to date describes the relationship between acute compartment syndrome (ACS) resulting from trauma, and its association with renal dysfunction. The purpose of this study is to evaluate the incidence of AKI in cases of ACS.

Methods: A retrospective review of all patients treated at a level-1 trauma center for acute fasciotomy of the lower leg, from 2010 to 2022, was conducted. Patient demographics, clinical characteristics, operative details, laboratory values and renal complications were recorded. The primary outcome was diagnosis of AKI during hospitalization.

Results: The final study population consisted of 54 patients with acute tibial fractures and acute compartment syndrome treated with lower leg fasciotomies. The mean age of the entire cohort was 42 (18-77), and 74% were male. The most common mechanism for index injury was motor vehicle crash (39%). The average number of surgical procedures was 3.7 and twelve patients required intubation at some point during their care. Four patients were diagnosed with AKI during their hospitalization. Three of the four patients had an AKI diagnosed post fasciotomy. The average age of the patients with an AKI was 56.5 compared to 41.4 in the non-AKI group; this difference was statistically significant ($p=0.03$). Dialysis was necessary in one patient, but renal dysfunction was most likely a result of massive polytrauma, which was diagnosed prior to fasciotomy; this patient later expired. In the remaining three patients, their renal injury was resolved prior to discharge.

Conclusion: Acute compartment syndrome of the lower leg treated with fasciotomy occurred in 54 patients. Acute kidney injury was observed in four patients (7%). The rate of AKI (7%) is in line with similar studies in trauma and orthopaedic surgery patients (7-20%). There does not appear to be an increase in renal dysfunction in the setting of acute compartment syndrome treated with fasciotomy in patients with tibial fracture.

Long Pre-Hospital Times In A Rural Trauma System and Their Association with Outcomes In Traumatic Brain Injury

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Introduction: Traumatic brain injury (TBI) leads to significant mortality and morbidity and outcomes are worse when timely access to trauma care is lacking. Trauma dogma has long held that the “golden hour” to arrival for definitive care is imperative in quality trauma care. However, in rural settings, this goal is often unattainable due to low density population, and long distances to trauma centers. As most research is done at large urban trauma centers, real-world data evaluating pre-hospital times in rural trauma is lacking.

Methods: We performed a retrospective review of all TBIs admitted to the only level 1 trauma center (TC) serving a large rural catchment area in the northern Midwest US. Pre-hospital times, patient demographics and injury factors were compared based on TBI outcomes, using Mann-Whitney U tests for non-parametric continuous variables and Chi Square tests for categorical variables. P values < 0.05 were considered significant. A “good outcome” was defined by Glasgow Outcome Scores of good recovery or mild disability but who were able to be mostly independent. Odd ratios (OR) and 95% Confidence Intervals (95% CI) were calculated to assess for factors associated with timely arrival (within 60 minutes) to the TC.

Results: 1107 patients with TBI were admitted and had pre-hospital data available. Demographics and injury data are presented in table 1. Only 31% of TBI patients arrived at the trauma center within 60 minutes of emergency medical service (EMS) notification. Good outcomes were associated with a shorter time to arrival at the TC and were more likely to be brought to the TC direct from scene. There was no significant association between outcome and rural injury, however rural injuries did have significantly longer time to arrival to the TC than urban injuries (149 versus 64 minutes respectively; $p < 0.001$). There was a significantly lower likelihood of timely arrival to the TC for rural injuries (OR 0.3 [95% CI 0.2-0.4]), transfer patients (OR 0.005 [95% CI 0.001-0.01]), and nighttime admissions (OR 0.6 [95% CI:0.5-.8]). Good outcomes were more likely for those that arrived within 60 minutes (OR 1.3 [95% CI: 1.03-1.7]).

Conclusion: Conclusion: Pre-hospital times in our trauma system are long, and shorter times were associated with better outcomes. In this study of a large rural catchment area, the “golden hour” of arrival time is infrequently achieved, with worse arrival times in the rural population. Further work defining the factors limiting timely pre-hospital care is warranted to strategize ways to circumnavigate this barrier for rural trauma patients.

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	All TBI Patients N = 1107	Good Outcome n = 578	Bad Outcome N = 529	P value
Age median (Range)	59 (39-75)	49 (18-98)	69 (18-103)	<0.001
Male Sex n (%)	723 (66)	391 (68)	332 (63)	0.09
Race				0.02
White	1002 (90)	509 (88)	485 (92)	
Black	19 (2)	12 (2)	6 (1)	
Native American/Indian	73 (7)	47 (8)	26 (5)	
Asian	2 (0.2)	0 (0)	2 (0.4)	
Hispanic	4 (0.4)	4 (0.7)	0 (0)	
Not disclosed	16 (1)	6 (1)	10 (2)	
Rural Injury n (%)	655 (60)	340 (59)	315 (60)	0.81
Severe Head Injury (AIS \geq3) n (%)	538 (49)	164 (28)	374 (71)	<0.001
Time from EMS Notification to Level 1 TC Arrival (minutes)	110 (50-237)	99 (48-243)	126 (54-236)	0.04
Patient Brought Direct from Scene to Level 1 TC n (%)	316 (55)	350 (61)	263 (50)	<0.001

Trauma Paper Competition | Abstract | Clinical Research

Emergency Medical Services Level of Training Affects Mortality in High-Risk Trauma Patients: A Combined Prehospital and In-Hospital Database Analysis

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Introduction: There is conflicting evidence regarding prehospital provider level of training and outcomes in trauma. Paradoxically, most studies show no survival benefit or increased mortality in trauma patients transported by advanced life support (ALS) providers. We hypothesized that basic life support (BLS) provider transport is associated with higher mortality compared to ALS transport for high-risk patients.

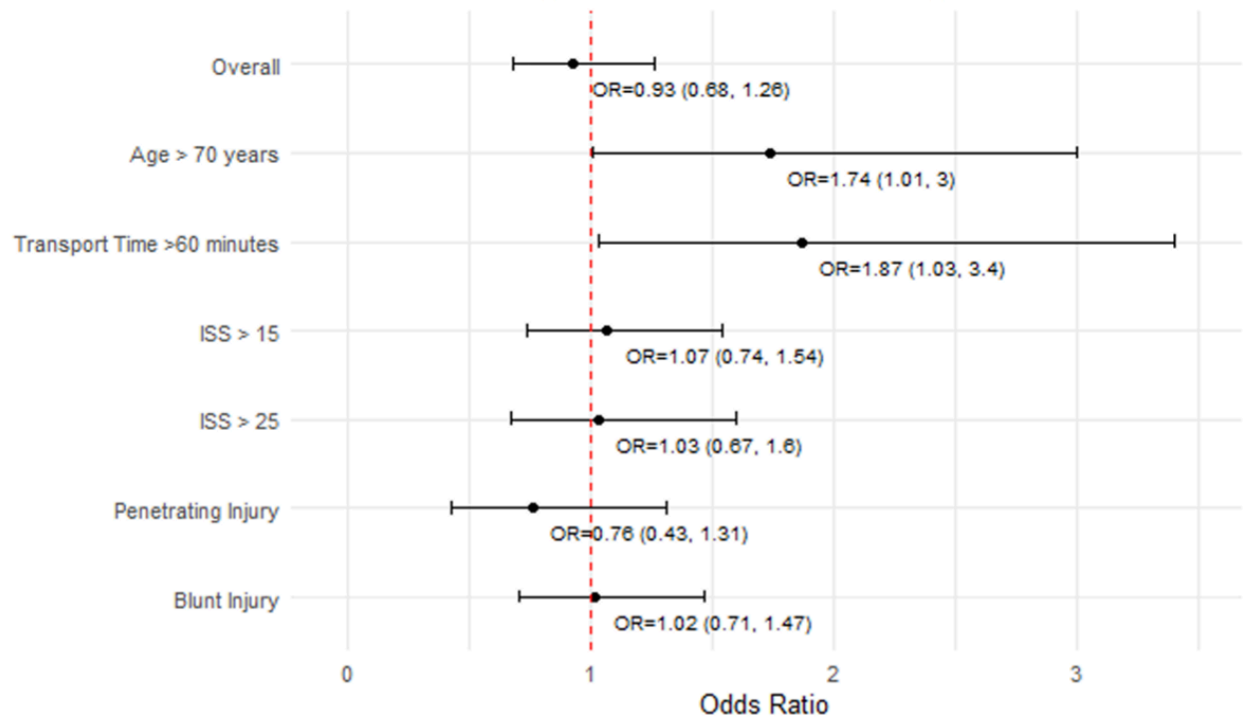
Methods: We performed secondary analysis of a combined prehospital and in-hospital database of trauma patients utilizing ESO® electronic medical records from 2018 to 2022. We included encounters with trauma-specific International Classification of Diseases, Tenth Revision (ICD-10-CM) codes, patients aged 15-100 years, transported by ground to a level 1 or 2 trauma center. We excluded patients dead upon EMS arrival and transfers. The primary outcome was composite pre-hospital and in-hospital mortality. The exposure was EMS level of training. We included age, ICD-10 based injury severity score (ISS), blunt versus penetrating mechanism, transport time, race, gender, and year for risk adjustment given previous literature describing their status as confounding variables. We conducted a complete case multivariable logistic regression with subgroup analyses on populations we hypothesized to be high risk. Model discrimination and calibration were assessed via the C statistic and hosmer-lemeshow goodness of fit.

Results: We identified 30,738 ALS and 1,758 BLS encounters. We did not observe a significant association between EMS level of training and mortality (OR 0.93, $p = 0.63$, 95% CI 0.68-1.26, c-stat 0.85). Subgroup analyses identified a significant association between BLS transport and mortality for age > 70 years (odds ratio 1.74, $p = 0.047$, 95% CI 1.01-3.00, c-stat 0.83) and transport time > 60 minutes (odds ratio 1.87, $p = 0.04$, 95% CI 1.03-3.40, c-stat 0.85). There was no significant association between EMS level of training and mortality in subgroup analyses of ISS > 15, ISS > 25, blunt or penetrating mechanism of injury.

Conclusion: In this national sample, we did not identify an independent association between EMS provider level of training and mortality among trauma patients for all comers, however BLS level of training was associated with increased mortality in elderly patients and those with prolonged transport times. This may have implications for policy decisions regarding EMS provider training and trauma system strategies for responding EMS units.

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Odds Ratio Plot of Regression Models for Subsets of High Risk Trauma Patients



VTE TRAUMA PATIENTS HAVE GREATER VWF A1 EXPOSURE WITHIN 12 HOURS OF INJURY COMPARED TO NON-VTE PATIENTS

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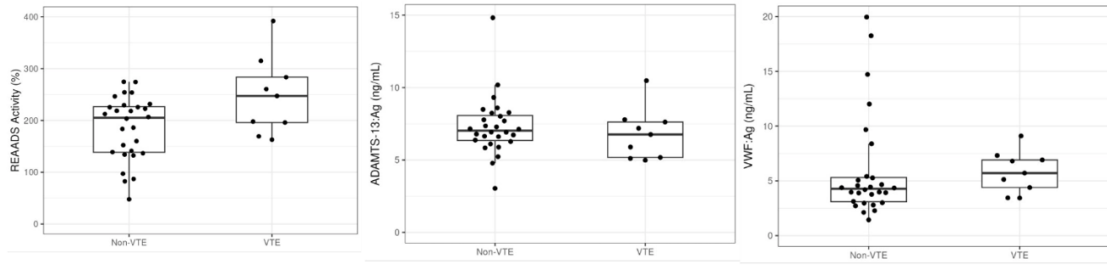
Introduction: Von Willebrand factor (VWF) is an acute phase reactant synthesized in the megakaryocytes and endothelial cells. VWF forms ultra-large multimers (ULVWF) which are cleaved by the metalloprotease ADAMTS-13, preventing spontaneous VWF-platelet interaction. After trauma, ULVWF is released into circulation as part of the acute phase reaction. We aimed to characterize the effects of trauma on A1 domain exposure of VWF after trauma and assess linkage to VTE. We hypothesized that trauma patients would have increased levels of VWF and decreased levels of ADAMTS-13, linking increased A1 related activity related to the pathogenesis of venous thromboembolism (VTE) in trauma.

Methods: Patients presenting to a Level I Trauma Center Emergency Department (ED) as trauma activations, with samples collected within 12 hours of time of injury, were included in this prospective pilot study. We assessed plasma concentrations of VWF and ADAMTS-13 antigen, and conducted Rapid Enzyme Assays for Autoimmune Diseases (REAADS) activity of VWF, which measures the exposure of the platelet-binding A1 domain, in 37 trauma patients. Data are presented as median [IQR] or n (%), and Kruskal-Wallis or Fisher's exact tests were performed between trauma patients who developed symptomatic VTE vs those who did not develop VTE within 90 days, confirmed either by imaging or at autopsy during inpatient stay or post-discharge.

Results: A total of 37 trauma patient samples were analyzed (50.7 years [31.8, 64.6], 62.2% male, 97% blunt, ISS 17 [12, 25]): 9 pts with VTE to 28 with non-VTE. VTE patients had a median time to VTE of 150 days, with 1 developing deep venous thrombosis (DVT), 4 with pulmonary embolism (PE), and 4 with DVT/PEs. No differences were found in age (42.5 [31.8, 55.9]; 51.5 [35.6, 65.0]; $p=0.92$), gender (66.7%, 60.7%, $p=1.00$), Body Mass Index (BMI) (31.3 [29.0,33.0]; 27.5 [23.1,30.9]; $p=0.051$), or surgery within 24 hours. (77.8%, 39.3%, $p=0.062$). ISS was noted to be significantly greater in VTE patients (33.0 [19.0,38.0], 14.0 [10.0,22.0], $p=0.003$). REAADS activity in trauma patients who developed VTE was significantly greater as compared to those who did not (247.2 [195.9, 283.4], 205.0 [138.2, 226.6], $p=0.047$); whereas ADAMTS13 antigen levels and VWF antigen levels were not significantly different between the VTE and non-VTE patients (6.76 [5.17, 7.62], 7.02, [6.35, 8.07], $p=0.42$) and (5.71 [4.39, 6.91], 4.28 [3.09, 5.31]; $p=0.19$), Figure 1.

Conclusion: These findings suggest that A1 exposure in VWF may contribute to the development of VTE observed after traumatic injury; this needs to be further investigated as an early biomarker predictive of VTE.

Figure 1: Box-plot comparison of REAADS, ADAMTS-13 Ag, VWF Ag Levels between VTE and non-VTE patients



Clinical Talks | Abstract | Clinical Research

Current Status of Adrenalectomy in the USA

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Introduction: More than 90 million CT scans are performed in the USA annually, increasing the potential to detect incidentally identified adrenal masses. Increased awareness of the subclinical function of adrenal masses and the recognition that primary aldosteronism is the leading cause of secondary hypertension (affecting 10% of all patients with hypertension) both contribute to a higher number of cases warranting adrenal surgery. Additionally, cost and quality initiatives drive outpatient adrenalectomies for a variety of surgical indications and demographics. Despite these practices, there remain significant gaps in our understanding of the current trends and indications for adrenalectomy. The National Inpatient Sample (NIS), the largest publicly available all-payer inpatient healthcare database, and the Nationwide Ambulatory Surgery Sample (NASS), the only all-payer ambulatory surgery database in the USA, were jointly utilized to yield national estimates for selected surgery encounters performed in hospital-owned facilities.

Methods: We analyzed hospital record data from the NIS and NASS from 2016-2020 to evaluate functional indications, age at resection, laterality (if available), and malignant status at the time of adrenalectomy. We estimated utilization and trends in both inpatient and outpatient populations over the specified period. Surgical procedures were determined using the International Classification of Diseases, Tenth Revision, Procedure Coding System (ICD-10-PCS) for NIS and current procedural terminology for the NASS. For both data sets the (ICD-10) Clinical Modification (cm) was used to determine the indications for surgery using up to 15 codes. We excluded patients undergoing an adrenalectomy as part of a nephrectomy either due to cancer or donor nephrectomy, a larger retroperitoneal procedure such as pancreatectomy, and adrenal biopsies or ablative procedures. Statistical analysis was performed using Stata 18 to account for the complex survey design of the NIS and control for changes in the data structure due to the four-year timeframe.

Results: Between 2016 and 2020 the estimated population for inpatient adrenalectomies was 42,610, with 7,955 records in 2016 and a peak of 9,530 records in 2019 ($p < 0.0001$). The mean age was 58 years (CI 52.7-54.9) with 53.8% female. The estimated population for outpatient encounters increased from 1,048 to 1,624 ($p < 0.0001$) with a total of 6,886 adrenalectomies, despite an overall reduction in encounters for the population in 2020 due to the pandemic. The mean age was 51.1 (CI 50.6-51.8) years. Table 1 depicts diagnoses associated with inpatient adrenalectomies across age groups. Meaningful differences in functional diagnoses and benign status were observed across age groups. There was no difference in laterality.

Conclusion: Surgical adrenal disease varies over the lifespan. Outpatient adrenalectomy, unheard of in the past, is now a rapidly growing option for selected patients.

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Table 1: Inpatient Adrenalectomy Population Estimates (2016-2020)

Inpatient Variables N (%)	Age Group						P value
	0-4 N=290	5-20 N=227	21-39 N=881	40-59 N=2979	60-79 N=3801	≥80 N=397	
Female	131 (45)	117 (52)	572 (65)	1637 (55)	1927 (51)	198 (50)	<0.001
Laterality							
Left Side	157 (54)	120 (53)	482 (55)	1637 (56)	2212 (58)	229 (58)	0.16
Right Side	130 (45)	97 (43)	367 (42)	1246 (43)	1549 (41)	166 (42)	0.61
Bilateral	<11	13 (6)	38 (4)	59 (2)	45 (1)	<11	<0.001
Indication							
Benign	11 (4)	73 (32)	438 (50)	1271 (43)	1220 (32)	59 (15)	<0.001
Aldosteronoma	<11	<11	59 (7)	168 (6)	103 (3)	<11	<0.001
Cushing's	<11	<11	68 (8)	187 (6)	160 (4)	<11	<0.001
Pheochromocytoma	<11	<11	<11	19 (1)	24 (1)	39 (1)	0.47
Uncertain Behavior	<11	<11	32 (4)	102 (3)	86 (2)	<11	<0.001
Surgical Approach							
Open	157 (54)	91 (40)	183 (21)	520 (18)	681 (18)	75 (19)	<0.001
Laparoscopic	63 (22)	99 (44)	593 (67)	2123 (73)	2748 (72)	290 (73)	<0.001

A Comprehensive Analysis Of The Influence of the Robotic Platform On 30-Day Readmission And Reoperation After Primary Bariatric Surgery

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Introduction: The robotic platform is rapidly becoming a commonplace tool for bariatric surgery. We aim to determine whether the robotic platform confers improvements in key consequential bariatric outcome measures- 30 day readmission and reoperation, in particular.

Methods: Considering eight years of MBSAQIP national data, 1,138,626 included patients who underwent primary Roux-en-Y gastric bypass (RYGB) or sleeve gastrectomy (SG) via multi-port laparoscopic or robotic approach were identified. Demographics, comorbidities, patient factors and outcomes were compared between the RYGB and SG cohorts using unpaired t-tests or chi-squared tests, as appropriate. Python was used to run univariate and subsequent multivariate logistic regression models to determine risk factors for 30-day readmission and reoperation, to elucidate the risk profile of robotic surgery.

Results: RYGB patients were older, female, of higher BMI (45.8 vs. 45.0 kg/m²; P<0.001), and with more comorbidities. Robotic surgery was more common in RYGB relative to SG (16.3% vs. 15.9%; P<0.001). RYGB patients demonstrated a 30-day readmission and reoperation rate approximately double that of SG patients. SG (relative to RYGB; P<0.001, odds ratio 0.790 [0.781-0.800]) and robotic platform (relative to laparoscopic; P<0.001, odds ratio 0.988 [0.977-0.996]) had a lower adjusted risk (protective effect) of 30-day readmission (n=910,900; R²=0.02, AUC=0.63); additionally, SG (P<0.001, odds ratio 0.703 [0.688-0.719]) and robotic platform (P<0.001, odds ratio 0.969 [0.948-0.990]) had a lower adjusted risk (protective effect) of 30-day reoperation, upon multivariate analysis (n=860,402; R²=0.03, AUROC=0.67).

Conclusion: Buoyed by improvements in safety and technology, robotic surgery may offer improved safety outcomes after bariatric surgery, with ostensible temporal improvement.

Clinical Talks | Abstract | Clinical Research

The Use of Palliative Care Consultations During ECMO

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Introduction: Palliative care can help alleviate the suffering of a person and their loved ones as they face a serious, life-threatening disease. Extracorporeal membrane oxygenation (ECMO) supports patients who have severe cardiac or respiratory failure, however, there is a mortality rate of roughly 50% associated with ECMO use. A previous study found that only 19% of patients supported by ECMO received a palliative care consultation. Therefore, additional investigations into how palliative care is used in ECMO patients is needed.

Methods: A retrospective, observational cohort study was performed. Patients supported by VV-ECMO at four ECMO centers of excellence in MN were included in the study. Variables associated with palliative care consults were collected in REDCap and descriptive statistics were performed.

Results: A total of 346 individuals were included in the analysis. The average age of patients on admission was 45.7 (SD \pm 13.1) years old and 66.5% were male. The majority of patients were white at 61.6%, 17.6% were Black/African American, and 6.6% were Asian. A total of 218 of patients had a palliative care consultation during their admission. A total of 202 (58.9%) of patients had a palliative consult during ECMO run. The average number of palliative care consults per VV-ECMO run was 4.11 (SD \pm 3.77). A total of 113 (33.1%) of individuals had a code-status change during the VV-ECMO run. There were a total of 22 (6.6%) ethics consults and 155 individuals (46.8%) had a care conference.

Conclusion: A majority of patients supported by ECMO received a palliative care consultation during their time on ECMO.

Outcomes of Patients with Renal Cell Carcinoma in The Modern Era of Immunotherapy

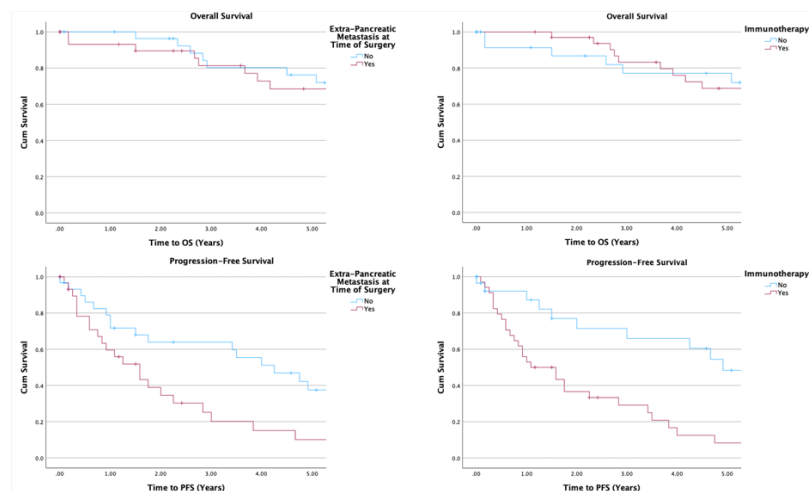
A Sultan, J Cisneros, B Costello, S Boorjian, V Sharma, B Leibovich, M Truty, C Thiels
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Introduction: Metastatic Renal Cell Carcinoma (RCC) to the pancreas is a rare indication for pancreatectomy. The management of metastatic RCC has evolved considerably as a result of the use of immunotherapies with checkpoint inhibitors but the indication for, and outcomes of, pancreatectomy for RCC in the modern era are unknown.

Methods: Patients diagnosed with metastatic RCC to the pancreas who underwent surgery at Mayo Clinic between 2011 and 2022 were retrospectively identified. Demographics, tumor characteristics, and data on medical and surgical treatments were abstracted from the medical record. Patients were categorized based on the metastatic presentation at the time of surgery (isolated pancreatic metastasis vs. pancreatic and extra-pancreatic metastasis) and use of immunotherapy (including targeted therapies) at any timepoint during their disease course. Descriptive analysis was conducted using chi-square tests, Mann Whitney U test and independent t-tests as appropriate. Kaplan Meier with log-rank tests was used to assess for overall survival (OS) and progression free survival (PFS).

Results: Sixty-two patients were included with median age 66 [IQR 61-70] years, of which 22 (35.5%) were females. The median interval from nephrectomy to metastasectomy was 108 [36-174] months. The most common tumor location was body/tail (41.9%) with rest being head/neck (34.8%) or multiple tumors (24.2%). Mean tumor size was 3.09 ± 2.04 cm. The one-, three-, and five-year OS and PFS from date of surgery in all patients was 92%, 80%, and 70%, and 65%, 43%, and 24% respectively. Median length of follow-up was 64 [27.75-95.25] months. Fifty percent (n=31) of patients had extra-pancreatic metastasis at time of presentation. When compared to those without extra-pancreatic metastasis there was no difference in age, sex, tumor size, or location (all $p > 0.05$). Overall and progression free survival is shown in Figure 1. Half of patient (n=34, 54.8%) received immunotherapy during their course of disease. When compared to those who did not receive immunotherapy there was no difference in age, sex, tumor size, or location (all $p > 0.05$).

Conclusion: Pancreatectomy continues to be performed for metastatic RCC in the modern era. This data suggests that oncologic outcomes for patients appears acceptable, although recurrence rates remain high.



The Genetic Evaluation Of Small Intestinal Adenocarcinoma: A Case Report and Proposed Mechanism

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Introduction: Small intestinal adenocarcinomas are rare malignancies that account for a tiny fraction of gastrointestinal tumors. Despite their infrequency, they present significant diagnostic and therapeutic challenges due to nonspecific clinical manifestations. Early detection is often difficult, leading to delayed diagnosis and treatment. This report examines a case of small intestinal adenocarcinoma in a patient with a history of intra-abdominal sarcoma and previous radiation therapy, highlighting aspects of diagnosis, management, and genetic testing in the patient's treatment strategy.

Summary: A 33-year-old man with a history of intra-abdominal sarcoma treated at age 8 presented with obstructive symptoms. A CT scan demonstrated gastric and bowel distension and a potential mass. Non-operative therapy failed, leading to surgical interventions which eventually identified small intestinal adenocarcinoma. Genetic testing revealed MMR protein deficiency. The patient received capecitabine as postoperative chemotherapy. The patient has shown no evidence of recurrence at three years follow-up.

Case Description: A 33-year-old man presented with abdominal bloating and fever. The patient had a past surgical history of resection of an intra-abdominal desmoplastic small round cell sarcoma treated with postoperative radiation at age 8. The patient's vital signs were normal. Mild abdominal distention was present without abdominal tenderness on examination. A nasogastric tube was placed to low continuous wall suction. The patient was evaluated by the gastroenterology service; an abdominal CT scan demonstrated gastric and small bowel dilation and a possible 3 cm mass. The patient's proximal small bowel wall thickening was initially considered to be due to radiation enteritis, an intestinal stricture, or a possible small bowel fistula. The patient failed non-operative therapy. General surgery was consulted, and laparoscopic exploration revealed only thick adhesive bands covering the proximal small bowel. The adhesions were lysed laparoscopically, and no tumor was identified. The patient again failed to improve. On POD6, an open abdominal exploration was performed, and a proximal jejunal mass was identified. A segmental resection with a primary anastomosis was performed. The tissue was sent for a lymphoma workup in the frozen section laboratory. The abdominal exploration was otherwise negative. Pathologic examination revealed a 5.5 x 4.1 x 1.7 cm moderately differentiated T3 mucinous adenocarcinoma with lymphovascular involvement, negative margins, and a single negative mesenteric lymph node. Genetic testing of the tumor was positive for MMR protein deficiency of both MSH2 and MSH6 genes. Extensive genetic germline testing was negative. The patient was evaluated by the Colorectal Surgery division postoperatively; a colonoscopy revealed only a single benign 2 mm polyp. The patient was administered six cycles of postoperative capecitabine (XELODA). The patient continues to do well with three years of follow-up. All surveillance studies have failed to demonstrate tumor recurrence.

Discussion: A paucity of conclusive research limits investigation into the molecular progression of small bowel adenocarcinoma. Our analysis of sequencing studies reported by the National Cancer Institute Genomic Data Commons Data Portal yielded insights from a cohort of 10 individuals diagnosed with small bowel neoplasia. Specific genes exhibiting alterations, such as single nucleotide variations (SNVs), were identified across the 10

samples. Approximately twenty genes were found to be altered or affected in at least two-thirds of the tumor samples. Not all identified genes, however, could be easily integrated into a hypothesized molecular progression pathway. An example of this is the EYS gene, which is predominantly expressed in the retina and does not have a clear role in small bowel pathology. Upon further analysis of these twenty genes, a subset was identified that may contribute significantly to the molecular progression of small bowel adenocarcinoma. These genes include RASGRP4, ESX1, PI3K, LTZS2, KMT2B, and BRINP1, suggesting potential pathways and mechanisms underlying the development and progression of small bowel malignancy.

Conclusion: Our patient's tumor exhibited the absence of expression of DNA mismatch repair proteins MSH2 and MSH6 in the tumor nuclei. MMR proteins exist as heterodimers. MSH2 and MSH6 are partners, with MSH2 being dominant. With a loss of MSH2, there is also a loss of MSH6, which is not the result of a mutation in the MSH6 gene. MSH6 is lost without loss of MSH2 if there is a mutation in the MSH6 gene; however, MSH2 loss is almost always accompanied by loss of MSH6. The absence of expression of the MSH2 protein is usually due to a hereditary germline mutation (Lynch syndrome) and occasionally due to the inactivation of the EPCAM gene.

Lessons Learned: This case underscores several key lessons, including the importance of considering secondary malignancies in patients with a history of cancer and prior radiation therapy and the role of comprehensive genetic testing in identifying specific tumor characteristics that can guide targeted therapy for small intestinal adenocarcinomas. We also present a hypothesized genetic mechanism for the development of small bowel neoplasia.

Post-operative Ileostomy Intussusception and Necrosis Following Sigmoid Colectomy for Sigmoid Volvulus

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Introduction: The sigmoid colon is the most common location for colonic volvulus followed by cecal volvulus. Less common locations include the splenic flexure and transverse colon (1-2% and 1-4%, respectively). There is a male predominance (2:1) and incidence is increased in populations with a high-fiber diet, as well as diabetes, pregnancy, black race, colonic dysmotility, chronic constipation, institutionalized patients, and those with disability related to psychiatric or neurologic disorders. Though the exact pathophysiology has not been fully described, it is thought that the sigmoid colon becomes elongated and redundant leading to twisting and narrowing on its mesenteric attachment with resultant large-bowel obstruction. Work-up includes history and physical exam often with either slow insidious onset of pain, nausea, emesis, distention, and constipation or more acutely with severe pain associated with fulminant colonic gangrene. Additional investigative modalities include plain abdominal/pelvic radiography, and either computed tomography or contrast enema if plain radiography is equivocal. Classically, one may see a “coffee bean” or “bent inner tube” sign showing the apex of the sigmoid colon pointing toward the right upper quadrant. Goals of treatment include reducing the twisted bowel and preventing recurrence. Management options are often determined by the patient’s clinical status. Patients with peritonitis or sepsis, or suspected gangrenous or perforated bowel, require emergent surgery. In the absence of emergent characteristics, management may proceed in a stepwise fashion, often first with endoscopic decompression and detorsion followed by definitive sigmoid colectomy during the index admission. There have been no statistically significant differences in perioperative morbidity and mortality between Hartman’s procedure and sigmoid colectomy with primary anastomosis and proximal diversion. We present the case of a 67-year-old male who presented sigmoid volvulus requiring endoscopic detorsion followed by sigmoid colectomy with primary anastomosis and proximal diversion. His post-operative course was complicated by prolapse and incarceration of his loop-ileostomy resulting in bowel necrosis, requiring emergent take-down and revision to an end-ileostomy and mucous fistula. While prolapse is a well-described complication after ileostomy, acute incarceration of a prolapsed stoma is a rare event, seldom reported in the literature.

Summary: The patient is a 67-year-old male who initially presented to the hospital with a sigmoid volvulus requiring endoscopic decompression followed by open sigmoid colectomy with primary colorectal anastomosis and diverting loop ileostomy for proximal diversion. His post-operative course was complicated by ileostomy prolapse with resultant ileostomy necrosis requiring revision to end-ileostomy and mucous fistula with ileocecectomy approximately one month after his index operation. He recovered successfully and had successful takedown of his end ileostomy and mucous fistula approximately 3 months later.

Case Description: A 67-year-old male with history of type 2 diabetes mellitus, polysubstance use disorder including cocaine and opioid use, latent tuberculosis infection, major depressive disorder, post-traumatic stress disorder, housing insecurity, and previous incarceration who was admitted with abdominal pain and distention, weakness, and falls. He had a body mass index of 22 kg/m². His initial work-up included computed tomography angiography of the chest as well as computed tomography of the abdomen/pelvis with

intravenous contrast. He was found to have acute bilateral pulmonary emboli, cocaine washout, acute kidney injury, and sigmoid volvulus. Imaging with dilation of the colon to approximately 10 mm with normal enhancement of the sigmoid wall and no evidence of ischemia or perforation and “bent inner tube sign” with apex of the sigmoid colon directed to the right upper quadrant (Figure 1). He underwent successful endoscopic detorsion on hospital day #0. He had recurrence of significant distention and required repeat endoscopic detorsion on hospital day #2 with successful colonic decompression. His initial operative plan was for robotic-assisted sigmoid colectomy. Unfortunately, he had recurrent volvulus with persistent and increasing distention again precluding safe abdominal access with trocar/ports for minimally invasive approach. We discussed surgical options and on hospital day # 7 proceeded with open sigmoid colectomy with primary colorectal anastomosis, with diverting loop ileostomy for proximal diversion. Intraoperatively, the sigmoid colon was resected using a two 40-mm “green” contour stapler to divide the proximal and distal resection margins. Our colorectal anastomosis was completed via a primary stapled, end-to-end colorectal anastomosis using the 28-mm tri-load EEA circular stapler. Leak test was negative. A loop ileostomy was then created in the standard fashion. We chose a previously marked stoma site. A 3 cm circular disk of skin and subcutaneous tissue was resected down to the anterior rectus sheath, and we made a cruciate incision. The rectus muscle was spread, and the posterior sheath incised. The opening was large enough to fit two fingers. A loop of distal ileum was delivered, and the loop ileostomy (Figure 2) created with standard Brooke sutures as well as several intervening mucocutaneous sutures. Post-operatively he had high ileostomy output managed with supportive care as well as ileus. He otherwise progressed well from a surgical standpoint and after stoma care teaching, discharged home with planned close follow-up on hospital day #35. He returned to the Emergency Department on the day of discharge with severe abdominal pain and prolapse of his loop-ileostomy with evidence of ischemia and early necrosis versus significant venous congestion of the afferent limb (Figure 3). Small bowel mucosa was visible throughout the site of the afferent proximal limb rather than serosa. He reports having dinner consisting of a corndog and sweet tea an hour prior to his symptoms. Approximately 15 cm of the afferent limb had intussuscepted and prolapsed. He required emergent exploratory laparotomy, adhesiolysis, loop ileostomy takedown, ileocecectomy, and creation of an end ileostomy and mucous fistula (Figure 4). He recovered well from surgery and was discharged on hospital day #7. After reassuring retrograde contrast enema without stricture, he had successful takedown of his end ileostomy and mucous fistula approximately 4 months after his index revision.

Discussion: In 1952, Professor Brooke introduced a technique for everting an ileostomy, popularly used amongst general and colorectal surgeons to this day. Reported post-operative complications of ileostomy include parastomal prolapse, parastomal hernia, peristomal skin irritation, necrosis of the ileostomy, stoma retraction and stenosis, and high stoma output. Complication rates range from 5-100%. Stomal prolapse is often described as a long-term complication. One article cites the rate as 22% in adults and 38% in children with a loop stoma having a greater risk of prolapse than an end stoma. Immediate stomal prolapse is rare.

Our patient presented with immediate stoma prolapse following discharge from the hospital. He was noted to have normal appearing stoma on the day of discharge from his index admission. Additionally, he was also noted to have evidence of stomal necrosis, suspected to be secondary to venous congestion with the incarcerated segment of ileum. Risk factors proposed for stomal prolapse include obesity, advanced age, increased intra-

abdominal pressure, weakness of the abdominal fascia, and chronic obstructive lung disease, and operative risk factors include excessive stoma orifice or redundant bowel at the stoma site, stoma outside of the rectus muscle, absence of fixation of the mesentery to the abdominal wall, or lack of preoperative marking by an enterostomal nurse. Our patient was not identified to have any of these risk factors. Often, the prolapse or intussusception through an ileostomy is due to factors that cause increased intra-abdominal pressure. There have been reports of pregnancy causing intussusception via stoma in this manner. Additionally, the timeline of his complication is unusual. He presented with significant stomal prolapse within 8 hours of discharge from the hospital, and recent exam documenting normal stoma from the hospital. During admission he denied known triggering antecedent event such as trauma to the ostomy. Notably, there was some suspicion for an assault, however he denied this. Alternatively, we have inquired as to whether there was a known lead point as the etiology for his intussusception. His pathology revealed ischemic small intestine. One benign node was identified; however, pathology did not identify any discrete masses or lesions that may otherwise act as a lead-point. One prior case similar case study in 2019 of a 44-year-old has been described, treated with an elective reduction of the proximal stoma under anesthesia. Notably, this patient did not have any signs of necrosis. Nevertheless, our patient recovered well with successful takedown of his ileostomy and mucous fistula, following revision.

Conclusion: Prolapse or intussusception through an ileostomy can occur at any moment. Though intussusception or prolapse with associated ischemia and necrosis are rare, this presentation serves as surgical emergency requiring prompt surgical correction. Often the etiology, as in this case, may remain unclear.

Lessons Learned: Rare presentations of emergent conditions do occur. Though the etiology may not always be clear, prompt recognition and treatment are keys to a successful outcome.

