RUTGERS
Robert Wood Johnson Medical School

2021

12th Annual

Surgical

Resident

Research Day

May 19th

8:00-9:30 AM

Virtual

HISTORY

The first Robert Wood Johnson Medical School Surgery Resident Research Day was in 2009. It was founded by Geoffrey D. Young, M.D.,Ph.D. (resident) who believed that research was an important part of being a good surgeon, with the help of faculty member, Nell Maloney Patel, M.D. Dr. Maloney Patel brought many ideas for the Resident Research Day from her own residency program, where this was also an annual tradition. With the support of the Department of Surgery Chair, Stephen F. Lowry, M.D., Resident Research Day has become an annual showcase for the wonderful research and scholarship that occurs in the program.

JUDGES:

2009 – David August, MD and Stephen Lowry, MD

2010 – James Goydos, MD and Vincente Gracias, MD

2011 - Darren Carpizo, MD and Henry Hsia, MD

2012 - Peter Scholz, MD

2013 - Ramsey Foty, PhD

2014 - Siobhan Corbett, MD

2015 - Edmund Lattime, PhD

2016 – Matthew Lissauer, MD

2017 – Richard Agag, MD and Thomas Bauer, MD

2018 – H. Richard Alexander, MD and Yi-Horng Lee, MD

2019 – Ronald Pelletier, MD

2021 – Stanley Trooskin, MD

PREVIOUS WINNERS:

1ST Annual Resident Research Day (2009)

Best Podium Clinical Presentation – **Nora Cheung, M.D.**
Best Clinical Poster Presentation – **C. Aitor Macias, M.D.**
Best Podium Basic Science Presentation – **Colin Failey, M.D.**
Best Basic Science Poster Presentation – **Eric Chang, M.D.**

2nd Annual Resident Research Day (2010)

Best Podium Clinical Presentation – **Dana Yip, M.D.**
Best Clinical Poster Presentation – **Georg Herlitz, M.D., J.D.**
Best Podium Basic Science Presentation – **Deepak Malhotra, M.D.**
Best Basic Science Poster Presentation – **Maithao Le, M.D., Ph.D.**

3rd Annual Resident Research Day (2011)

Best Podium Clinical Presentation – **Victoriya Chernyavsky, M.D.**
Best Clinical Poster Presentation – **Beth-Ann Shanker, M.D.**
Best Podium Basic Science Presentation – **Irina Bernescu, M.D.**

4th Annual Resident Research Day (2012)

Best Podium Clinical Presentation – **Kris Bagdasarian, M.D.**
Best Poster Presentation – **Robin Lee, M.D.**

5th Annual Resident Research Day (2013)

Best Podium Clinical Presentation – **Negar Salehomoum, M.D.**
Best Podium Basic Science Presentation – **Sumana Narayanan, M.D.**
Best Poster Presentation – **Dena Arumugam, M.D.**

6th Annual Resident Research Day (2014)

Best Podium Clinical Presentation – **Izak Faiena, M.D.**
Best Clinical Poster Presentation – **Jessica Zaman, M.D**
Best Podium Basic Science Presentation – **Joshua Honeyman, M.D.**
Best Basic Science Poster Presentation – **Neal Patel, M.D.**

7th Annual Resident Research Day (2015)

Best Podium Clinical Presentation – **Oliver Eng, M.D.**
Best Podium Basic Science Presentation – **Ashley Tai Tsang, M.D.**
Best Basic Science Poster Presentation – **Jessica Crystal, M.D.**

8th Annual Resident Research Day (2016)

Best Podium Clinical Presentation – **R. Nick Hernandez, M.D.**
Best Clinical Poster Presentation – **Parth Kiran Modi, M.D.**
Best Basic Science Poster Presentation – **Jessica Crystal, M.D.**
Best Podium Basic Science Presentation – **Christopher Sejong Han, M.D.**
Best Basic Science Poster Presentation – **Kristen Danielle Donohue, M.D.**

9th Annual Resident Research Day (2017)

Best Podium Clinical Presentation – **Elizabeth J. Lilley, M.D., M.P.H.**
Best Clinical Poster Presentation – **Renee L. Arlow, M.D.**
Best Podium Basic Science Presentation – **Monica D. Chow, M.D.**
Best Basic Science Poster Presentation – **Eyone Jones, M.D.**

10th Annual Resident Research Day (2018)

Best Podium Clinical Presentation – **Rachel E. NeMoyer, M.D.**
Best Clinical Poster Presentation – **Saeed Tarabichi, M.D.**
Best Podium Basic Science Presentation – **Monica D. Chow, M.D.**
Best Basic Science Poster Presentation – **Anthony I. Squillaro, M.D.**

11th Annual Resident Research Day (2019)

Best Podium Presentation – **Zach Brown, M.D.**
Best Poster Presentation – **William Burns, M.D. & David You. M.D.**

12th Annual Resident Research Day (2021)

Best Podium Basic Science Presentation – **Laurence Diggs, M.D.**
Best Basic Science Poster Presentation – **Alexander Rossi, M.D.**
Best Podium Clinical Presentation **– Joshua Chao, M.D.**
Best Clinical Poster Presentation – **David You, M.D.**

SCHEDULE OF EVENTS

8:00AM – 9:30AM PRESENTATIONS

Karan Grover: Understanding How the Experts Do It: A Conceptual Framework for the Open Transversus Abdominis Release Procedure

Louis Chai: Regional Delivery of CAR-T Effectively Controls Tumor Growth in Colorectal Liver Metastasis Model

Lindsay Volk: Deep Hypothermic Circulatory Arrest in Cyanotic Piglets is Associated with Increased Neuronal Necrosis

Catherine Davis: Robotic Pancreatoduodectomy: Trends in Technique and Training Challenges

Laurence Diggs: CD40-mediated immune cell activation enhances response to anti-PD-1 in murine intrahepatic cholangiocarcinoma

Joshua Chao: Clinical Outcomes after Cardiac Surgery During the COVID-19 Pandemic: Experience from an Epicenter During Peak First Wave Conditions

Stephen Iacono: Resident Education and Operative Volume in the Time of COVID-19

Additional Abstracts 2021

Fernando Arias: Identifying Racial Disparities in Patients Undergoing Colorectal Operations at an Academic Center Using the Vizient Database

Michelle Abghari: Characteristics of Biopsies Performed for Abnormal Breast Findings and Imaging During the COVID-19 Pandemic at a Community Hospital

Anthony Azzolini: Evaluation of Reconstructive Surgery and Social Media Influencers on Twitter

Stephen Iacono: Age Is But A Number: Damage Control Surgery Outcomes In Geriatric Emergency General Surgery

Omar Elfanagely: A Comparison of the Highest and Lowest Ranked Social Media Influencers in Colorectal Surgery on Twitter

Alexander Manzella: The Impact of Surgical Boot Camp on Medical Students Regarding Confidence and Imposter Syndrome

Ashley Newman: Necrotic chest wall mass: Atypical presentation of giant basal cell carcinoma (GBCC)

Michael Scott: Implementing a training program to improve feedback in a surgical residency

Rachel NeMoyer: Postoperative Chemotherapy May Not be an Optimal Multimodality Treatment Strategy for Patients with Resectable Gastric Adenocarcinoma

Rachel NeMoyer: The effect of a superficial cervical block with liposomal bupivacaine on postoperative narcotic use for pain management after thyroidectomy and/or parathyroidectomy

Rachel NeMoyer: Identifying the Academic Needs of Surgical Faculty at a Training Hospital in Hawassa Ethiopia

Rachel NeMoyer: The Utility of Total Parenteral Nutrition on a Modern-Day Colorectal Surgery Service

Rachel NeMoyer: Surgical Outcomes of Patients Undergoing Colorectal Operations at High and Low Volume Academic Centers Using a National Administrative Database

Rachel NeMoyer: Cecal Volvulus Within a Left Inguinal Hernia: An Uncommon Problem Resulting in a Closed Loop Obstruction and Loss of Domain

Sharon Lawrence: Creation of a Remote Curriculum for Incoming Interns during COVID Quarantine

Sharon Lawrence: Development and Utilization of a Reproducible Simulation Model to Teach Vascular Anastomosis Techniques to Surgical Trainees

Christopher Bargoud: Fever in the ICU: A Predictor of Mortality in Mechanically Ventilated COVID-19 Patients

Omar Gonzalez-Vega: Pathogenesis of Chronic Liver Disease

Catherine Davis: COVID-19 is affecting the presentation and treatment of melanoma patients in the Northeastern US

Krish Dewan: Opioid Use Disorder Increases Readmissions After Cardiac Surgery: A Call to Action

Joshua Chao: Surgical Outcomes in Thoracic Surgery During the COVID-19 Pandemic: Utilizing the NSQIP Risk Calculator as a Measure of Comparative Morbidity and Mortality

Dov Levine and Siva Kandasamy: Managing Massive Transfusion Protocol During Cardiopulmonary Bypass in the Setting of Penetrating Traumatic Injury

Dov Levine: Underutilization of Nonopioid Pain Medication in Patients Undergoing Abdominal Aortic Aneurysm Repair

Dov Levine: Traditional Femoral Artery Cannulation is Safe for Ascending Aortic Dissection Repair

Dov Levine: The Approach of Insertion of the Impella Ventricular Assist Device Does Not Impact Stroke Risk

Lanre Eletta: Creation And Validation Of An Outreach Metric For Community Nephrologists In A Concentrated Market

Lanre Eletta: Feasibility of a Virtual Renal Transplant Simulation Model for Surgical Trainees in the Covid Era

Alexander Rossi: The Use of an *Ex Vivo* Tumor-Bearing Perfusion Model to Investigate the Effects of a Novel Immunotherapeutic Agent

Victor Gazivoda: Expression of PD-L1 in patients with Malignant Peritoneal Mesothelioma: A pilot study

Victor Gazivoda: Pancreatoduodenectomy: Does the Metabolic Syndrome Alter Outcomes?

Victor Gazivoda: Factors associated with upstaging of melanoma thickness on final excision – review of the National Cancer Database (NCDB)

Victor Gazivoda: Assessing the immediate impact of COVID-19 on surgical oncology practice: experience from an NCI-designated Comprehensive Cancer Center in the Northeastern United States

Priya Patel: Sex Specific Aortic Diameter and Aortic Size Index Thresholds for Repair in Patients Undergoing Aortic Aneurysm Repair

Priya Patel: Composite dialysis, paralysis, stroke, or mortality following endovascular aortic interventions in the Society for Vascular Surgery Vascular Quality Initiative

Priya Patel: Similar in-hospital outcomes following transcarotid artery revascularization in female and male patients

Priya Patel: Chronic Obstructive Pulmonary Disease Severity Effects Outcomes Following Endovascular Aortic Repair

Priya Patel: Sex Based Differences Following TEVAR for Penetrating Aortic Ulcer and Intramural Hematoma

Saeed Tarabichi: Giant Inguinal Hernia: A Case Report of a Patient Who Successfully Underwent Laparoscopic Davinci Approach to Tension Free Transabdominal Pre-Peritoneal Repair

Lindsay Volk: Impact of Risk Factors on In-Hospital Mortality for Octogenarians Undergoing Cardiac Surgery

Lindsay Volk: Increased Cerebral Mitochondrial Dysfunction and Reactive Oxygen Species with Cardiopulmonary Bypass

Lindsay Volk: Residency Accommodations: Assessing Need in a General Surgery Program

David Walls: Admitted on Friday for Acute Cholecystitis. Can the Operation Wait until Monday?

David You: Automated Image Processing with Point-of-care Ocular Ultrasound for Real-time Intracranial Pressure Monitoring

Abstract Title: Identifying Racial Disparities in Patients Undergoing Colorectal Operations at an Academic Center Using the Vizient Database

Authors:
Fernando D. Arias, MD- Resident, Rutgers Robert Wood Johnson Medical School, Department of Colon and Rectal Surgery (Role: **Presenting Author**)
Rachel Nemoyer, MD- Resident, Rutgers Robert Wood Johnson Medical School, Department of Colon and Rectal Surgery (Role: Co-Author)
Omar Elfanagely, MD- Resident, Rutgers Robert Wood Johnson Medical School, Department of Colon and Rectal Surgery (Role: Co-Author)
Cristan Anderson, MD- Assistant Professor of Surgery, Rutgers Robert Wood Johnson Medical School, Department of Colon and Rectal Surgery (Role: Co-Author)
Daniel Feingold, MD- Professor of Surgery, Rutgers Robert Wood Johnson Medical School, Department of Colon and Rectal Surgery (Role: Co-Author)
Nell Maloney Patel, MD- Associate Professor of Surgery, Rutgers Robert Wood Johnson Medical School, Department of Colon and Rectal Surgery (Role: Co-Author)

Introduction: Despite advancements in technology and surgical techniques across different surgical specialties, racial and ethnic disparities continue to exist. Some studies suggest that Enhanced Recovery After Surgery (ERAS) may eliminate racial disparities. Determining where we can improve and striving to narrow these disparities has increasingly important implications in our current state of healthcare.

Methods: Using the Vizient Clinical Database, a national administrative database with more than 300 participating academic centers, we reviewed 30-day readmissions and length of stay (LOS) for all colorectal surgeries from October 2015 to August 2019. The database was queried using ICD-10 codes for any surgical procedure involving the colon or rectum, whether laparoscopic, robotic, or open. Patients were split into groups of non-Hispanic White, non-Hispanic Black, and Hispanic (of any race).

Results: From October 2015 to August 2019, we had a total of 595 colorectal surgery cases. 55 patients identified as non-Hispanic (NH) Black, 85 as Hispanic (of any race), and 331 as NH White. The overall 30-day readmission rate for all 595 patients was 4.80% and the average LOS was 8.71 days (this includes those that did not identify with a specific race/ethnicity). NH Black, Hispanic, and NH White patients had a 30-day readmission rate of 7.27%, 7.06%, and 5.74%, respectively. NH Black, Hispanic, and NH White patients had an average LOS of 11.8 days, 8.71 days, and 8.60 days, respectively. There was a statistically significant difference in average LOS between NH Black patients and NH White patients ($p < 0.05$), but no statistically significant difference in average LOS between Hispanic patients and NH White patients ($p = 0.47$).

Conclusion/Discussion: In our study, we found that there were similar 30-day readmission rates for NH Black, NH White, and Hispanic patients over a 4-year interval, but NH White patients were about 2% less likely to be readmitted within 30 days. During this interval, NH Black patients were more likely to have a longer LOS than their NH White counterparts. This adds to the body of literature showing that racial disparities remain evident in surgical specialties. Further studies analyzing racial disparities at high volume academic centers pre and post- ERAS implementation may help further elucidate the importance of ERAS for eliminating racial disparities in Colorectal Surgery.

Characteristics of Biopsies Performed for Abnormal Breast Findings and Imaging During the COVID-19 Pandemic at a Community Hospital

Background:
The COVID 19 pandemic has resulted in decreased breast patient encounters, from screening to treatment. We sought to understand the characteristics of biopsies performed for abnormal breast findings during this period.

Methods:
A retrospective chart review was performed of patients seen at our small community breast center with abnormal findings or mammogram between 12/01/2019 and 9/30/2020. Peak pandemic months were defined as March-June. Time interval from date of consultation to diagnostic biopsy was calculated and compared based on demographic information and temporal relationship.

Results:
Of the 62 consultations performed, 39 (63%) were for BIRADS 4 findings and 13 (21%) for BIRADS 5. Biopsy was recommended for all patients of which 57 were performed. Ultrasound guidance was used for 81%, and stereotactic guidance for 15%. Mean time to biopsy was longer during the peak pandemic months (22.9 days) compared to before or after (14.1 vs 17.1 days, respectively). Interval to biopsy was longer in patients with Hispanic background (16.7 days), without insurance (39.8 days), with BIRADS 4 classification (14.9 days), and receipt of biopsy procedure at a non-affiliated radiology center (23.1 days). A total of 24 (45.3%) biopsies resulted in a cancer diagnosis.

Conclusion:
Almost half of the biopsies performed during this pandemic time period showed cancer. Interval to biopsy differed based on peak time period, level of suspicion, ethnicity, insurance status, and

biopsy location. Further research to understand these characteristics as they relate to the pandemic may help reduce delays in our patient population.

Title: Evaluation of Reconstructive Surgery and Social Media Influencers on Twitter

Authors:
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1. Department of Surgery, Robert Wood Johnson Medical School, New Brunswick, New Jersey
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Background:
The distribution of medical content on social media platforms is steadily increasing. Social media influencers possess large audiences and are frequently viewed as authority; however, their credibility is often unchecked. We aimed to analyze and compare the most and least influential accounts on Twitter within the field of reconstructive plastic surgery.

Methods:
Twitter influence scores for accounts associated with reconstructive plastic surgery were collected using Cronycle software. The accounts associated with the top and bottom quartile accounts were linked to individual names, and crossed-checked for advanced degrees, specialty, occupation, practice setting, location, practice type, gender, race, h-index, number of

publications, number of citations, NIH funding, industry funding, fellowship, years on Twitter, and faculty position.

Results:
A total 107 Twitter users were identified. Of those, the top (n=27) and bottom (n=25) quartile were included in the study. Overall, the majority were US based (80%) male (60%) private practice (54%) surgeons (82%). Organizations made up 18% of all influencers. Median *h*-index was 15. Compared to the bottom cohort, top influencers were statistically significantly ($p<0.05$) more likely to have an advanced degree and work in an academic setting. There were no statistical differences between cohorts regarding gender, occupation, location, race, years on Twitter, fellowship training, faculty position, *h*-index, industry funding, and NIH funding. All physician influencers were board certified.

Conclusion:
Multiple distinguishing characteristics exist between the most and least influential reconstructive plastic surgery Twitter accounts. Individuals in the top quartile of influence on Twitter trended towards higher metrics of academic success, but only differed statistically based on faculty position and presence of advanced degree. As social media continues to expand as a source of information for patients, this study provides some reassurance to the quality and merit of content disseminated by influencers of Twitter on reconstructive plastic surgery.

Title: Age Is But A Number: Damage Control Surgery Outcomes In Geriatric Emergency General Surgery
Presenter: Stephen Iacono, MD MPH
Co-Authors: Nicole J. Krumrei, MD, Anna Niroomand BA, David O. Walls, MD, MPH, Matthew Lissauer, MD, Jennifer To, DO, Christopher A. Butts, PhD, DO

Abstract

Background:
Damage control surgery (DCS) with temporary abdominal closure (TAC) is increasingly utilized in emergency general surgery (EGS). As the population ages, more geriatric patients (GP) are undergoing EGS operations. Concern exists for GP's ability to tolerate DCS. We hypothesize that DCS in GP does not increase morbidity or mortality and has similar rates of primary closure compared to non-geriatric patients (NGP).

Methods:
A retrospective chart review from 2014-2020 was conducted on all non-trauma EGS patients who underwent DCS with TAC. Demographics, admission lab values, fluid amounts, length of stay (LOS), timing of closure, post-operative complications and mortality were collected. GP were compared to NGP and results were analyzed using Chi square and Wilcox signed rank test.

Results:
Ninety-eight patients (n=50, <65 years; n=48, ≥65 years) met inclusion criteria. There was no significant difference in median number of operations (3vs2), time to primary closure (2.5vs3days), hospital LOS (19vs17.5days), ICU LOS (11vs8days), rate of primary closure (66%vs56%), post op ileus (44%vs48%), abscess (14%vs10%), need for surgery after closure (32%vs19%), anastomotic dehiscence (16%vs6%), or mortality (34%vs42%). Average time until

take back after index procedure did not vary significantly between young and elderly group (45.8vs38.5hours; p=0.89). GP were more likely to have hypertension (83%vs50%; p≤ 0.05), atrial fibrillation (25%vs4%; p≤0.05) and lower median heart rate compared to NGP (90vs103; p≤ 0.05).

Conclusions: DCS with TAC in geriatric EGS patients achieves similar outcomes and mortality to younger patients. Indication, not age, should factor into the decision to perform DCS.

Presented at Academic Surgical Conference QuickShots
Submitted to Journal of Surgical Research

Title: A Comparison of the Highest and Lowest Ranked Social Media Influencers in Colorectal Surgery on Twitter

Presenter: Omar Elfanagely

CO-AUTHORS (LAST NAME, FIRST NAME): Gorrai, A. ; Wallden, O. ; Arias, F. ; Feingold, D. ; Maloney Patel, N.

INSTITUTIONS (ALL): 1. Division of Colorectal Surgery, Department of Surgery, Rutgers Robert Wood Johnson Medical, New Brunswick, NJ, United States.

ABSTRACT BODY:
Purpose/Background: The distribution of content related to colorectal surgery in social media is steadily increasing. Despite this, only a small percentage of the content comes from physicians. Twitter is one of the most popular social platforms used to disseminate information. The aim of this study was to identified and compare the 20 highest and lowest ranked social media influencers in the field of colorectal surgery on Twitter, with respect to their demographics, academic productivity, and industry funding.

Methods/Interventions: Twitter influence scores for the topic search “colorectal surgery” were collected in August 2020 using Cronycle software. The accounts associated with the 20 highest and lowest influencer scores were linked to individual names, advanced degrees, specialty, practice setting, location of practice, gender, h-index, number of publications, number of citations, NIH funding, industry funding, the year they graduated fellowship, the residency program they attended, and their faculty position.

Results/Outcome(s): Of the 40 social influencers included, the majority were international (55%) and male gender (75%). Physicians were identified as colorectal surgeons (73%), as general or

gastrointestinal surgeons (25%), and as a pathologist (2%). The median h -index was 13 ± 11.7. The top influencers were more likely to have higher academic h -index, number of publications, and number of citations when compared to the bottom influencers ($p<0.05$).

Conclusions/Discussion: This study shows that while no difference in demographics existed between the highest and lowest tier social influencers, a difference in academic productivity was noted between the groups.

The abstract was accepted at ASCRS 2021.

The Impact of Surgical Boot Camp on Medical Students Regarding Confidence and Imposter Syndrome

Rachel L. Choron MD, Alexander Manzella MD, Amanda L. Teichman MD, Jenny Cai MD, Mary E. Schroeder MD FACS, Meizhen Yao, Patricia Greenberg MS

ABSTRACT

Introduction:

Transitioning from medical student to surgical intern is accompanied by increased responsibility, stress, and clinical burden. This environment lends itself to imposter syndrome(IS), a psychological condition grounded in self-doubt causing fear of being discovered as fraud despite adequate abilities. We aimed to determine whether a two-week surgical boot-camp for fourth-year medical students would improve confidence in technical skills, knowledge, and IS.

Methods:

Thirty medical students matching into surgical specialties completed the boot-camp in February 2020. Pre/post-surveys assessed confidence levels using a 1-5 Likert scale regarding 32 technical skills and knowledge points. The Clance Impostor Phenomenon Scale(CIPS) assessed characteristics consistent with IS.

Results:

Median subject age was 27 years(IQR26, 28), 20(66.7%) were male, and 21(70%) were Caucasian. 23 (76.7%) had a break in training with a median of 2 years (IQR1, 3) outside of medicine. Table1A revealed significantly improved confidence scores in all assessment categories ($p<0.05$) and no change in CIPS [65.5(IQR52, 75) vs 64(52, 75), $p=0.70$] in pre vs post-surveys. Females had higher pre-CIPS than males [68.4(SD15.2) vs 61.6(14.9), $p=0.02$]. There was no strong correlation between age and CIPS in the pre (SRCC 0.29, $p=0.19$) or post-survey (SRCC 0.31, $p=0.10$). While subjects who worked outside of medicine had a stronger

relationship with IS(SRCC 0.37, p=0.05), multivariate regression analysis(Table 1B) did not reveal any significant differences.

Conclusion:

We advocate for surgical boot-camp training courses to improve trainee skill and confidence. As IS is not improved by boot-camp, additional research is needed to identify opportunities to improve IS among surgical trainees.

Pre and Post-Boot Camp Confidence Levels and Clance Impostor Phenomenon Scale (20-100) Levels

Table 1A. Pre and Post-Boot Camp Survey Comparisons Confidence Assessment Categories	**Pre-course n=30**	**Post-course n=30**	***p*-value**
Diagnostic Interpretation Skills, median (IQR)	2 (2, 2)	4 (3, 4)	<0.01
Surgical Technique	2 (2, 3)	4 (3, 4)	<0.01
Surgical/Medical Knowledge	2.5 (2, 3)	3 (3, 4)	0.02
Communication Skills	3 (2, 3)	3 (3, 4)	0.01
Clance Impostor Phenomenon Scale Score	65.5 (52, 75)	64 (52, 75)	0.70

Table 1B. CIPS Multivariate Regression Model	**B Coefficient**	**SE**	**T Value**	***p*-value**
Age (>27 years)	3.3	6.6	0.5	0.63
Gender (Female)	2.5	5.9	0.4	0.67
Non-Caucasian	12.7	8.0	1.6	0.12
Number of years worked outside of medicine	5.2	3.2	1.7	0.11
Subjects with breaks in medical training	2.9	11.1	0.26	0.80

Abbreviations: CIPS, Clance Impostor Phenomenon Scale; IS: imposter syndrome.
CIPS <40: few IS characteristics, 41-60: moderate IS characteristics, 61-80: frequent IS characteristics, >80: intense IS characteristics.

Title: Necrotic chest wall mass: Atypical presentation of giant basal cell carcinoma (GBCC)

Authors: Ashley Newman, MD, Daniel Ventarola, MD, Jennifer To, DO

Intro: Giant basal cell carcinomas (GBCC's) are rare occurrences despite the high incidence of BCC in the general population1. GBCC's are defined as those over 5cm in diameter, and account for less than 1% of all BCC2-3. These lesions are most often reported in men approximately 70 years of age, have an indolent time course (10-20 years on average) and are located on the back, face, and upper extremities1,4. Few patients with this GBCC have been reported in the literature, and diagnosis and treatment is developed on a case-by-case basis. We report a case of GBCC of the anterior chest wall initially diagnosed as triple negative breast cancer.

Case presentation: The patient is a 73-year-old male who initially presented for evaluation after an episode of bleeding from a large ulcerated lesion of his right anterior chest wall. The lesion had been present for approximately 10 years and gradually enlarging. On the day of presentation to the hospital the patient noted bloody drainage from this lesion prompting him to seek medical attention. Physical exam revealed an ulcerative lesion, approximately 20x20 cm on right anterior chest wall with exposed intercostal muscles, ribs, lung and sternum (Figure 1). CT confirmed a right chest wall subcutaneous defect with emphysema along the right axilla, sternal fracture with 5mm displacement, and possible osteomyelitis. During his admission he underwent two incisional biopsies of this lesion, initially being diagnosed with triple negative breast cancer. Given the indolent course of this lesion, there was concern from both medical and surgical oncology that this was a misdiagnosis and the biopsy was repeated. The pathology results from the second biopsy were consistent with basal cell carcinoma. He was not considered a surgical candidate for resection or reconstruction at this time given his overall poor nutritional status, bacteremia, and osteomyelitis of his sternum. The patient was eventually discharged with a PICC line for continued outpatient antibiotics for osteomyelitis of his sternum and plans to follow up with medical oncology for further management.

Discussion: Giant basal cell carcinomas are rarely encountered malignancies which often present challenges in diagnosis and treatment. Diagnosis and treatment planning for this patient were delayed, requiring multiple biopsies and evaluation by several different oncologic specialists. Due to the low rate of regional and distant disease in GBCC, treatment is often primarily focused on excision and reconstruction, or in cases of unresectable disease like the presented case, on supportive care.

Understanding How the Experts Do It: A Conceptual Framework for the Open Transversus Abdominis Release Procedure

Karan Grover, Archana Babu, Dina Podolsky, Alfredo Carbonell, Sean Orenstein, Eric Pauli, Yuri Novitsky, Dylan Nieman, Amin Madani, Maura Sullivan

Background

The safe and effective performance of a posterior component separation via a transversus abdominis release (TAR procedure) requires the application of a complex body of knowledge and skills. This qualitative study aims to:

1. Define the tasks, subtasks, and decision points that comprise the TAR procedure.
2. Characterize the cognitive behaviors demonstrated by experts in the TAR procedure.
3. Create a framework upon which training and evaluation of the TAR procedure can be based.

Method

Hierarchical and cognitive task analyses for the TAR procedure were performed using semi-structured interviews of experts to describe the thoughts and behaviors that exemplify optimal performance. Verbal data was recorded, transcribed verbatim, supplemented with published literature, coded and thematically analyzed by two independent reviewers.

Results

A conceptual framework was synthesized based on 8 literary sources (4 book chapters, 1 peer-reviewed article, 3 online videos) and interviews of 4 experts (median 66 minutes [44-78]). Subject matter experts have practiced a median of 6.75 years [1.5-16] and have completed a median of 300 TARs [60-500]. After 3 rounds of inductive analysis, 93 tasks, 74 potential errors, 34 cognitive behaviors, and 15 decision points were identified and categorized into 10 procedural steps and 8 fundamental principles.

These fundamental principles included: considering patient physiology and disease burden, anticipation and forward planning, establishing exposure, identifying safe planes and danger zones, minimizing tissue trauma, tactical modification, verifying task completion, and effectively reconstructing tissue. Experts stressed the importance of understanding the anatomy of the transversus abdominis at all levels of the abdomen. Experts described techniques to minimize the risk of inadvertent injury to posterior components (eg. incising the posterior rectus sheath layer by layer and confirming entry into the proper plane by recognizing muscle fibers). An emphasis was placed on the importance of clear and constant communication with the assistant to provide optimal exposure via dynamic traction/countertraction that is finetuned as the procedure progresses. Surgeons stressed using visual and tactile cues for feedback for successful task completion (eg. using the neurovascular bundles along the linea semilunaris as the lateral boundaries of the retrorectus dissection) or whether tactical modification was necessary (eg. if only fat is seen after presumed entry into the “retrorectus space”, an overly medial incision has been made; back out and enter more laterally to access to the the true retrorectus space.)

Conclusion

This study defines the key tasks, decisions, and cognitive behaviors that are essential to perform the TAR procedure safely and effectively. This framework has the potential to serve as the basis for training novices.

Presented at Americas Hernia Society annual meeting September 2020.

Title: Implementing a training program to improve feedback in a surgical residency

Authors: Michael Scott, Shahyan Rehman, William Burns, Nell Maloney Patel

Introduction: Increasing demands on faculty-level surgeons coupled with stricter work restrictions on surgical residents implores methods to improve efficiency in surgical training. Feedback is an essential and highly effective learning tool in surgical education. We sought to include feedback training in our program to optimize resident education. We evaluated our strategy using the Kirkpatrick model, a workplace training assessment framework.

Methods: We surveyed surgical trainees (n=37) for baseline attitudes on feedback. Training modules were done separately with faculty (n=12) and residents (n=28) and consisted of a 35-minute presentation on effective feedback followed by a workshop modeled after the *Association for Surgical Education* Committee on Graduate Surgical Education's "Giving Verbal Feedback" workshop. Analysis of the training model was done using a Kirkpatrick Level 1 survey and a Kirkpatrick Level 2 pre- and post-training quiz. Finally, a Kirkpatrick Level 3 evaluation was completed by comparing baseline attitudes among residents two years later. Analyses used Student's t-test and z-test of proportions.

Results: Among surgical residents, 97.4% agree that feedback is an important part of resident learning. 64.1% do not believe attendings make feedback a priority and only 24.3% of residents believe that attendings provide effective feedback. Residents agree that feedback should be part of faculty training (94.9%) and senior-resident training (89.7%). On Level 1 surveys, 100% of faculty and residents were satisfied with the training module. On Level 2 quizzes, the average score of the pre- and post-training assessment among faculty improved significantly (63% to 83%, p-value = 0.03), as well as among residents (56% to 77%, p-value = <0.001). On Level 3 evaluation, over two years, more residents believed that attendings provided feedback effectively (24% to 54%, p-value = 0.05).

Conclusions: Feedback is an efficient and impactful tool to complement surgical residency training. Our experience demonstrates that surgical trainees feel that feedback is essential to their training and is inadequately provided by their educators. Our training modules were well-accepted and facilitated learning on techniques for effective feedback. However, continued effort is needed for to improve the long-term effects of the training.

Title: Regional Delivery of CAR-T Effectively Controls Tumor Growth in Colorectal Liver Metastasis Model

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Background

Effective treatment of solid tumors requires multi-modality approaches. In many patients with stage IV liver disease, current treatments are not curative. Chimeric antigen receptor T cells (CAR-T) are an intriguing option following success in hematological malignancies, but this has not been translated to solid tumors. Limitations include sub-optimal delivery and elevated interstitial fluid pressures. We developed a murine model to test the impact of high-pressure regional delivery (HPRD) on trafficking to liver metastases (LM) and tumor response.

Materials and Methods

CAR-T were generated from CD45.1 mice and adoptively transferred into LM-bearing CD45.2 mice via regional or systemic delivery (RD, SD). Trafficking, tumor growth, and toxicity were evaluated with flow cytometry, tumor bioluminescence (TB, photons/sec log_2-foldover baseline), and liver function tests (LFTs).

Results

RD of CAR-T was more effective at controlling tumor growth vs. SD from post-treatment days (PTD) 2-7 ($p=0.002$). HPRD resulted in increased CAR-T penetration vs. low-pressure RD (LPRD, $p=0.004$), suppression of tumor proliferation ($p=0.03$), and trended towards improved long-term control at PTD17 (TB=3.7 vs. 6.1, $p=0.47$). No LFT increase was noted utilizing HPRD vs. LPRD (AST/ALT $p=0.65/0.84$) while improved LFTs in RD vs. SD groups suggested better tumor control (HPRD AST/ALT $p=0.04/0.04$, LPRD AST/ALT $p=0.02/0.02$).

Conclusion

Cellular immunotherapy is an emerging option for solid tumors. Our model suggests RD and HPRD improved CAR-T penetration into solid tumors with improved short-term tumor control. Barriers associated with SD can be overcome using RD techniques to maximize therapeutic delivery and HPRD may further augment efficacy without increased toxicity.

Title: Postoperative Chemotherapy May Not be an Optimal Multimodality Treatment Strategy for Patients with Resectable Gastric Adenocarcinoma

Authors: Anthony Casabianca, Rachel NeMoyer, Subir Goyal, Jeffery M. Switchenko, Yong Lin, Darren R. Carpizo, David A. August, H. Richard Alexander, Mihir M. Shah, Timothy J. Kennedy

Introduction: Multimodality therapy is the standard of care in majority of patients with non-metastatic gastric adenocarcinoma(GC). Current literature lacks head-to-head comparison between perioperative chemotherapy(PEC), postoperative chemoradiation therapy(POCR), and postoperative chemotherapy(POC). We aim to identify the optimal sequence of adjuvant therapy.

Methods: National Cancer Database(2006-2016) was reviewed to analyze non-metastatic GC patients undergoing curative-intent surgery. We compared patients receiving PEC, POCR and POC. We repeated this comparison in a cohort of patients who received optimal therapy -- margin-negative resection, chemotherapy within 45days of diagnosis(PEC), resection within 45days of diagnosis(surgery-first), adjuvant therapy within 90days of resection, and standard radiation dose. Kaplan-Meier survival curves were computed. Univariable and multivariable analyses(MVA) were performed.

Results: We analyzed 11,976 patients(PEC-1320, POC-3123, POCR-7533). Majority of patients(median age=63years) were male(62.8%), white(66.4%), with Charlson-Deyo score=0(70.7%) and poorly differentiated/undifferentiated tumors(74.4%). Margin-negative resection(80.9%) and positive regional nodes(79.0%) were common. Median overall survival was 50.8months(PEC), 40.5months(POCR) and 31.2(POC) ($p<0.001$). On MVA, patients who received PEC/POCR independently predicted improved survival compared to POC(HR0.83, HR0.81, $p<0.001$). In the optimal cohort(n=4,123), results were maintained on MVA(HR0.81, HR0.76, $p<0.001$). Younger age(<63years; $p<0.001$), treatment at an academic program($p=0.016$), well/moderately differentiated tumors(<0.001) and negative regional nodes($p<0.001$) independently predicted improved survival.

Conclusion: Perioperative chemotherapy or postoperative chemoradiation therapy for non-metastatic gastric adenocarcinoma is associated with an improvement in overall survival compared to postoperative chemotherapy. This association persists in patients who are able to receive optimal therapy. This data would suggest that perioperative chemotherapy or postoperative chemoradiation therapy is the optimal multimodality treatment strategy for resectable gastric cancer patients.

The effect of a superficial cervical block with liposomal bupivacaine on postoperative narcotic use for pain management after thyroidectomy and/or parathyroidectomy

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BACKGROUND: We compared the effectiveness of liposomal bupivacaine (LB) and bupivacaine with epinephrine (BE) in treating post-operative pain following thyroidectomy and/or parathyroidectomy. Perioperative and postoperative pain control contributes significantly to postoperative complications and patient satisfaction. Pain control presents an additional challenge in the context of the opioid epidemic. Liposomal bupivacaine (LB) injected into soft tissues showed superior pain relief when compared to bupivacaine with epinephrine (BE) in several different types of operations. Few studies over the last 5 years have focused on the effectiveness of LB in the context of thyroid and/or parathyroid operations; and no study to date has looked at LB and postoperative pain control specifically following thyroidectomy and/or parathyroidectomy.

MATERIALS AND METHODS: A retrospective review was performed on 267 consecutive patients who underwent a thyroidectomy and/or parathyroidectomy from 2017 to 2018, and who received cervical nerve blocks (LB or BE) administered by the surgeon. Pain scores, in-hospital narcotic utilization, and outpatient narcotic utilization were examined and un ivariate analyses were performed to compare these outcomes between the two groups.

RESULTS: 267 patients underwent thyroidectomy or parathyroidectomy. Table 1 reflects the demographic data of the study cohort.73 (27%) patients received BE and 194 (72%) were administered LB. There were no significant differences in age, insurance status, ASA class, history of neck radiation, and surgery type between the two groups. 54 patients (74%) in the BE group required morphine in PACU compared to 79 patients (40.7%) in the LB group (p-value < 0.01). In the LB group, only 40 patients (20.6%) were given a narcotic prescription at discharge and 146 patients (76.6 %) received non-narcotic prescriptions, compared with 62 patients (84%) receiving narcotics prescriptions and 6 patients (8.2%) receiving non-narcotics prescriptions in the BE group (p value < 0.01). 34 patients (54.8%) in the BE group used their narcotics for pain control in the outpatient setting, whereas only 14 patients (35%) did so in the LB group (p value 0.05). During their first postoperative visit, generally 10-14 days after surgery, 7 patients (9.6%) in the BP group reported having severe pain, whereas 3 patients (1.6%) in the LB group reported having severe pain (p value < 0.01).

CONCLUSIONS: LB paravertebral blocks significantly decreased the amount of pain in PACU and in the outpatient setting. They decreased the amount of narcotics used as inpatient and outpatient compared to the patients who received BE blocks after thyroidectomy and/or parathyroidectomy. The LB group had a significantly lower proportion of patients who were sent home with a narcotic prescription, and there was a significantly lower proportion in the LB group that actually filledthe prescription to treat their postoperative pain. In summary, LB used in combination with acetaminophen and ketalorac deliver better postoperative pain control than BP in combination with narcotics.

Title: Identifying the Academic Needs of Surgical Faculty at a Training Hospital in Hawassa Ethiopia

Presenter Name: Rachel E. NeMoyer, Chris Dodgion, Theresa Chin, Robyn Richmond, Girma Tefera, Natalie Bell, Mengistu Gebreyohanes, Taye Gari, Dawit Jembere, Mary E. Schroeder

Introduction In 2018 The American College of Surgeons' Operation Giving Back (OGB), created a training hub with the Hawassa University Comprehensive Specialty Hospital (HUCSH), with the goal of addressing the academic needs of the surgical faculty and residents. This included education, surgical training, systems capacity building, and research. A needs assessment was administered to identify the priorities of the Hawassa surgeons.

Methods: An anonymous needs assessment survey was distributed to surgical residents and attendings. Questions included current research projects, areas of interest and resource availability.

Results: There were 26 respondents, 21 were surgical residents, 2 General practioners, and 3 surgical attendings. Six (25%) stated they were involved in current research, only one of whom was a resident. Twenty-one responded (80%) they were very interested in trainee fellowship/career development in research with 12 of 26 answering that this should be an immediate priority. When asked "what broad areas of research interest you?", 22 of 26 chose clinical research.

Discussion/Conclusion: A training course was created to teach basic research principals and guide participants through the process of creating a research proposal. In addition, a pool of mentors was created for individual projects, serving to review ideas, edit proposals, and provide ongoing support. A partnership was created with the Hawassa University School of Public Health to provide guidance and statistical support for research within the department of Surgery. By creating a needs assessment, the OGB research workgroup was tasked with addressing the needs and interests of the faculty and residents at HUCSH.

Submitted to ACS

Title: THE UTILITY OF TOTAL PARENTERAL NUTRITION ON A MODERN-DAY COLORECTAL SURGERY SERVICE

Authors: Nicholas Arcomano, Rachel E. NeMoyer, Cristan Anderson, Daniel Feingold, Kristen Donohue, Nell Maloney Patel

Introduction: Total parenteral nutrition (TPN) is often used as a supplement for patients with poor nutritional status or the inability to eat for extended periods of time. Often, TPN is used in a hospital setting as a bridge to surgery, to supplement or augment a patient's nutrition, or to allow a patient to have a better nutritional status for their future treatment. However, recent reports on the use of TPN specifically in patients admitted to a colorectal surgery service remain sparce. Given this sparsity of reports as well as recent advancements in perioperative management, we aim to look at the use of TPN on our colorectal surgery service.

Methods: This is a retrospective review of patients admitted under the care of four colon and rectal surgeons at a large tertiary care center between July 2017 and July 2020.

Results: We identified a total of 72 consecutive patients in our cohort. Almost half of the patients were female (35; 49%). The mean age was 55.4 years. The majority of patients were White (45; 62.5%), with 14% Black, 6% Asian-Indian, and 15% other. The most common admission diagnoses were inflammatory bowel disease (11; 15%), Small bowel obstruction (11; 15%) colon cancer (9; 12.5%) and fistula (9; 12.5%). The most common reasons for use of TPN were NPO status of the patient (31; 43%), nutritional optimization prior to surgery (18; 25%), and the patient met criteria for malnutrition (16; 22%). The mean albumin was 3.2 with an average prealbumin of 12.6.

Conclusions: An optimal supply of nutrients can help improve intestinal permeability, bowel motility, reduce inflammatory mediators, improve wound healing, and improve overall nutritional status. Although TPN must be infused via a central line, which may have some added morbidity, we believe that TPN is helpful as a supplement for patients who ultimately have been deemed to have poor nutritional status, a supplement for patients who are NPO for an extended period of time, and for nutritional optimization prior to surgery.

Submitted/Accepted to SAGES 2021

TITLE: RESIDENT EDUCATION AND OPERATIVE VOLUME IN THE TIME OF COVID-19

Stephen A. Iacono MD MPH, Rachel E. NeMoyer MD MPH, Michael T. Scott MD MPH, Nell Maloney Patel, MD, Stanley Trooskin MD

INTRODUCTION: The novel Coronavirus pandemic had an irrevocable impact on surgical education inside and outside of the operating room (OR). Elective caseload halted during the height of the pandemic causing a decrease in case volume for residents, particularly graduating seniors. While the pandemic led to elective surgery cessation, the need for urgent and emergent surgeries continued. The purpose of this study was to investigate the impact of COVID-19 on resident operative case volume compared to prior years and discuss the potential impact on overall surgical education.

METHODS: A retrospective review of all OR cases and resident case logs at a large tertiary care center between 3/22/2020 and 6/1/2020 were reviewed. The OR cases and case logs in 2020 were compared to the same dates in 2018 and 2019. Case volumes were stratified by services covered by General Surgery residents. Trauma activations for the same months were also reviewed. Statistical analysis was done using analysis of variance (ANOVA) at a significance level of p=0.05.

RESULTS: In 2018 and 2019 there were 1,609 and 1,759 OR cases eligible for resident coverage. OR cases decreased significantly in 2020 to 1,015 cases ($p<.05$). The decrease in case volume between years 2018 and 2019 compared to 2020 was significant in almost all specialties including general surgery (426 vs 390 vs 151; p=0.002), cardiothoracic surgery (349 vs 422 vs 199; p=0.002), pediatric surgery (187 vs 214 vs 147; p=.05), and vascular surgery (224 vs 296 vs 114; p=.01). There was no significant difference in case volume for surgical oncology (204 vs 192 vs 185; p=0.902) or acute care surgery (218 vs 203 vs 208; p=0.730). There was also no significant difference in number of trauma activations in 2020 compared to 2018 and 2019 (329 vs 400 vs 421 respectively; p=0.11). Amongst surgical residents, there were significantly lower cases logged per resident ($p<0.05$) in Postgraduate Year (PGY)-2 (49.5 vs 61.4 vs 15.5), PGY-3 (47.5 vs 52.0 vs 18.2), and PGY-5 (51.5 vs 47.5 vs 18.2). Cases logged by PGY-1 (23.6 vs 32.2 vs 15.3; p=0.11) and PGY-4 (54.8 vs 46.0 vs 30.0; p=0.10) were not significantly lower than previous years.

CONCLUSION: The COVID-19 pandemic had a significant decrease on operative experience during the initial surge. The overall effects on surgical education and operative experience remains to be seen as OR volumes have increased over recent months, but possibility of resurgence continues to loom, threatening surgical resident education.

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Abstract Title: Surgical Outcomes of Patients Undergoing Colorectal Operations at High and Low Volume Academic Centers Using a National Administrative Database

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Purpose/Background: Enhanced Recovery After Surgery (ERAS) has been shown to improve outcomes after colorectal surgery, but complications and readmissions continue to affect postoperative care of these patients. Understanding why some institutions have superior outcomes is imperative to improving ERAS protocols. Methods/Interventions: 30-day readmissions for all colorectal surgeries from October 2016 to August 2019 were reviewed using the Vizient Clinical Database, a national administrative database with more than 300 participating academic centers. The database was queried using ICD-10 codes for any surgical procedure involving the colon or rectum, whether laparoscopic, robotic, or open. Data was ordered by number of cases over this time interval and the top 20 and bottom 20 volume academic centers were identified. Centers performing less than 100 colorectal surgeries over this time interval were excluded. Results/Outcomes: The highest volume academic center performed 3,350 colorectal surgery cases and all of the top 20 highest volume academic centers performed > 1,000 cases over this time interval. All of the bottom 20 lowest volume academic centers performed < 200 cases over this time interval. The average readmission rate for the top 20 highest volume and bottom 20 lowest volume academic centers was 4.55% and 5.10%, respectively. There was no statistical significance between these two groups ($p = 0.13$). The average LOS for the top 20 highest and bottom 20 lowest volume academic centers was 7.66 and 11.2 days, respectively. There was a statistical significance between these two groups ($p < 0.001$). When looking at our institution, we had a total of 595 colorectal surgery cases during this time period. The readmission rate at our institution for all colorectal surgeries was 4.80%. The average length of stay (LOS) was 8.71 days.

Conclusion/Discussion: In our study, we found that academic centers performing a higher number of colorectal surgery cases had similar 30-day readmission rates when compared to academic centers with a low volume number of colorectal surgery cases, but had statistically significant lower length of stays. Our institution, which is mid-tier for number of colorectal surgery cases, had similar 30-day readmission rates and average LOS as the higher volume academic centers. Further studies analyzing ERAS pathway adherence vs nonadherence between these centers may help elucidate why even mid-tier volume academic centers may have similar outcomes as academic centers performing nearly 6-times as many cases.

Submitted/Accepted ASCRS 2021

Cecal Volvulus Within a Left Inguinal Hernia: An Uncommon Problem Resulting in a Closed Loop Obstruction and Loss of Domain

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Approximately 75% of all hernias occur within the inguinal region, with a lifetime risk of 25% in men. Due to its serious complications, these hernias present a common problem in adults. Limited cases have been reported of a cecal volvulus with perforation within an ipsilateral inguinal hernia, however, there have been no reported cases of a cecal volvulus affecting the contralateral side.

Here, we present the case of a 61-year-old male with history of schizophrenia and a chronic left inguinal hernia who presented to the Emergency Department with a three-day history of intractable nausea, vomiting, abdominal distention, and abdominal and scrotal pain. The patient was hemodynamically intact and physical examination was notable for a tender large left inguinal hernia (LIH) and a reducible right inguinal hernia. Computed tomography (CT) revealed a closed loop obstruction and pneumatosis from a volvulized cecum within the LIH (Figure 1). The patient was taken emergently to the operating room (OR) for exploratory laparotomy, reduction of LIH and intestinal volvulus, right hemicolectomy, and temporary closure with an ABThera wound VAC. He was left in discontinuity due to ongoing hemodynamic instability and significant loss of domain. He was subsequently closed with a fascio-cutaneous flap after multiple trips to the OR. His hospital course was complicated by acute kidney injury requiring temporary hemodialysis and a scrotal fluid collection which was managed with percutaneous drainage. After an extended hospitalization, the patient fully recovered and was discharged to rehabilitation.

Hernias have a wide range of presentations, ranging from a clinically insignificant defect to life-threatening bowel strangulation with perforation. We have found no previous reports describing a perforated, closed loop obstruction from a volvulized colon in a contralateral inguinal hernia. Furthermore, likely due to anatomic constraints, there have been no reports of the right colon herniating into a LIH. Complicating abdominal wall closure is the inevitable loss of domain which develops due to the displacement of the viscera in giant chronic hernias. Complex abdominal hernias continue to pose a dilemma in treatment. Knowledge of advanced techniques to achieve tension-free closure such as component separation and other flaps greatly improve the chance for successful abdominal closures. Hernias continue to provide challenging problems because of variability in presentation and complexity in management

Submitted/Accepted SESC

Creation of a Remote Curriculum for Incoming Interns during COVID Quarantine

Sharon Lawrence MD, Barbara Perry MBA, Cristan Anderson MD

Introduction

Surgical training programs face the need to provide in-person and hands-on instruction for incoming trainees every July. Surgical interns starting in the summer of 2020 faced a unique challenge in acquiring needed skills for their new roles as they 1) experienced decreased patient interactions at the end of medical school due to the novel corona virus, and 2) were unable to participate in traditional didactic and simulation sessions due to group size restrictions. Our aim was to develop a remote curriculum to introduce trainees to needed skills while maintaining social distancing and reduced group sizes during quarantine.

Methods

A total of eighteen surgical interns in general surgery, urology, and orthopedics were invited to participate, with fifteen choosing to participate. A kit containing suture, needle drivers, knot tying anchors, and simulated tissue were provided to all participants. American College of Surgeons simulation modules for aseptic technique, knot-tying, and suturing, as well as Centers for Disease Control (CDC)-provided videos reviewing donning and doffing personal protective equipment were used for at home didactics. Video conferencing applications were used for weekly evaluation of the interns' progress through the curriculum.

Results

Six-sessions were held with an average participation of 12 participants weekly. Each topic required a pre-test and post-test to quantify the trainees' progress. A self-assessment survey prior to starting the curriculum demonstrated that most participants had 2 or more months if subinternship experience and 50% felt comfortable in the OR. 44.5% of participants felt uncomfortable suturing lacerations in the trauma bay and 83.4% felt uncomfortable identifying instruments in the operating room. Participant test scores improved after each session.

Conclusion

A remote curriculum designed to introduce surgical trainees to needed skills was successful in increasing their knowledge base regarding these techniques. It is a feasible way to ensure development of surgical skills and can be used for distance learning even when COVID restrictions are lifted.

Development and Utilization of a Reproducible Simulation Model to Teach Vascular Anastomosis Techniques to Surgical Trainees.

Sharon Lawrence MD, David Walls MD, Olanrewaju Eletta MD, Stephen Iacono MD, Barbara Perry MBA, Advaith Bongu MD, Cristan Anderson MD

Introduction

Surgical simulation creates a safe and low-stress environment for practicing difficult techniques such as vascular anastomosis. High-fidelity simulators for vascular procedures exist but are not readily available in many training programs. Development of a simulation model with readily-available material is essential for surgical training programs. Our aim was to develop such a model and use it for teaching vascular anastomosis techniques.

Methods

A simulation model was created using penrose drains of various sizes, PTFE graft and clamps to secure them in place. Quarter-inch penrose was used to practice microvascular anastomoses, while PTFE graft and half-inch penrose were used for practicing end-to-end and end-to-side anastomoses. Participants were provided with donated 6-0 prolene sutures and Castroviejo needle drivers, and were encouraged to bring loupes. A faculty member from the Transplant Surgery department provided instruction and oversight for the session.

Results

Fifteen general surgery residents of varying levels participated. Of these, 60% of the residents completed a feedback survey. Seventy-seven percent of the respondents felt more comfortable performing a vascular anastomosis after participating in the session, and 75% felt the different variations on the model provided level-appropriate experience. However, only 22.2% of participants felt comfortable performing anastomoses with minimal guidance from an attending after the session was complete.

Conclusion

Our simulation model provided realistic simulation of the steps needed to perform a vascular anastomosis. It contributed to resident confidence in performing this task without causing over-confidence in respondents. Its reproducibility and ease of use will allow for easy incorporation into simulation curricula in the future.

Title: Fever in the ICU: A Predictor of Mortality in Mechanically Ventilated COVID-19 Patients

Presenter Name: Christopher Bargoud, MD

Name of Co-authors (in appropriate order)
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Introduction
While fever may be a presenting symptom of COVID-19, fever at hospital admission has not been identified as a predictor of mortality. However, hyperthermia during critical illness among ventilated COVID-19 patients in the ICU has not yet been studied. We sought to determine mortality predictors among ventilated COVID-19 ICU patients and we hypothesized that fever in the ICU is predictive of mortality.

Methods
We conducted a retrospective cohort study of 103 ventilated COVID-19 patients admitted to the ICU between March 14 and May 27, 2020. Final follow-up was June 5, 2020. Patients discharged from the ICU or who died were included. Patients still admitted to the ICU at final follow-up were excluded.

Results
103 patients were included, 40 survived and 63(61.1%) died. Deceased patients were older {66 years[IQR 18] vs 62.5[IQR 10], (p = 0.0237)}, more often male {48(68%) vs 22(55%), (p = 0.0247)}, had lower initial oxygen saturation {86.0%[IQR 18] vs 91.5%[IQR 11.5], (p = 0.0060)}, and had lower pH nadir than survivors {7.10[IQR 0.2] vs 7.30[IQR 0.2] (p < 0.0001)}. Patients had higher peak temperatures during ICU stay as compared to hospital presentation {103.3°F[IQR 1.7] vs 100.0°F[IQR 3.5], (p < 0.0001)}. Deceased patients had higher peak ICU temperatures than survivors {103.6°F[IQR 2.0] vs 102.9°F[IQR 1.4], (p = 0.0008)}. Increasing peak temperatures were linearly associated with mortality. Febrile patients who underwent targeted temperature management to achieve normothermia did not have different outcomes than those not actively cooled. Multivariable analysis revealed 60% and 75% higher risk of mortality with peak temperature greater than 103°F and 104°F respectively; it also confirmed hyperthermia, age, male sex, and acidosis to be predictors of mortality.

Discussion/Conclusion
This is one of the first studies to identify ICU hyperthermia as predictive of mortality in ventilated COVID-19 patients. Additional predictors included male sex, age, and acidosis. With COVID-19 cases increasing, identification of ICU mortality predictors is crucial to improve risk stratification, resource management, and patient outcomes.

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Title: Pathogenesis of Chronic Liver Disease

Presenter Name: Omar Gonzalez-Vega M.D.
Name of PI: Ragui Sadek M.D FACS SOEMBS.
Name of Co-authors: Andrew Wassef PhD candidate., Michael Donaire M.D FACS, Lora Melman M.D. FACS. FASMBS , Heath Antoine M.D. FACS., Siddharth Kudav M.D.,., Keith King M.D., Lisa Siracusa RPA-C.

Introduction: Chronic liver disease (CLD) is becoming more prevalent in the developing world and a leading cause of mortality. Most chronic liver diseases in the developed world include alcoholic liver disease, chronic viral hepatitis, including hepatitis B and C, non-alcoholic fatty liver disease (NAFLD), and hemochromatosis. The long-term consequences of these chronic diseases, including liver cirrhosis and hepatocellular carcinoma, will cause significant morbidity and mortality. According to the Centers for Disease Control and Prevention, more than 4 million people in the United States are affected by liver diseases. With the increasing prevalence of obesity and metabolic syndrome in U.S. Adults, prevalence of their manifestations in the liver like NAFLD and its more progressive form Non-Alcoholic Steatohepatitis (NASH), is also increasing. It is estimated that NASH will become the most common cause of advanced liver disease within the next 10 to twenty years. NAFLD was the most common cause of CLD and cirrhosis in a multiethnic cohort study published in 2016. An estimated 44 - 64% of patients with NAFLD develop NASH. Of these, 10 - 25% further progress to fibrosis and cirrhosis and 2 - 13% eventually develop hepatocellular carcinoma (HCC). In addition, NASH related cirrhosis is the most rapidly rising cause of liver transplantation and is anticipated to be the leading indication for liver transplantation in the near future.

Methods: Patients being seen at Robert Wood Johnson University Hospital (Dr. Sadek and his team) for surgery are routinely given a liver biopsy if sonogram or surgeon suspects liver abnormality. Patients 18-80 years of age with chronic liver disease will be included. Exclusions will be made for individuals with other infectious diseases, other than hepatitis B or C viral infection. The following biomaterials from participating patients will be included: 1. Fresh Liver Tissue, a pathologist will examine the tissue. After the pathologist's examination, small portion of fresh tissue may be collected. These tissue materials may be either kept frozen or processed freshly. 2. Blood, An approximate 10 mL of blood will be taken from either right or left arm of the patient before or on the same procedure date. Blood samples are processed by either placement in RNALater solution or centrifuged to separate plasma from cells and later stored in his -80*C freezer until analysis. After specimens are collected and stored, the tissue sections, fresh liver tissues, sera, or blood will be processed to downstream study including, but not limited, to patient-derived tumor xenograft, 3D liver organoids, cell line establishment, histological analysis, genetic and epigenetic analysis, and biomarker analysis.

Results: Specimen collection is currently underway at RWJUH. To date we have collected over 120 specimens. We anticipate recruiting 500 patients in this study. This sample size will provide sufficient data to identify the alterations at genetic/epigenetic and molecular/cellular levels associates with pathogenesis of liver diseases and HCC.

Discussion/Conclusion: The mechanisms for the establishment of chronic infection and carcinogenesis are not defined. Determining the alteration in genetic and/or epigenetic landscape, cytokine levels, as well as gene expression pattern will significantly contribute toward the understanding of pathogenesis and the finding of novel biomarkers for clinical diagnosis, prevention, and targeted treatment.

Robotic Pancreatoduodectomy: Trends in Technique and Training Challenges

Presenter: Catherine Davis, MD, MPH
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Background: As robot access increases and surgeon experience becomes more advanced, more complex cases are being performed robotically. However, no nationally sanctioned training program currently exists for robotic surgery akin to “Fundamentals of Laparoscopic Surgery.” A robotic pancreatoduodenectomy (RPD) curriculum has been developed and is being implemented at a very select number of institutions. However, the learning curve is at least 20-40 cases. This study aims to characterize trends in RPD over time, associated patient outcomes and opportunities for advanced trainees.

Methods: Using the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) Procedure Targeted Pancreatectomy database from 2014 to 2019, PD cases were studied, and operative approach (open-OPN, laparoscopic-LAP, robotic-ROB) was characterized. Proficiency was assessed by conversion rates, OR time, and case complexity. Postoperative outcomes were described by year and operative technique. Statistical analysis was performed using Wilcoxon rank sum and Mann-Kendall trend tests. AHPBA, SSO, and ASTS websites were used to determine the number of fellows per year.

Results: During the study period, a total of 24,268 PDs were identified, 71% of which were for malignant disease. The annual number of PD cases increased from 3,137 in 2014 to 4,820 in 2019. An increase was observed in the proportion of cases performed using minimally invasive techniques (LAP+ROB) from 7.0% to 11.0%. The ROB approach increased from 2.8% to 7.5% while the LAP approach decreased from 4.2% to 3.6%. By 2019 ROB accounted for a greater portion of minimally invasive operations (40.0% to 67.7%, $p<0.0001$). (Figure) OR time did not change over time in ROB cases (mean 372 minutes, $p=0.861$). Unplanned conversion increased over time for LAP (27.7 to 40.4%, $p=0.003$) but was unchanged for ROB cases (14.8% to 14.7%, $p=0.257$). No change was observed in the vascular reconstruction rate for patients undergoing robotic PD for malignancy ($p=0.628$). Morbidity increased in OPN PD (35.5% to 36.8%, $p=0.041$) and decreased in ROB PD (38.7% to 30.3%, $p=0.010$). Length of stay (LOS) decreased over time overall as well as by operative approach ($p<0.0001$). Mean LOS was lower in ROB than LAP and OPN (9.51 vs. 10.90, $p<0.00001$). Approximately 100 AHPBA, SSO, and ASTS fellows are being trained each year in North America. In 2019, only 360 RPDs were performed in NSQIP, which accounts for approximately 70% of the PDs. Thus, only about 5 RPDs are available per trainee per year which is far below the learning curve.

Conclusion: Over a six-year period, a gradual, but significant, increase was observed in the use of robotic pancreatoduodenectomy (RPD) without a concomitant increase in conversion rates. RPD was associated with decreased morbidity and length of stay. Despite a shift towards more RPDs, the number of cases being performed in North America is not adequate for all fellows to achieve the learning curve before graduation.

COVID-19 is affecting the presentation and treatment of melanoma patients in the Northeastern US

Presenter: Catherine Davis, MD, MPH

CH Davis[1], SH Greco[2], J Ho[1], VP Koshenkov[1], JM Farma[2], AC Berger[1]

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Background: The Covid-19 pandemic significantly affected healthcare delivery over the past year, with a shift in focus away from non-urgent care. There is data emerging showing that screening for breast and colon cancer has dramatically decreased. It is unknown whether the same trend has affected patients with melanoma.

Methods: This is a retrospective cohort study of melanoma patients at two large volume NCI-designated comprehensive cancer centers in the Northeastern US, an area significantly affected by the current Covid-19 pandemic and subject to widespread lockdowns. Patients were compared for 5 months prior to the lockdown (10/19–3/20) and after the lockdown (5/20-9/20). Outcomes focused on delay in treatment and possible resultant upstaging of melanoma.

Results: 237 patients were treated prior to the lockdown and 179 patients were treated after the lockdown (a 14% decrease). The primary site of melanoma included: 25% head and neck, 40% truncal, and 35% extremity. There was no delay in care after biopsy seen comparing the two groups (Table). However, fewer patients presented with in situ disease post-lockdown (18.1% vs 11.2%, p=0.054), and a higher proportion presented with stage III and IV melanoma (12.3% vs 11.0%). Finally, in Stage IIIB-IIID patients, there was a dramatic decrease in patients receiving adjuvant therapy in the post lockdown period (50% pre vs 23% post).

Conclusion: The recent pandemic has shifted focus away from non-urgent medical care. As a result for melanoma patients, it appears there has been a shift away from melanoma in situ and towards more advanced disease, which may have significant downstream effects on prognosis. Significantly fewer melanoma patients have presented to Surgical Oncology after the lockdown and fewer patients are undergoing the recommended adjuvant therapies. Though there does not appear to be a delay from time of biopsy to surgery, there may be delay in routine dermatology visits and obtaining biopsies of skin lesions. We also may see more disparity as the pandemic progresses. Patient outreach efforts are essential to ensure that patients continue to receive preventative medical care as the pandemic continues.

Table: Characteristics of Melanoma Patients Before and After Lockdown

	Pre-Covid Group (n=237)	Post-Covid Group (n=179)
Age, years (mean)	65.7	67.0
Sex, male (%)	62.9	58.1
Site of melanoma (%)		
Head/neck	26.7	23.6
Trunk	39.4	41.0
Extremity	33.9	35.4
Time from biopsy to surgical consultation, days (median)	17	16
Time from surgical consultation to surgery, days (median)	18	16
Pathologic Staging, %		
0	18.1	11.2
1a	44.7	46.9
1b	9.3	12.8
2a	8.0	8.9
2b	5.9	2.8
2c	3.0	5.0
3a	2.1	3.9
3b	2.5	2.2
3c	4.6	5.0
3d	1.3	0.0
4	0.4	1.1

CD40-mediated immune cell activation enhances response to anti-PD-1 in murine intrahepatic cholangiocarcinoma

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Background & Aims: While cholangiocarcinomas (CCAs) commonly express programmed cell death 1 (PD-1) and its ligand (PD-L1), they respond poorly to immune checkpoint inhibitors (ICIs). We aimed to determine whether stimulating antigen-presenting cells, including macrophages and dendritic cells, using a CD40 agonist could improve this response.

Methods: We compared treatment responses in subcutaneous, orthotopic, and 2 plasmid-based murine intrahepatic CCA (iCCA) models. Mice were treated for 4 weeks with weekly IgG control, a CD40 agonistic antibody, anti-PD-1, or the combination of both (anti-CD40/PD-1). Flow cytometric (FACS) analysis of lymphocytes and myeloid cell populations (including activation status) was performed. We used dendritic cell knockout mice, and macrophage, CD4+ and CD8+ T cell depletion models to identify effector cells. Anti-CD40/PD-1 was combined with chemotherapy (gemcitabine/cisplatin) to test for improved therapeutic efficacy.

Results: In all 4 models, anti-PD-1 alone was minimally efficacious. Mice exhibited a moderate response to CD40 agonist monotherapy. Combination anti-CD40/PD-1 therapy led to a significantly greater reduction in tumor burden. FACS demonstrated increased number and activation of CD4+ and CD8+ T cells, natural killer cells, and myeloid cells in tumor and nontumor liver tissue of tumor-bearing mice treated with anti-CD40/PD-1. Depletion of macrophages, dendritic cells, CD4+ T cells, or CD8+ T cells abrogated treatment efficacy. Combining anti-CD40/PD-1 with gemcitabine/cisplatin resulted in a significant survival benefit compared to gemcitabine/cisplatin alone.

Conclusion: CD40-mediated activation of macrophages and dendritic cells in iCCA significantly enhances response to anti-PD-1 therapy. This regimen may enhance the efficacy of first line chemotherapy.

Opioid Use Disorder Increases Readmissions After Cardiac Surgery: A Call to Action

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Abstract Presented as oral presentation at Society of Thoracic Surgeons Annual Meeting 2021. Manuscript under consideration in Annals of Thoracic Surgery

INTRODUCTION:
Due to the opioid epidemic, more cardiac surgery patients present with opioid use disorder (OUD). A better understanding of the national landscape of readmissions among these patients is necessary to improve outcomes and optimize resource utilization. We sought to examine the effect of OUD on readmission after cardiac surgery.

METHODS:
Of 555,394 cardiac surgery patients from 2016-2017 in the Nationwide Readmissions Database, 6,082 (1.1%) presented with OUD. These patients were analyzed as three timepoints: 30-days, 90-days, and 180-days post-discharge. OUD and non-OUD patients were propensity-score matched for patient- and procedure-level characteristics. Kaplan-Meier curves were compared using the log-rank test. Patients who died during index admission were excluded.

RESULTS:
OUD patients were significantly younger, more likely to be uninsured, and more likely to undergo an urgent operation compared to those without OUD. After matching, first-time readmissions were significantly higher among those with OUD (30-day 19.7% vs 15.7%, $p=0.04$; 90-day 31.8% vs 24.2%, $p<0.0001$; 180-day 42.3% vs 30.6%, $p<0.0001$) (Figure 1). There was a trend toward higher reoperation by 180 days (1.2% vs 0.9%; $p=0.46$) with 90% of these being isolated valve surgery. By 180-days, significantly more OUD patients had 3+ readmissions (7.8% vs 4.5%) compared to non-OUD patients. Yet, only 2.4% of OUD patients received any counseling or treatment for substance abuse during index admission. The most common readmitting diagnosis was infection (56% vs 45%; $p<0.0001$) including endocarditis, prosthetic infections, and skin/subcutaneous infections. Acute respiratory failure and opioid overdose were also more common among those with OUD. There were no differences in procedure-related complications ($p=0.33$).

CONCLUSIONS:
Cardiac surgery patients with OUD are subject to multiple readmissions but are rarely provided adequate addiction management during their index admission. Greater emphasis on multidisciplinary management is necessary to limit costs and morbidity associated with readmission/reoperation.

FIGURE 1: Freedom from readmission after cardiac surgery at 180 days

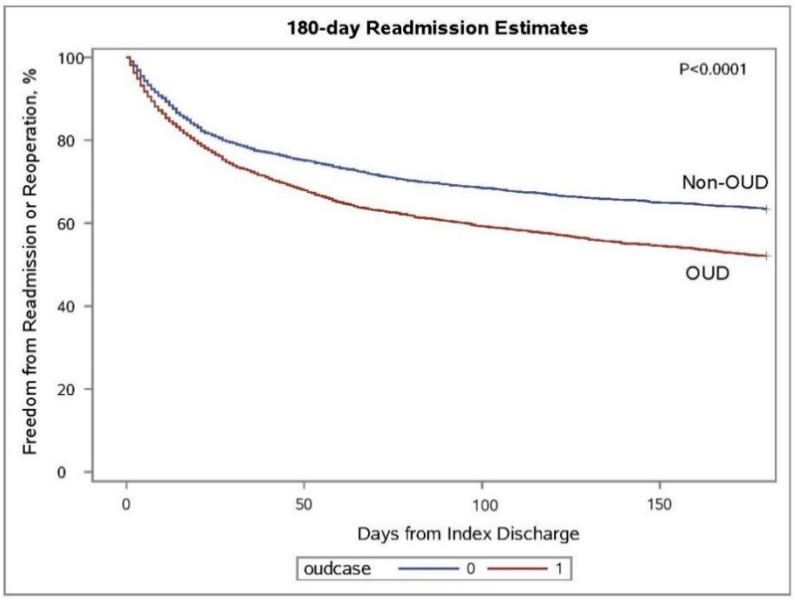
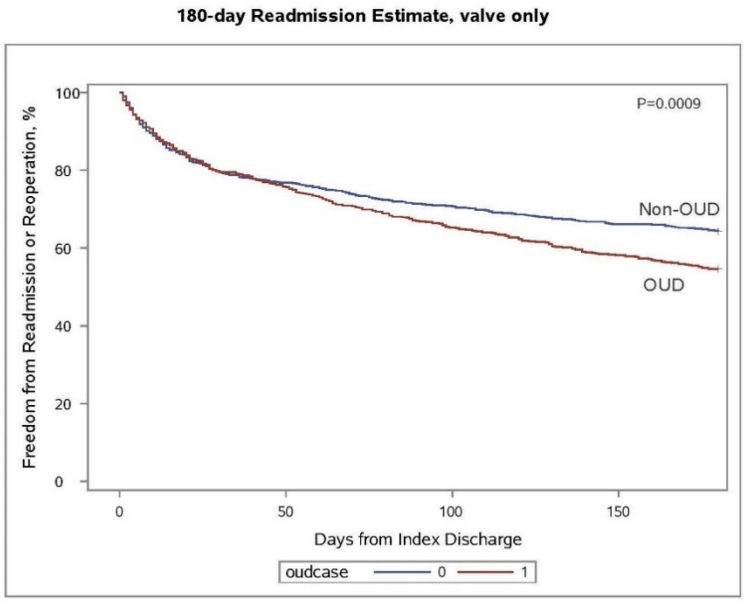


FIGURE 2: Freedom from readmission after isolated valvular surgery at 180 days



Surgical Outcomes in Thoracic Surgery During the COVID-19 Pandemic: Utilizing the NSQIP Risk Calculator as a Measure of Comparative Morbidity and Mortality

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Purpose: The COVID-19 pandemic has placed new restrictions on surgical management of disease. Initial guidelines have been in favor of delayed surgical management unless a critical need exists. Recently, more nuanced information has emerged that suggests that operative intervention may not pose the magnitude of risk originally anticipated.

Methods: This was a single-center retrospective observational study of patients who had surgery during the period from March 1, 2020 to May 26, 2020, the regional peak of the SARS-CoV-2 pandemic. Demographic data was collected and analyzed. Primary outcomes included in-hospital mortality, length of stay (LOS), 30-day readmission, ICU admission, readmission, and serious complications as defined by National Surgical Quality Improvement Program (NSQIP). COVID-19 status during admission was also recorded. Predicted values for primary outcomes were calculated using the NSQIP risk calculator. These predictions were then compared with the observed outcomes in our cohort.

Results: 14 thoracic surgery procedures were identified. Of these, 8 were video-assisted thoracoscopic surgery (VATS), 3 were thoracotomies, and 3 were esophagectomies. The average age of this cohort was 55.5 years old. 9 (64 %) of the procedures were on male patients. None of the patients in the cohort died within their index admission (0.0 % versus 7.57% predicted). Median LOS was 13 days (6.5 days predicted). 33% of patients were readmitted within 30 days (12.2% predicted). 4 patients (27%) were admitted to the ICU for during their admission, and 33% of patients experienced serious complications (23.1% predicted). (See Figure 1) None of the patients were COVID-19 positive and did not seroconvert during their admission.

Conclusions: Future waves of COVID-19 will place new constraints on thoracic surgical-procedures. Our initial-experience demonstrates higher observed-morbidity with limited impact on mortality. Limited risk of COVID-19 seroconversion from hospitalization likely resulted from hospital-practices instituted to minimize exposure/mitigate infective-risk to patients and practitioners. This study may help in triaging procedural-risk during pandemic-conditions.

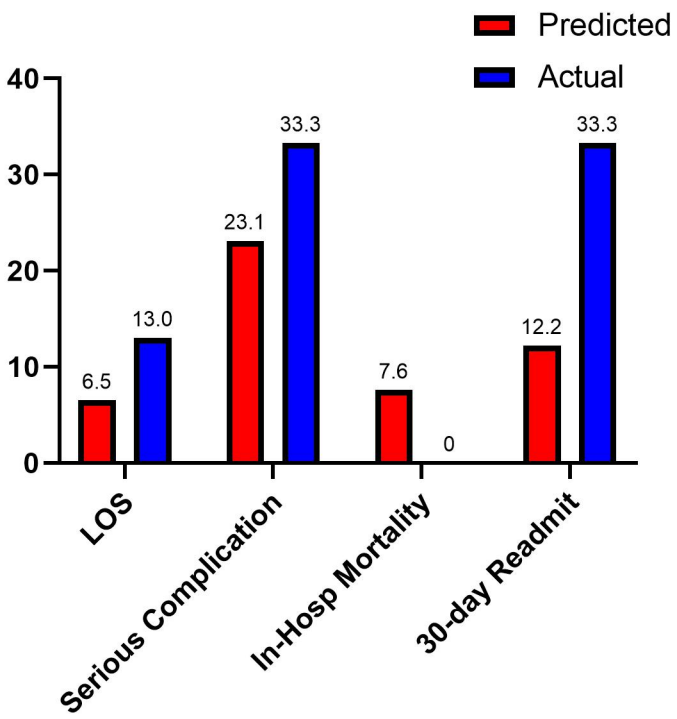

Figure 1. Observed outcome vs NSQIP prediction

Clinical Outcomes after Cardiac Surgery During the COVID-19 Pandemic: Experience from an Epicenter During Peak First Wave Conditions

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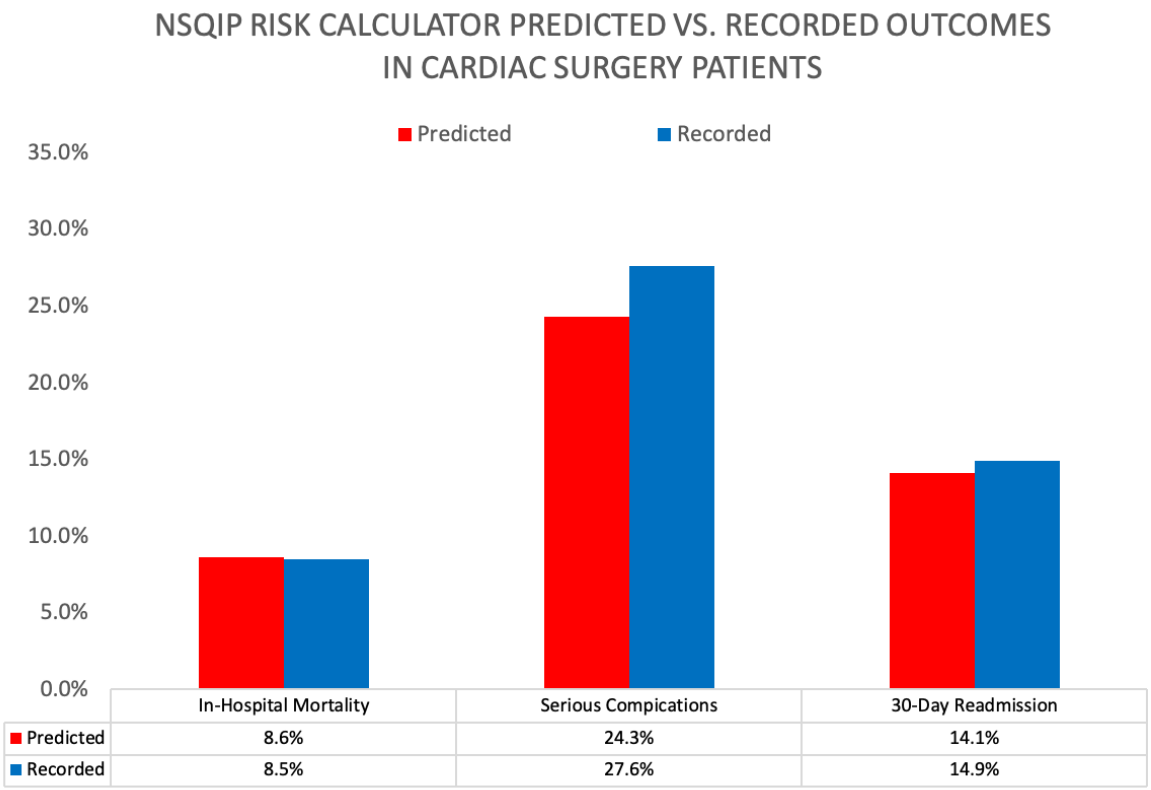
Purpose: The COVID-19 pandemic has created unprecedented circumstances. Pandemic practice-guidelines of various surgical societies recommend conservative management unless dire circumstances or impending mortality necessitates intervention. Limited data exist regarding cardiac-surgical outcomes during the pandemic. We describe clinical-outcomes of a series of patients who had cardiac-surgery under emergent-conditions at a pandemic epicenter.

Methods: This was a single-center retrospective observational cohort study of patients who had emergent cardiac surgery during the period from March 1, 2020 to May 26, 2020. This period coincided with peak COVID-19 infection rates in the region. Demographic data was collected and analyzed. Outcomes investigated included in-hospital mortality, serious complications, length of stay (LOS), in-hospital transmission, and 30-day readmission. Recorded rates were compared to predicted rates as estimated by the National Surgical Quality Improvement Program (NSQIP) surgical risk calculator; all cases were entered into the NSQIP calculator with an adjustment to reflect circumstances of significantly-higher than baseline risk.

Results: 47 patients undergoing cardiac surgery were identified. Of these, 23 underwent CABG (48.9%), 4 (8.5%) underwent concurrent CABG and valve replacement, and 1 underwent conventional mitral valve repair (2.1%). There were 19 (40.4%) minimally invasive (mini) interventions: 14 transcatheter aortic valve replacements (29.8%), 1 mini-aortic valve replacement (2.1%), 1 mini-mitral valve replacement (2.1%), 2 mini-mitral valve repairs (4.3%), and 1 MitraClip (2.1%). The mean age was 63.9 years old and 26 (55.3%) of the patients were male. Rates of in-hospital mortality, serious complications, readmission within 30-days, and in-hospital transmission were 8.5%, 27.6%, 14.9%, and 6.4%, respectively. Observed median LOS was 7 days. The NSQIP risk calculator accurately estimated comparable rates of morbidity to those observed. (Figure 1)

Conclusions: In this observational study from an epicenter of the COVID-19 pandemic, the rate of in-hospital transmission was very low. Mortality and morbidity rates were comparable with that estimated by the NSQIP risk calculator.

Figure 1:



	In-Hospital Mortality	Serious Compications	30-Day Readmission
Predicted	8.6%	24.3%	14.1%
Recorded	8.5%	27.6%	14.9%

Title: Managing Massive Transfusion Protocol During Cardiopulmonary Bypass in the Setting of Penetrating Traumatic Injury

Presenter Name: Dov Levine, MD and Sivaveera Kandasamy, MD

Other Authors: James Alford Flippin, MD; Hirohisa Ikegami, MD, and Rachel L. Choron, MD

Institution: Robert Wood Johnson Medical School

Case: A 34-year-old African American man was brought to the trauma resuscitation area with 2 gunshot wounds to his right anterior chest below his clavicle and his left back. On arrival, he appeared diaphoretic and in extremis, airway was intact, and he had breath sounds bilaterally. His heart rate was 154 bpm, he had palpable femoral pulses, and was hypotensive. His Glasgow Coma Scale was 14. Massive transfusion protocol (MTP) was initiated and a right femoral introducer catheter was placed. Bilateral chest tubes were placed without significant output. An expanding hematoma was noted extending from his sternal notch up his neck, which prompted intubation for airway protection. His focused assessment with sonography in trauma was negative. Chest and abdominal X-ray revealed mediastinal widening and 2 foreign bodies: 1 in the mediastinum and 1 in the left upper abdominal quadrant (Figure 1). He was transported to the operating room emergently.

The patient did not lose pulses prior to incision; therefore, a resuscitative left anterolateral thoracotomy was not performed. A sternotomy was performed 15 minutes after initial presentation, as we find sternotomy to be a less morbid incision than clamshell thoracotomy. There was substantial hematoma extending the length of the mediastinum originating from the great vessels along with massive active bleeding, direct pressure was held. Pericardiotomy was performed, the heart was beating, and there was no evidence of tamponade or cardiac injury. The pleura was opened bilaterally excluding pulmonary injury. Injuries were then identified to the brachiocephalic vein, brachiocephalic artery, and the aortic arch. Cardiothoracic Surgery was consulted intraoperatively and was available rapidly in this instance. Cardiopulmonary bypass (CPB) was initiated 38 minutes after initial incision. Dissection was carried out to reveal the brachiocephalic vein which was injured in multiple places and ligated. This exposed the proximal brachiocephalic artery which had severe destruction at the takeoff of the aortic arch. The bullet was identified lodged in the wall of the aortic arch and removed. The patient was systemically cooled to 24 degrees centigrade nadir for cerebral protection, and the CPB pump was stopped for circulatory arrest. The aorta was cross clamped and antegrade cold blood cardioplegia solution was provided to arrest the heart. After obtaining distal control and trimming the edges of the proximal and distal brachiocephalic artery, a 14 mm tube graft was sewn in place using 4-0 Prolene suture (Figure 2A). After 34 minutes of circulatory arrest, CPB was resumed and the patient was rewarmed. A simultaneous exploratory laparotomy was performed by a second trauma surgeon which revealed pancreatic tail and splenic injuries along with 2 gastrotomies. Because the injury to the innominate artery and aortic arch resulted in massive blood loss proximally, there was no substantial hemoperitoneum. Distal pancreatectomy, splenectomy, and primary repair of gastrotomies and diaphragm were completed.

Once regular heart rate and rhythm was established, he was rewarmed to 36°C, and CPB was weaned off after 133 minutes. Once off bypass, cannulas were removed. Protamine sulfate was given to reverse the heparin. Initially, the patient maintained his blood pressure. However, he eventually became bradycardic, and despite ventricular pacing, resuscitation and confirmation

hemorrhage control were obtained in both cavities; he had pulseless electrical activity and died. During his decompensation, a transesophageal echocardiogram (TEE) revealed substantial intracardiac thrombus which developed off pump (Figure 2B). Of note, TEE was used throughout the case and did not identify any thrombus until his demise.

Discussion: While a previous case series indicated innominate artery injury maybe amenable to repair without CPB and hypothermia, this patient's injury was extensive and not initially amenable to repair using a side biting clamp. Cardiopulmonary bypass also offers several benefits with this injury pattern. First, in the setting of massive hemorrhage with persistent bleeding expected during injury repair, heparinized blood is returned to the pump by pump suction so circulatory volume is not lost (cell salvage). An additional benefit is cooling the patient for circulatory arrest. While our cardiac surgery team was available without delay, that is not always the case; therefore, if the injury is amenable to repair without CPB that is preferable.

Despite massive hemorrhage, CPB requires heparinization; we followed standard cardiac surgery protocols regarding systemic heparinization prior to placing cannulas and maintained activated clotting time >400 seconds while on pump. Prior to going on pump, a 1:1:1 standard MTP resuscitation was utilized. Once on pump, packed red blood cell transfusion (pRBC) was pursued, and fresh frozen plasma (FFP) and platelet transfusion were limited to avoid pump thrombosis. When coming off pump, protamine was given. While protamine is not an absolute necessity, without it, massive bleeding can ensue, especially after a long pump run with circulation arrest. While intracardiac thrombus was secondary to low blood flow due to significant hemodynamic collapse and cardiogenic shock, protamine and massive resuscitation including FFP and platelet transfusion may have contributed to thrombotic burden. Because of our patient's severe hemorrhagic shock, we did not replace cannulas to restart CPB to pursue thrombectomy as it would have been unlikely to change the outcome as his arrest was multifactorial and not solely secondary to thrombus.

This case identified complex decision-making associated with MTP during CPB, as it differed from our standard trauma resuscitation. Trauma resuscitation has well-established protocols for blood product resuscitation in hemorrhagic shock. Decreased time to hemostasis and decreased mortality rates due to exsanguination have been found when following a 1:1:1 pRBC:platelet:FFP ratio. However, the literature has yet to describe optimal transfusion ratios for trauma patients undergoing cardiac surgery with CPB. Understanding the pathophysiology of trauma vs. cardiac surgery-induced coagulopathy is necessary to understand potentially differing resuscitation strategies. Trauma-induced hemorrhagic shock leads to loss of coagulation factors via hemorrhage and hemodilution with resuscitation fluids, excessive activation of coagulation factors, and coagulation cascade dysfunction due to hypothermia and acidosis, whereas CPB causes a consumptive coagulopathy as fibrinogen binds to the circuit, activating platelets. The tubing causes intrinsic and extrinsic pathway activation, ultimately leading to degranulation of platelets. In trauma and CPB, both mechanisms of coagulopathy exist.
Cell salvage during CPB is used to reduce the need for pRBC transfusion. Even so, additional pRBC transfusion is often required during CPB in cardiac surgery patients, based on increased morbidity when operating on CPB with decreased hematocrit. Several observational studies have examined resuscitation strategies and optimal ratios of product in the cardiac surgery (non-trauma) pop- ulation.3,4 Retrospective evidence for balanced re- suscitation suggests improved survival and reduction in organ dysfunction scores in patients receiving greater than 6 units pRBC and who received high ratios (greater than 1:1) of plasma:pRBC or platelets:pRBC

The management of blood component ratios delivered during MTP while on CPB in the setting of trauma- induced hemorrhagic shock is complex and yet to be studied. Several factors need to be considered. First, cell salvage may not replace all of the blood lost in trauma patients on CPB as additional injuries outside of the operating field may exist. The literature referenced above indicating higher plasma to pRBC or platelet to pRBC ratios does not take this into account. Further, complexity is added when considering the impact heparinization and protamine administration has on trauma-induced coa- gulopathy. Ultimately, randomized multicenter trials are needed to further address optimal ratios of blood product transfusion during MTP in trauma patients on CPB.

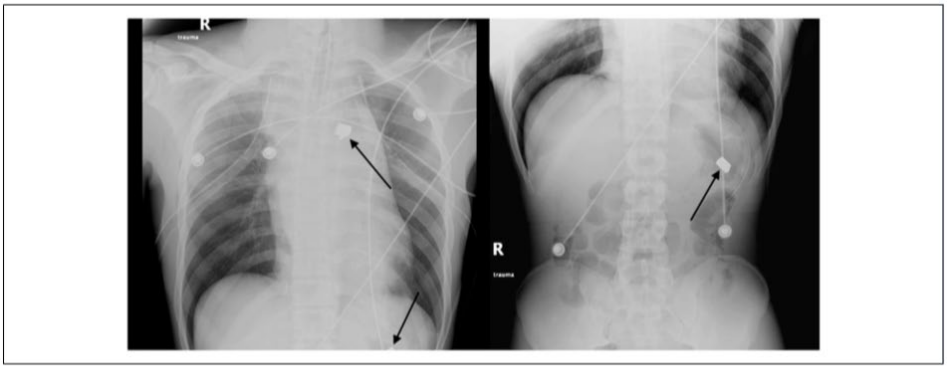


Figure 1. Radiographic imaging taken during the trauma resuscitation revealing mediastinal widening and foreign bodies consistent with bullets in the mediastinum and abdominal left upper quadrant.

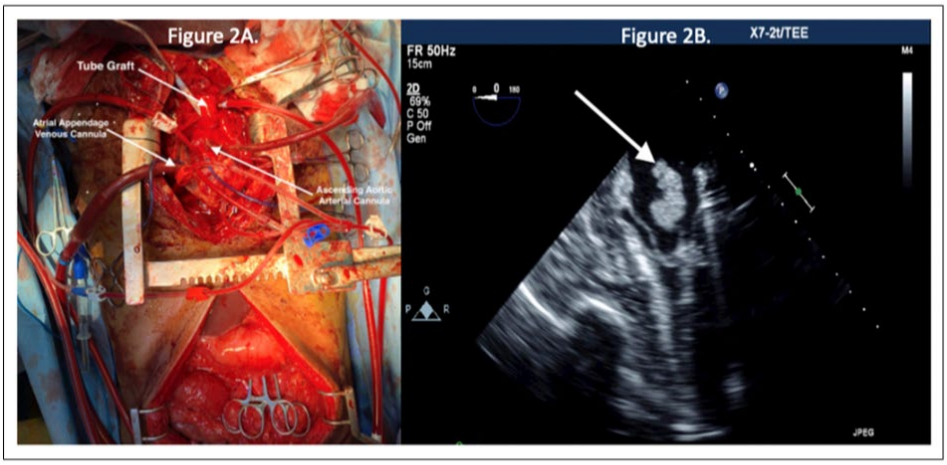


Figure 2. (A). Brachiocephalic artery injury repaired with tube graft while on cardiopulmonary bypass. (B). Transesophageal echocardiogram revealing intraoperative intracardiac thrombus.

Journal: Published in The American Surgeon, December 19th, 2020; **Preference:** Poster

Title: Underutilization of Nonopioid Pain Medication in Patients Undergoing Abdominal Aortic Aneurysm Repair

Presenter Name: Dov Levine MD

Other Authors: John Phair MD, Matthew Carnevale MD, Evan C. Lipsitz, MD Larry Scher MD, Saadat Shariff MD and Karan Garg MD

Institution: Albert Einstein College of Medicine

Introduction: With increased focus on the opioid crisis, it was our goal to describe rates and risk factors for postoperative use of opioids in patients undergoing abdominal aortic aneurysm (AAA) repair as well as identify pain modalities that are underutilized.

Methods: We retrospectively analyzed perioperative analgesic prescriptions for endovascular (EVAR) and open AAA repair between January 1, 2010 and January 1, 2018. Patients' baseline opioid use, demographics, and medical comorbidities were obtained. The EVAR group was further subdivided into percutaneous (pEVAR) and cutdown (cEVAR) groups. Primary outcomes were postoperative and discharge pain medication prescriptions. Relative rates of opioid prescribing were obtained through the electronic medical record and normalized into morphine milligram equivalents (MMEs).

Results: Of the 128 patients analyzed in the entire cohort, 21.8% (n=28) underwent open repair and 78.12% (n=100) underwent EVAR (46 pEVAR, 54 cEVAR). As expected, open repair had increased postoperative pain reported compared to EVAR (2.67 ± 0.75 vs. 0.96 ± 0.19, $P < 0.01$). Adjunctive epidural reduced postoperative pain for open repair (0.77 ± 0.48 vs. 3.50 ± 0.96, $P < 0.01$). EVAR had less postoperative opioid prescriptions compared to open repair (35.0% vs. 77.3%, $P < 0.01$). In the endovascular group, there was no difference between postoperative opioid prescription based on access, pEVAR versus cEVAR (65.8% vs. 80.1%, P=0.11). When stratifying patients by number of cutdowns, patients with bilateral cutdown as opposed to a single cutdown received more opioid prescriptions than pEVAR patients (84.44% vs. 65.8%, P=0.036). Of those receiving opioids, the average MME for open repair was 320.94 mg compared to 28.82 mg for EVAR ($P < 0.01$). Those undergoing percutaneous repair had significantly less MME use during hospitalization compared to femoral cutdown (17 ± 3.52 vs. 31.90 ± 5.43 mg, $P < 0.01$). Nonsteroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen and ketorolac, were rarely used in the postoperative period for open or EVAR (8.3% vs 1.1%). Percutaneous EVAR patients reported less pain at discharge compared to cEVAR patients (0.18 ± 0.12 vs. 0.88 ± 0.29, P ¼ 0.036). Open and EVAR had comparable low rates of NSAID and acetaminophen prescriptions at discharge. Open patients had longer postoperative length of stay compared to EVAR patients (9.82 ± 1.27 vs. 3.86 ± 0.47, $P < 0.01$). pEVAR had a shorter length of postoperative course compared to cEVAR (3.2 ± 0.26 vs. 4.12 ± 0.30, $P < 0.01$). Patients undergoing EVAR with use of pain medications amounting to <20 MME had a significantly shorter length of stay.

Conclusions: This single institutional retrospective study evaluated pain prescription patterns for patients undergoing AAA repair. AAA patients are predominantly treated with opioid pain medications with few adjunctive therapies. Intraoperative epidural and pEVAR may aid in decreasing the total MME used; however, the total number of opioids prescribed is similar for pEVAR and cEVAR despite the difference in approach. Clinicians must consider alternative nonopioid based pain management strategies.

Journal: Published in Annals of Vascular Surgery, October 2020

Title: Traditional Femoral Artery Cannulation is Safe for Ascending Aortic Dissection Repair
Presenter Name: Dov Levine, MD

Other Authors: Joshua Chao MD, Lauren Salgueiro BS, Hirohisa Ikegami MD, Mark J Russo MD, MS, Leonard Y. Lee MD, and Anthony Lemaire MD

Institution: Robert Wood Johnson Medical School

Introduction: The optimal cannulation site for repair of Type A Aortic dissection remains controversial. The concern for malperfusion syndrome has initiated a national trend away from femoral cannulation to axillary artery and direct ascending aortic cannulation. The purpose of this study was to report a single center experience with femoral artery cannulation for the repair of type A aortic dissection.

Methods: A retrospective study was performed on 111 patients who underwent surgical repair for a Type A dissection between January 1st, 2011 and September 11th, 2019 at a single institution. A total of 116 arterial cannulations were performed. These consisted of 83 (71.6%) femoral, 16 (13.8%) ascending aorta, and 17 (14.7%) axillary cannulations. Deep hypothermic circulatory arrest was used in all the patients. Rates of postoperative complications and mortality were reported.

Results The mortality rate for all patients undergoing repair of the Type A dissections was 26.1% (29/111), with no difference observed between those undergoing femoral, axillary, ascending aorta cannulations (26.8%, 20.0%, 28.6%, respectively; p=0.88). None of the mortalities identified were directly attributable to the cannulation approach in each case. There was no statistically significant difference in rates of malperfusion directly due to cannulation strategy (1.2% femoral, 5.8% axillary, 6.3% ascending aorta; p=0.19). Similarly, there was no difference in bleeding rates at the site of cannulation (1.2% femoral, 0% axillary, 0% ascending aorta; p=1).

Conclusions: Despite the recent shift away from femoral cannulation, the results of the study show that femoral artery cannulation is safe and produces excellent results for establishing cardiopulmonary bypass. The concerns for malperfusion syndrome related to femoral cannulation were not seen.

Conference: Presented at Eastern Cardiothoracic Surgical Society Annual Meeting. October 8, 2020

Title: The Approach of Insertion of the Impella Ventricular Assist Device Does Not Impact Stroke Risk

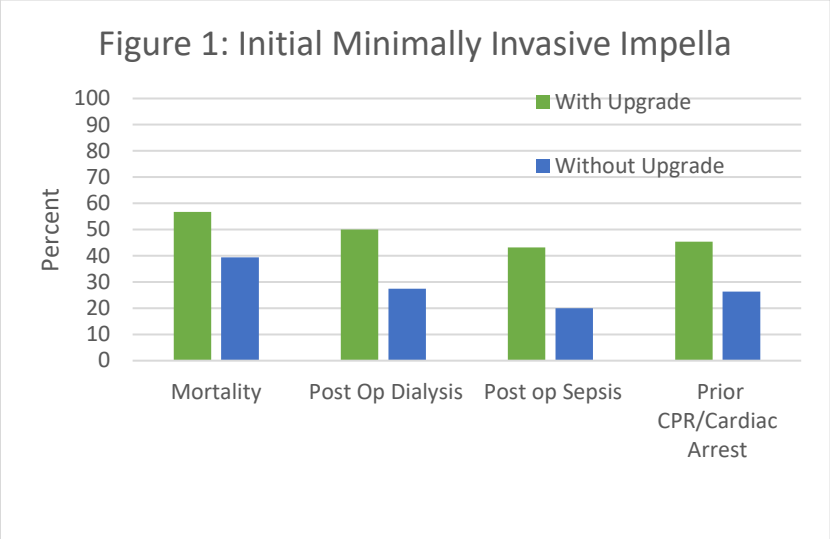
Presenter Name: Dov Levine, MD

Other Authors: Lindsay Volk MD, MPH, Fady Soliman BA, Hirohisa Ikegami MD, Mark J Russo MD, MS, Leonard Y. Lee MD, and Anthony Lemaire MD

Introduction: The Impella heart pump is an intravascular microaxial device that provides short-term mechanical circulatory support and can be placed through the femoral, axillary, or central vessels. One of the most feared complications is stroke. It is unclear if patient stroke risk varies based on access vessel.

Methods: A retrospective review of consecutive patients who underwent Impella placement at an academic institution from January 1st, 2007 through September 15th, 2018 was performed. Four groups were compared: (a) minimally invasive Impella (femoral or axillary access); (b) minimally invasive Impella upgraded to another minimally invasive Impella; (c) minimally invasive Impella upgraded to a central Impella (ascending aorta); (d) central Impella. Patient charts were reviewed to identify baseline characteristics. Outcome measures included length of stay (LOS), stroke, and mortality.

Results: 349 patients (or 407 Impellas) were identified and the majority of the devices were inserted through a minimally invasive approach (n=248, 60.9%), while the remainder were implanted via central access (n=159, 39.1%). 44 patients had their minimally invasive Impellas upgraded. The risk of stroke for the entire cohort was 10.3% (n=36), with no difference observed in one particular group. Overall mortality was 44.4% (n=155). Of the patients who initially received a minimally invasive Impella, those who were upgraded had significantly higher rates of mortality (56.8% vs. 39.4%, p=0.03), post-op dialysis (50.0% vs. 27.4%, p<0.01); and sepsis (43.2% vs. 20.0%, p<0.01). (Figure 1)



Conclusion: This study found no statistically significant different in rates of postoperative stroke based on initial access vessel.

Conference: Presented at Eastern Cardiothoracic Surgical Society Annual Meeting. October 8, 2020

Creation And Validation Of An Outreach Metric For Community Nephrologists In A Concentrated Market

O. Eletta, D.Walls, V. Roberts, J. Luden, S. Puri, R. Pelletier, A. Bongu, Rutgers Robert Wood Johnson Medical Center, New Brunswick, NJ

Introduction:

Although there are 250 transplant centers in the United States, densely populated regions of the country have more centers. While UNOS region 2 (NJ, PA, DE, MD, DC, WV) is considered competitive, in NJ few centers control the market share. For patients in metropolitan areas, selecting a center is determined by reputation and influenced by referral relationships. Programmatic changes can contribute to transient volume increases, however the target for sustainable growth is referral behavior. We used public and internal data to create a simple metric to trend and target outreach to community nephrologists.

Methods:

Our referral metric was calculated as a composite score based on core factors (Figure 1). The dialysis center data was obtained from CMS dialysis facility reports released annually. Based on the final distribution, we simplified referral metrics on a scale from 1-10. Higher scores corresponded to less favorable referral behavior. Our outreach to dialysis centers and nephrologists began 02/2019 but was limited as the COVID-19 pandemic progressed. We used our referral metric over the following periods: Interval 1 = 11/2018-04/2019, Interval 2 = 05/2019-10/2019, Interval 3 = 10/2019-10/2020.

Figure 1: Composite Score Calculation

A) Historical Transplants (10 years) – 0 to 5 points were assigned with a maximum given to the highest decile of 50+ transplants.

B) Number of referrals – 0 to 5 points were assigned with a maximum given to over 25 referrals over the interval.

C) Days since last referral – 0 to 3 points were assigned with a maximum given to a referral within the last 30 days.

D) Percentage of overall referrals – 0 to 3 points were assigned with a maximum given to >60% of overall referrals over the time period.

E) Dialysis center correction factor - If the percentage of listed dialysis facility patients at our center was >50% an additional point was given to the affiliated nephrologists.

Table 1: Referral Metrics

	Interval 1			Interval 2			Interval 3		
	Outreach (n=29)	No (n= 83)	*p*	Outreach (n=29)	No (n= 83)	*p*	Outreach (n=29)	No (n= 83)	*p*
Metric by Individual	6	6	.14	3	5	.00	4	5	.77
Metric by Practice	5	6	.36	3	5	.00	4	4	.26

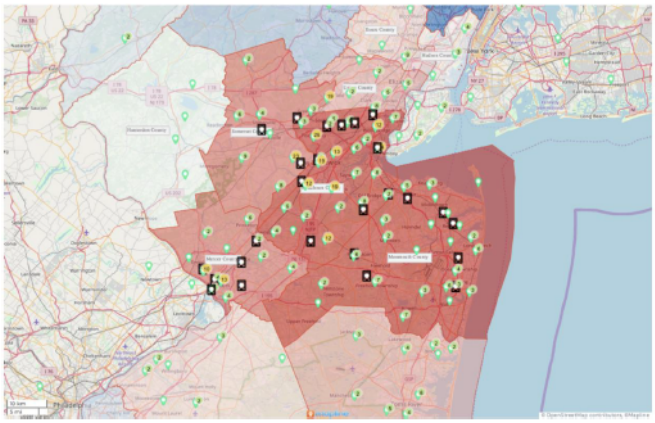


Figure 2: Heat map of referrals over Interval 3. Each referral is mapped as a point with dialysis centers (black)

Results:

We performed 29 outreaches from 11/2018-10/2019 and received 961 referrals. When comparing referral metrics for groups with and without outreach, the metrics were lower for the outreach groups. (Table 1). The metrics for Interval 2 were significantly lower (Outreach group - 3 vs. 5, $p<0.00$). Results did not change when scoring individual or practice-based outreaches. Interval 3 was used to pattern sustainable referrals. For the outreach group, comparison of metrics for Interval 1 to Interval 3 were improved, however this was not significantly different from the no intervention group. There were no differences in number of transplants over this duration between groups.

Conclusions:

Targeted outreach has a potential impact on improving referrals. For the longer Interval 3, sustainability may have been impacted by lack of in person outreach during COVID-19 pandemic. Further external validation is necessary for generalizability.

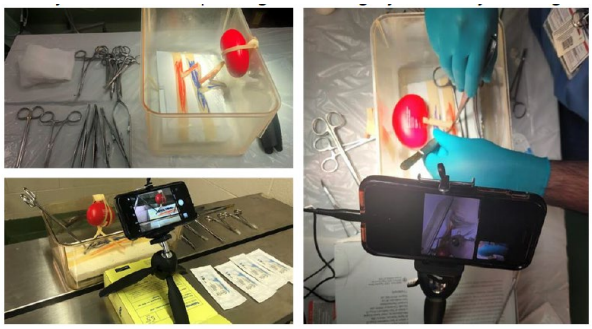
Feasibility of a Virtual Renal Transplant Simulation Model for Surgical Trainees in the Covid Era

Author Block O. Eletta1, S. Iacono1, D. Walls1, S. Lawrence1, S. Puri2, B. Perry1, C. Anderson1, M. J. Nguyen3, A. Bongu2, *1General Surgery, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ, 2Transplant, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ, 3Transplant Institute, Loma Linda University Medical Center, Loma Linda, CA*

Introduction: The COVID-19 pandemic and social distancing requirements has affected our resident education curriculum. We developed a virtual renal transplant simulation session to simulate renal vascular anastomoses (RVA). We hypothesize that this tool can be used to continue surgical skills education and enhance resident comfort with RVA in the COVID era.

Methods: We employed a well described model to mimic RVA to the iliac vessels using a mock kidney and penrose drains in a 5x8x11inch transparent container to simulate operating in the iliac fossa. Additionally, each kit included camera stands for mobile phones. General surgery residents with varying levels of experience participated. Our virtual workshop started with a demonstration and took place via a live video interface from several remote locations. An attending surgeon observed each resident and provided real time feedback. Pre and post simulation surveys were sent out to elicit comfort levels with procedure on a scale from 0 (not comfortable) to 100(very comfortable) and fidelity as a tool to improve general surgery residency training in renal transplantation.

Results: 16 surgical residents participated in the simulation. 12 (75%) had previously rotated on transplant surgery service. 75% of residents reported performing <10 vascular anastomoses. There was a statistically significant increase in mean comfort level score with performing a vascular anastomosis after the simulation compared to before (52 vs 23, P <0.01). There was also a statistically significant increase in mean comfort level score for assisting with a vascular anastomosis after compared to before (70 vs 38, p<0.01). 100% of residents reported that the model was useful for practicing needle control and precision, practicing knot tying, and learning the steps for completing renal vascular anastomoses. All residents recommended that this training model be used prior to rotating on the transplant service.



Conclusions: We demonstrated the feasibility of virtual sessions that surgical residents found to be effective in improving their technical skills. This method can be modified for other elements of surgical simulation while maintaining social distancing measures.

Accepted for Presentation at the American Transplant Congress

The Use of an *Ex Vivo* Tumor-Bearing Perfusion Model to Investigate the Effects of a Novel Immunotherapeutic Agent

Presenter: Alexander J. Rossi

Alexander J. Rossi[1], Emily A. Verbus[1], Tahsin M. Khan[1], Martha Teke[1], Areeba Saif[1], Shahyan U. Rehman[1], Hanna Hong[1], Allen J. Luna[1], Kirsten Remmert[1], Surajit Sinha[1], Michelle Padget[2], Andrew M. Blakely[1], Jeremy L. Davis[1], James W. Hodge[2], Jonathan M. Hernandez[1]

1 Surgical Oncology Program, Center for Cancer Research, National Cancer Institute
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Introduction: To guide the application of immuno-oncologic (IO) agents, a greater understanding of the tumor microenvironment (TME), including the dynamic interactions among the cells present, is required. Many IO agents have shown promising results in the treatment of various types of cancer, but the results are inconsistent and often confusing. This underscores the variability of tumor response to IO agents, and the need to interrogate patients individually to elucidate effect. We seek to gain insight into this problem by using our new SMART (Surgically-resected tuMor with intAct microenviRonmenT) System for sustaining tumor-bearing human tissue *ex vivo* to study a therapy's effects on the TME. Here, we study Bitrafusp alfa (Bintra), a novel IO agent consisting of the IgG1 anti-PD-L1 checkpoint inhibitor Avelumab fused via peptide linkers to two TGF-β receptor molecules, designed to bind and sequester TGF-β in the TME in an attempt to combat tumor progression. TGF-β is a well-studied cytokine that has immunosuppressive, pro-tumorigenic effects in the TME and is such an ideal target to combine with a PD-L1 inhibitor, as it has the ability to potentiate the IO agent's action.

Methods: Tissue containing tumor procured from seven patients was affixed to platforms and placed in a perfusion circuit. This setup, the SMART System, sustains human tissue by exposing it to continuously circulating perfusate made from the patient's own plasma (Figure 1). Bintrafusp alfa was introduced into the system and the perfusate was sampled at 1, 12, 24, and 48 hours after drug addition. A control system was set up concurrently using the same patient's tissue and plasma. Tissue and perfusate samples from each time point were then analyzed via ELISA, H&E, and IHC as well as multiplex imaging.

Results: TGF-β levels measured via ELISA decreased in all patients to an average of 3.9-5.6% of baseline as early as 1 hour after addition of drug, whereas TGF-β levels in control systems did not show a comparable decrease in concentration (Figure 2a). 1 patient out of the 7 with PD-L1 positive mesothelioma had potential drug-induced apoptosis on histology that was correlated with positive TUNEL apoptosis staining on IHC. This patient also had an over 5000% increase in the phagocytosis marker calreticulin from baseline as measured by ELISA (Figure 2b). Multiplex live imaging and IHC of the platforms in this patient's drug treated System also showed immune cell accumulation around tumor cells when compared to their control System.

Conclusion: Addition of Bintrafusp alfa yielded an immediate and sustained decrease in the circulating level of TGF-β in all Systems treated with the drug. Conversely, an increase in the phagocytotic marker calreticulin as well as positive staining for the TUNEL apoptosis stain was present in only one patient's drug-treated System. These findings suggest our novel SMART System allows for the successful *ex vivo* perfusion of resected tumor-containing peritoneum and gives insight into the varied effects of immune activity and IO agent responsiveness in different patients, which offers the potential for the development of personalized treatment strategies.

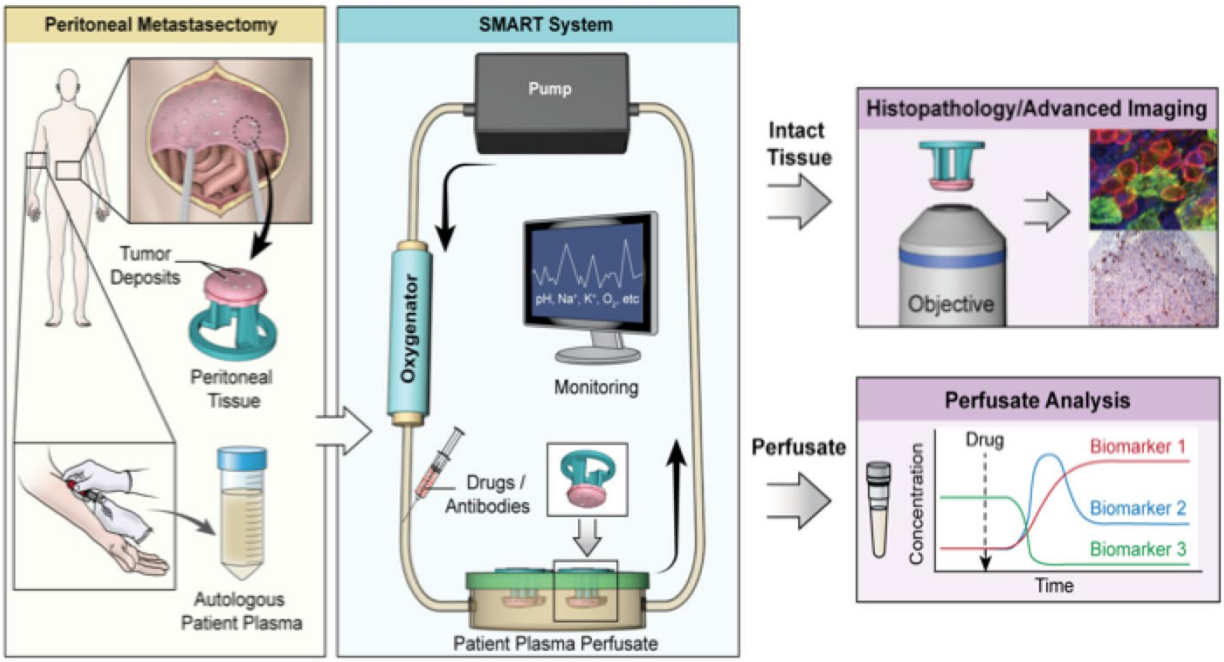

Figure 1 Schematic showing the normal workflow from tissue procurement in the operating room to perfusion our SMART System circuit with subsequent analysis being performed using both the intact tissue from the Platforms and the perfusate from the Systems

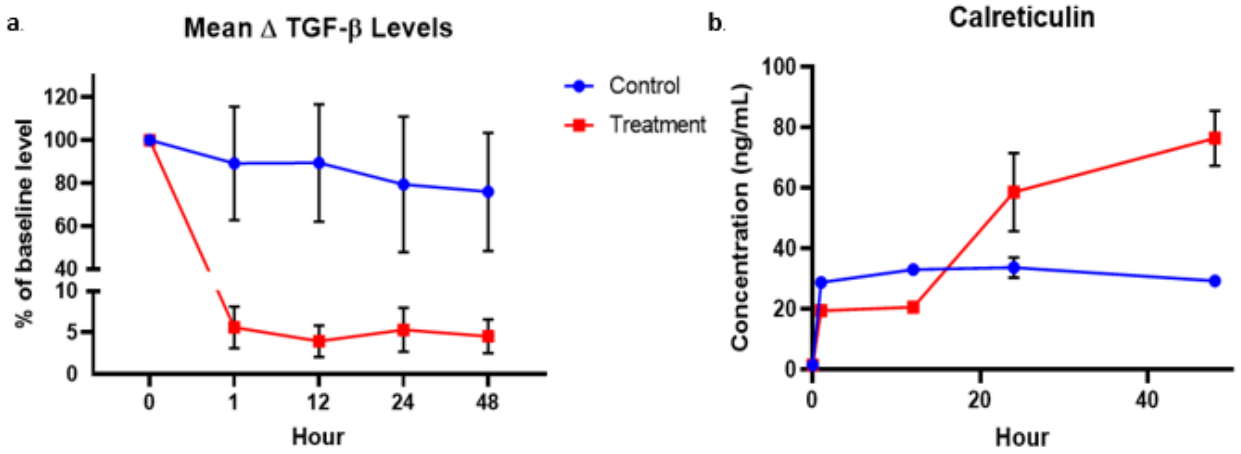

Figure 2 a. Average TGF-β in all 7 patients over time showing an immediate decrease in levels after 1 hour in a System exposed to Bintra with no relative decrease in Control Systems. **b.** Increase in calreticulin in patient with peritoneal mesothelioma indicating an increase in phagocytosis over the course of 48 hours in the treatment System without a concurrent increase in the Control System

Poster Presented at SSO Virtual Annual Meeting, March 2021

Expression of PD-L1 in patients with Malignant Peritoneal Mesothelioma: A pilot study

Presenter Name: Victor Gazivoda

Victor P Gazivoda[1], Aaron Kangas-Dick[1], Alissa Greenbaum[1], Joshua Roshal[2], Chinxia Chen[3], Dirk F Moore[3], Victor Gall[1], Russell C Langan[1], Miral S Grandhi[1], Timothy J Kennedy[1], David A August[1], Christine Minerowicz[4], H. Richard Alexander[1]

1. Division of Surgical Oncology, Rutgers Cancer Institute of New Jersey, New Brunswick, NJ, United States.
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ABSTRACT

Introduction: Several studies have demonstrated anti-tumor activity in patients receiving PD-L1 blockade for malignant mesothelioma with PD-L1 expression. However, the frequency of PD-L1 expression and possible role of immunotherapy in MPM has not been well characterized. The purpose of this study was to determine PD-L1 expression in MPM and perform exploratory analysis on its biological behavior in MPM.

Methods: MPM tumor samples were collected from patients undergoing cytoreductive surgery and regional and/or systemic chemotherapy between January 2018 and June 2020. Specimens were stained with anti-PD-L1 antibodies (Dako 22c3) according to manufacturer specifications with appropriate controls. Tumor proportion score (TPS) and combined positive score (CPS) were performed for each tumor sample with a threshold of ≥ 1% representing a positive score.

Results: Twenty-one total samples were obtained from 21 patients (M: 12; F: 9). Median age was 57.0 years (IQR 43.0-69.5). Sixteen of 21 (76%) tumor samples were CPS positive and 9/21 (43%) were TPS positive. Three patient samples had biphasic/sarcomatoid histology, known to be more aggressive, and high CPS and TPS scores (CPS: 3, 75, 95%; TPS: 2, 60, 90%). On exploratory analysis, as the CPS or TPS threshold increased, there was a trend towards shorter OS. With CPS or TPS scores $\geq$5% actuarial median OS was 49 months versus 110 months for PD-L1 scores < 5%.

Conclusion: MPM has high frequency of PD-L1 expression which may be associated with more aggressive tumor biology. These data provide the foundation for a continued evaluation of checkpoint inhibition in patients with MPM.

This project was accepted and presented as an oral presentation at the SSO 2021 – International Conference on Surgical Cancer Care virtual meeting on March 19, 2021.

Pancreatoduodenectomy: Does the Metabolic Syndrome Alter Outcomes?

Presenter Name: Victor Gazivoda

Victor P. Gazivoda[1], Alissa Greenbaum[1], Matthew A. Beier[2], Catherine H. Davis[1], Aaron W. Kangas-Dick[1], Russell C. Langan[1], Miral S. Grandhi[1], David A. August[1], H. Richard Alexander[1], Henry A. Pitt[1], Timothy J. Kennedy[1]

1. Division of Surgical Oncology, Rutgers Cancer Institute of New Jersey, New Brunswick, NJ, United States.
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Background:

Patients with the Metabolic Syndrome (MS) are a high-risk patient population who may have increased perioperative morbidity and mortality. Whether the MS is associated with worse outcomes after pancreatoduodenectomy (PD) remains unclear due to conflicting results in the literature. The aims of this analysis were to investigate the association of MS with mortality, serious morbidity, and pancreatectomy specific outcomes in patients undergoing PD.

Methods:

Patients with the MS who underwent PD were selected from the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) including the pancreatectomy specific PUF's from 2014-2018. MS was defined as having obesity (BMI ≥ 30 kg/m^2), diabetes mellitus (DM), and hypertension (HTN). Patients with missing variables for height, weight, DM, HTN, postoperative pancreatic fistula (POPF), delayed gastric emptying (DGE), and variables that constitute serious morbidity were excluded. Serious morbidity was defined as deep surgical site infection, organ space infection, dehiscence, pneumonia, unplanned intubation, pulmonary embolism, ventilator dependence, acute renal failure, cerebral vascular accident, cardiac arrest, myocardial infarction, sepsis, and septic shock. Demographics and outcomes were compared by χ^2 and Mann-Whitney tests. Additionally, adjusted odds ratios (aOR) were generated from multivariable logistic regression to assess the association between MS and primary outcomes adjusted for clinically relevant baseline characteristics.

Results:

Of the 19,054 patients undergoing PD who met inclusion criteria, 7.3% (n = 1,388) had the MS. Patients with the MS had increased cardiac and respiratory comorbidities as well as an ASA Classification ≥ III compared to patients without the MS. No significant differences in pancreatic duct size, pancreatic texture, or malignant vs benign pathology were found between MS and control patients. On univariable analysis, patients with the MS had significantly worse outcomes ($p < 0.05$), including 30-day mortality (3% vs 1.8%), serious morbidity (26% vs 23%), re-intubation (4.9% vs 3.5%), pulmonary embolism (2.0% vs 1.1%), acute renal failure (1.5% vs 0.9%), cardiac arrest (1.9% vs 1.0%), and DGE (18% vs 16.5%). On multivariable analysis, 30-day mortality and serious morbidity were significantly increased in patients with the MS (Table 1).

Conclusion:

The Metabolic Syndrome is associated with increased morbidity and mortality in patients undergoing pancreatoduodenectomy. Patients with the MS undergoing PD may benefit from being medically optimized prior to surgery. Preventive strategies with respect to thrombosis prophylaxis, fluid management, and cardiac protection should be employed in the perioperative

management of patients with the MS given the increased risk for pulmonary embolism, renal failure, and cardiac arrest.

Table 1. Multivariable analysis of outcomes related to the Metabolic Syndrome

Metabolic Syndrome	**aOR**	**95%CI**	**p value**
30-Day Mortality	1.58	(1.12, 2.17)	< 0.01
Serious Morbidity	1.14	(1.00, 1.30)	0.04
CR-POPF	1.16	(0.98, 1.37)	0.08
DGE	1.14	(0.99, 1.31)	0.07

This project was submitted and pending decision to the Americas Hepato-Pancreato-Biliary Association (AHPBA) 2021 Annual Meeting.

Factors associated with upstaging of melanoma thickness on final excision – review of the National Cancer Database (NCDB)

Presenter Name: Victor Gazivoda

Victor P Gazivoda[1], Patrick D Hilden[2], Aaron W Kangas-Dick[1], Alissa A Greenbaum[1], Catherine Davis[1], Franz O Smith[3], Vadim P Koshenkov[1], Adam C Berger[1]

1. Division of Surgical Oncology, Rutgers Cancer Institute of New Jersey, New Brunswick, NJ, United States.
2. Department of Biostatistics, RWJ-Barnabas Health, Livingston, NJ
3. Department of Surgery, RWJ-Barnabas Health, Livingston, NJ

Introduction: The incidence and risk factors associated with upstaging from initial biopsy to definitive excision in cutaneous melanoma have not been established. The aim of our study was to determine the incidence of T stage upstaging of cutaneous melanoma and associated risk factors using the NCDB.

Methods: A retrospective study of the NCDB between 2012-2016 was performed. After excluding patients not treated at the reporting center, those with missing T stage data, and clinical stage T4 patients, the remaining cohort was 133,592 patients. Differences in characteristics based on upstaging were determined using Wilcox rank-sum test, Chi-squared, or Fisher's exact test as appropriate. Multivariable (MV) analysis was performed using logistic regression to determine risks of upstaging.

Results: Incidence of upstaging was 5.2%. Upstaged patients tended to be older, male, of non-white race, and live in a zip code of lower education level (all $p<0.001$). Lesions of the head and neck (OR [95% CI]: 1.82 [1.68, 1.97]) and lower extremity (1.39 [1.26, 1.53]) had increased incidence of upstaging compared to the trunk (overall $p<0.001$). In addition, nodular melanoma (3.01 [2.73, 3.32]) and acral lentiginous (4.83 [4.13, 5.64]) were associated with the highest incidence of upstaging compared to superficial spreading melanoma (overall $p<0.001$). Finally, patients with lymphovascular invasion had an increased risk of upstaging (3.94 [3.53, 4.40], $p<0.001$).

Conclusion: Upstaging is infrequent but anatomic site and biologically aggressive tumor pathology contribute to increased risk of upstaging. These are important factors to consider since upstaging can alter surgical management, post-operative management, and prognosis.

This project was submitted and pending decision to ACS Clinical Congress 2021.

Variable	Group	OR	95% CI	P value
Age (per 10 years)		1.21	(1.18, 1.24)	< 0.001
Sex	Female Male	reference 1.13	 (1.07, 1.20)	< 0.001
Race	White, non-Hispanic Black, non-Hispanic Other, non-Hispanic Hispanic	reference 2.07 1.58 1.36	 (1.56, 2.72) (1.18, 2.07) (1.09, 1.68)	< 0.001
Facility Type	Academic Community Integrated	reference 1.13 1.29	 (1.06, 1.20) (1.17, 1.41)	< 0.001
Charlson/Deyo Score	0 1 2 3+	reference 1.36 1.41 1.66	 (1.26, 1.48) (1.21, 1.64) (1.33, 2.06)	< 0.001
Education (% did not graduate HS) (quartile)	< 6.3% 6.3%-10.8% 10.9%-17.5% 17.6%+	reference 1.12 1.14 1.41	 (1.05, 1.21) (1.06, 1.24) (1.28, 1.54)	< 0.001
Site	Trunk Head/Neck LE UE Other	reference 1.82 1.39 1.12 2.24	 (1.68, 1.97) (1.26, 1.53) (1.03, 1.21) (1.59, 3.08)	< 0.001
Histology	Superficial Spreading Malignant NOS Lentigo Maligna Nodular Acral Lentiginous Other	reference 0.85 0.51 3.01 4.83 4.48	 (0.79, 0.91) (0.45, 0.57) (2.73, 3.32) (4.13, 5.64) (3.99, 5.03)	< 0.001
Clinical T stage	0/IS 1 2 3	reference 1.08 1.40 0.82	 (0.99, 1.17) (1.28, 1.54) (0.73, 0.91)	< 0.001
Lymphovascular invasion	Absent Present	reference 3.94	 (3.53, 4.40)	< 0.001
Diagnosis to definitive surgery (per 1 month)		1.15	(1.12, 1.17)	< 0.001

Table 1. Multivariable analysis of factors leading to upstaging

Assessing the immediate impact of COVID-19 on surgical oncology practice: experience from an NCI-designated Comprehensive Cancer Center in the Northeastern United States

Presenter: Victor Gazivoda

Victor Gazivoda MD[1], Alissa Greenbaum MD[1], Joshua Roshal BA[2], Jenna Lee BA[2], Lekha Reddy BA[2], Shahyan Rehman BA/BS[2], Aaron Kangas-Dick MD[1], Stephanie Gregory MD[1], Maria Kowzun MD FACS[1], Ruth Stephenson DO FACOG[1], Amanda Laird MD FACS[1], H. Richard Alexander MD FACS[1], Adam C. Berger MD FACS[1]

1. Department of Surgical Oncology, Rutgers Cancer Institute of New Jersey, New Brunswick, NJ
2. Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ

Background: The effects of the coronavirus disease 2019 (COVID-19) pandemic on surgical oncology practice are not yet quantified. The aim of this study was to measure the immediate impact of COVID-19 on surgical oncology practice volume.

Methods: A retrospective study of patients treated at an NCI-Comprehensive Cancer Center was performed. “Pre-COVID” era was defined as January–February 2020 and “COVID” as March–April 2020. Primary outcomes were clinic visits and operative volume by surgical oncology subspecialty.

Results: About 907 new patient visits, 3897 follow-up visits, and 644 operations occurred during the study period. All subspecialties experienced significant de- creases in new patient visits during COVID, though soft tissue oncology (Mel/Sarc), gynecologic oncology (Gyn/Onc), and endocrine were disproportionately affected. Telehealth visits increased to 11.4% of all visits by April. Mel/Sarc, Gyn/Onc, and Breast experienced significant operative volume decreases during COVID (25.8%, $p = 0.012$, 43.6% $p < 0.001$, and 41.9%, $p < 0.001$, respectively), while endocrine had no change and gastrointestinal oncology had a slight increase ($p = 0.823$) in the number of cases performed.

Conclusions: The effects of the COVID-19 pandemic are wide-ranging within surgical oncology subspecialties. The addition of telehealth is a viable avenue for cancer patient care and should be considered in surgical oncology practice.

This project was accepted and published in the *Journal of Surgical Oncology* on March 25, 2021.

Title: Sex Specific Aortic Diameter and Aortic Size Index Thresholds for Repair in Patients Undergoing Aortic Aneurysm Repair.

Presenter: Priya B. Patel

Author: Priya B. Patel MD, Livia E.V.M De Guerre MD, Christina L. Marcaccio MD, Kirsten D. Dansey MD MPH, Chun Li MD MPH, Ruby Lo MD, Virendra I. Patel MD MPH, Marc L. Schermerhorn MD

Institution: Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

Previously presented: Society of Vascular Surgery Annual Meeting, 2020
Manuscript: Journal of Vascular Surgery (accepted – awaiting publication)

ABSTRACT:

Introduction: Female patients are more likely to undergo repair of intact and ruptured abdominal aortic aneurysm (AAA) at smaller aortic diameter compared with male patients. Aortic size index (ASI) indexes aortic diameter to body surface area. By adjusting for inherent anatomic differences between sexes, ASI may provide a more appropriate method for guiding treatment. We therefore evaluated the effect of ASI and aortic diameter on AAA repair and identified ideal aortic diameter and ASI thresholds of repair in female and male patients.

Methods: We identified all patients who underwent AAA repair between 2003-2019 in the Vascular Quality Initiative database. The Dubois and Dubois formula was used to calculate body surface area (BSA), aortic diameter was divided by BSA to calculate ASI. Cumulative distribution curves were used to plot the proportion of patients who underwent repair of ruptured aneurysm according to aortic diameter and ASI. We compared outcomes after repair in female patients stratified by diameter and ASI threshold.

Results: We identified 55,647 patients, of whom 12,664 were female (20%). Female patients were older (median 75 vs. 72 years, P<.001), less likely to undergo EVAR (76% vs. 82%, P<.001), and more likely to have comorbid conditions. Overall, female patients had higher perioperative mortality (4.9% vs. 2.9%, P<.001) and complication rates (13% vs. 9.0%, P<.001). Female patients underwent repair at smaller median aortic diameter compared with male patients for intact (5.4 vs 5.5cm, P<.001) and rupture repair (6.7 vs 7.7cm, P<.001)(Figure 1). However, ASI was higher in female patients for both intact (3.1 vs 2.7cm/m^2, P<.001) and rupture repair (3.8 vs 3.7cm/m^2, P<.001). When analyzing the cumulative distribution of rupture repair in male patients, 12% of rupture repairs were performed at a diameter below 5.5cm (Figure 2). To achieve the same proportion of rupture repair in female patients, the repair diameter was only 4.9cm. However, when ASI was used, female and male patients reached 12% of rupture repair at a similar ASI of 2.7cm/m^2, attenuating the sex discrepancy previously observed with the use of aortic diameter.

Conclusion: Our data identified an aortic diameter of 4.9cm in female patients or a sex-neutral ASI of 2.7cm/m^2 to be comparable to an aortic diameter of 5.5cm in male patients. Furthermore, our study provides data to strongly encourage the 5.0cm aortic diameter threshold suggested for repair in female patients by the Society for Vascular Surgery. The high percentage of

patients undergoing rupture repair below 5.5cm highlights the need to better identify patients at risk of rupture at smaller aortic diameter.

Figure 1. Vertical box plots showing the median and interquartile range aortic diameter (A) and ASI (B) in male and female patients for intact and rupture repair.

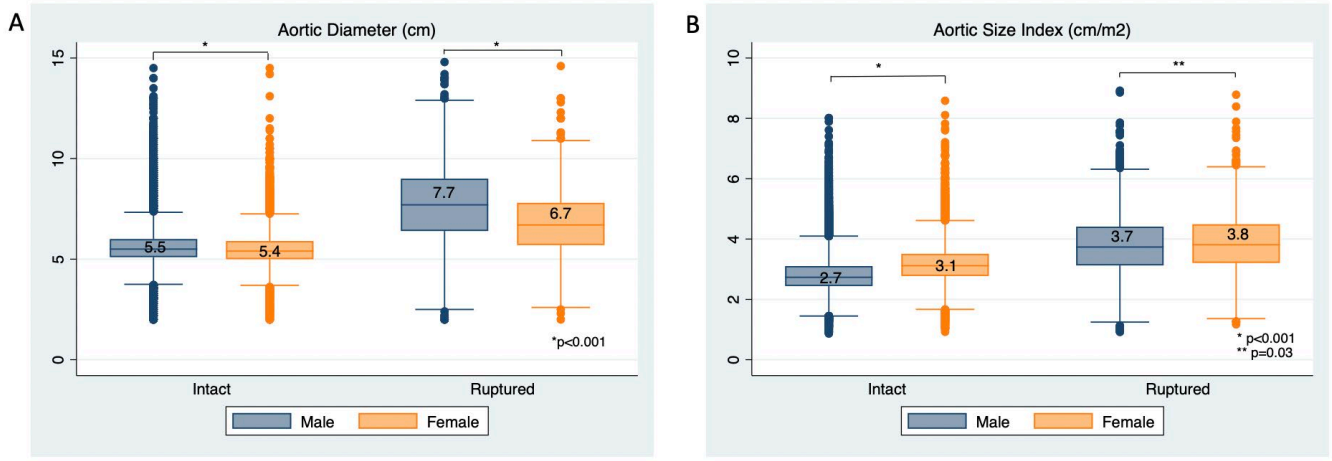
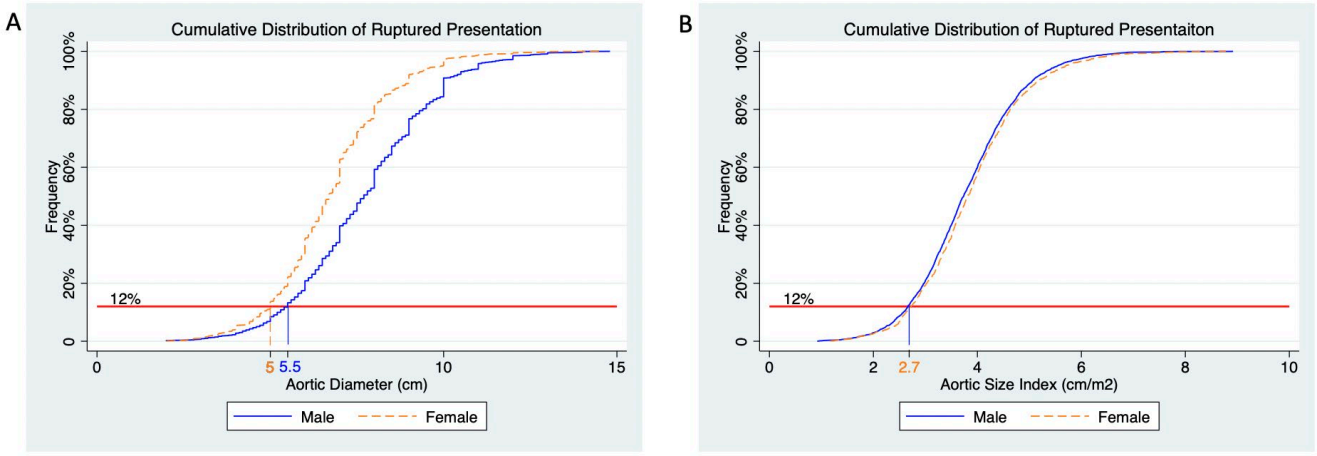


Figure 2. Plot of the cumulative distribution function for male and female patients undergoing ruptured AAA repair by (A) aortic diameter and (B) ASI



Title: Composite dialysis, paralysis, stroke, or mortality following endovascular aortic interventions in the Society for Vascular Surgery Vascular Quality Initiative.

Presenter: Priya B. Patel

Authors: Priya B. Patel MD, Christina L. Marcaccio MD, Livia de Guerre MD, Nicholas J. Swerdlow MD, Thomas F. X. O'Donnell, Sara Zettervall, Virendra I. Patel, Marc L. Schermerhorn MD

Institution: Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

Accepted for presentation: Society of Vascular Surgery Annual Meeting, 2021

ABSTRACT

Introduction: Thoracoabdominal aortic aneurysm life altering events, which include a combination of permanent dialysis, permanent spinal cord ischemia, stroke and/or death, have devastating impacts following complex endovascular repair. However, the monitoring of these life altering events following endovascular aortic repair (EVAR) and thoracic endovascular aortic repair (TEVAR) have not been studied. Therefore, we examined the effect of procedural and anatomic characteristics on a composite outcome of post-operative dialysis, stroke, paralysis, and/or mortality following endovascular aortic repair.

Methods: We identified all patients undergoing infrarenal EVAR, complex EVAR, and TEVAR within the Vascular Quality Initiative registry between 2014 and 2020. The primary outcome was a composite of new post-operative dialysis, in-hospital paralysis, in-hospital stroke, and/or 30-day mortality. Multivariable logistic regression modeling was utilized to identify procedural and anatomic characteristics associated with the composite outcome.

Results: We identified 46,246 infrarenal EVARs, 2,753 complex EVARs, and 5,211 TEVARs. The composite outcome was 1.5% after EVAR, 7.6% after complex EVAR, and 9.0% after TEVAR (Table 1). Aortic diameter >65mm and urgent repair were independently associated with increased risk of the composite outcome after all three types of repair (Table 2). In patients undergoing infrarenal EVAR, use of a proximal aortic extension cuff was also independently associated with the composite outcome (OR 1.5; 95%CI[2.7-4.2]). Among patients undergoing complex EVAR, chimney EVAR (chEVAR) was independently associated with the composite outcome (OR 1.9[1.3-2.7]) as was a proximal landing zone above zone 6 (OR 2.1[1.5-2.8]). In patients undergoing TEVAR, when compared with landing zone 4/5, more proximal landing zones were incrementally associated with increased risk of the composite outcome. When compared to no arm or neck access, either arm access or multiple access sites were associated with increased risk of the composite outcome (arm access: OR 1.5[1.3-2.1]; multiple: OR 3.1[1.7-5.9]).

Conclusions: New dialysis, paralysis, stroke, and/or mortality following endovascular repair occurred more frequently following TEVAR and complex EVAR compared with infrarenal EVAR. Overall, more complex and proximal repairs as well as repairs that involved increased wire manipulation in the aortic arch were associated with increased risk of our composite outcome. Aortic anatomy and anticipated procedural characteristics should be considered and factored into clinical decision-making.

Table 1. Perioperative outcomes by type of endovascular repair

	EVAR (N=46,246)	**Complex EVAR (N=2,753)**	**TEVAR (N=5,211)**
Composite Outcome	714 (1.5%)	209 (7.6%)	468 (9.0%)
New Dialysis	196 (0.4%)	53 (1.9%)	73 (1.4%)
In-hospital Paralysis		65 (2.4%)	84 (1.6%)
In-hospital Stroke	99 (0.2%)	46 (1.7%)	188 (3.6%)
Perioperative Mortality	506 (1.1%)	123 (4.5%)	238 (4.6%)

Table 2. Adjusted analysis for composite outcome by type of endovascular repair

Procedural characteristics associated with composite outcome following EVAR*			
	OR	95%CI	P-value
Aortic diameter >65mm	1.87	1.51-2.33	<.001
Urgent repair	3.4	2.72-4.24	<.001
Aortic extension	1.49	1.19-1.86	0.001
Procedural characteristics associated with composite outcome following complex EVAR*			
	OR	95%CI	P-value
Aortic diameter >65mm	1.61	1.18-2.21	0.003
Urgent repair	1.59	1.08-2.33	0.018
Arm Access	1.11	.93-1.33	0.23
Complex EVAR technique			
FEVAR	Reference		
chEVAR	1.87	1.30-2.70	0.001
Proximal Landing zone			
7 or below	Reference		
6 or above	2.07	1.50-2.84	<.001
Procedural characteristics associated with composite outcome following TEVAR*			
	OR	95%CI	P-value
Aortic diameter >65mm	1.71	1.32-2.23	<.001
Urgent repair	2.18	1.71-2.78	<.001
Proximal Landing Zone			
Zone 4/5	Reference		
Zone 3	1.65	1.20-2.28	0.002
Zone 2	2.11	1.45-3.07	<.001
Zone 0/1	3.04	2.01-4.62	<.001
Arm or Carotid Access			
None	Reference		
Arm	1.54	1.25-2.06	0.004
Neck	1.19	.68-2.07	0.541
Multiple	3.14	1.67-5.90	<.001

*Also adjusted for age, sex, estimated glomerular filtration rate <60 ml/min/1.73m^2, prior stroke, prior carotid revascularization

chEVAR, chimney EVAR; FEVAR, fenestrated EVAR

Title: Similar in-hospital outcomes following transcarotid artery revascularization in female and male patients.

Presenter: Priya B. Patel

Authors: Priya B. Patel MD, Christina L. Marcaccio MD, Patric Liang MD, Vinamr Rastogi BSc, Young Erben MD, Grace Wang MD, Marc L. Schermerhorn MD

Institution: Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

Accepted for presentation: Society of Vascular Surgery Annual Meeting, 2021

ABSTRACT

Introduction: Female sex is associated with increased risk of perioperative death and/or stroke following carotid endarterectomy and transfemoral carotid artery stenting. However sex differences in outcomes following transcarotid artery revascularization (TCAR) remains unclear. Therefore, our aim was to examine in-patient outcomes following TCAR in female versus male patients.

Methods: We identified all patients who underwent TCAR for asymptomatic and symptomatic atherosclerotic carotid disease between September 2016 and October 2020 in the VQI registry. The primary outcome comparison was in-hospital stroke/death between female and male patients. Multivariable logistic regression was used to adjust for baseline differences. Kaplan Meier life-table analysis was used to estimate stroke or death at 2-years following TCAR.

Results: A total of 15,018 patients underwent TCAR, of whom 5,435 were female (36%). There was no significant difference in symptomatic status between female and male patients (40.2% vs 40.1%; P=.95). Female patients had similar in-hospital stroke/death compared with male patients following TCAR for asymptomatic (1.3% vs 1.0%; P=.16) and symptomatic disease (2.3% vs 2.6%; P=.46). Following TCAR, female and male patients experienced similar in-hospital stroke (asymptomatic: 1.0% vs 0.8%; P=.26; symptomatic: 2.0% vs 2.4%; P.35) and in-hospital death rates (asymptomatic: 0.4% vs 0.2%; P=.06; symptomatic 0.6% vs 0.5%; P=.37). However, female patients were more likely to have post-operative length of stay greater than 2 days (asymptomatic: 11.7% vs 9.8%; P=.006; symptomatic: 24.1% vs 19.6%; P<.001) and were more likely to be discharged to a skilled nursing facility (asymptomatic: 3.5% vs 2.7%; P=.029; symptomatic: 14.5% vs 12.7%; P=.052). After adjusting for baseline demographic and anatomic differences, female sex was not independently associated with in-hospital stroke/death, in-hospital stroke/death/MI, in-hospital stroke, in-hospital death, in-hospital MI, or 30-day death (Table1). Using Kaplan-Meier analysis no significant difference was noted at 2-years for stroke or death (8% vs 9%; HR 0.90; 95% CI [.76-1.1]; P=.19). (Figure 1)

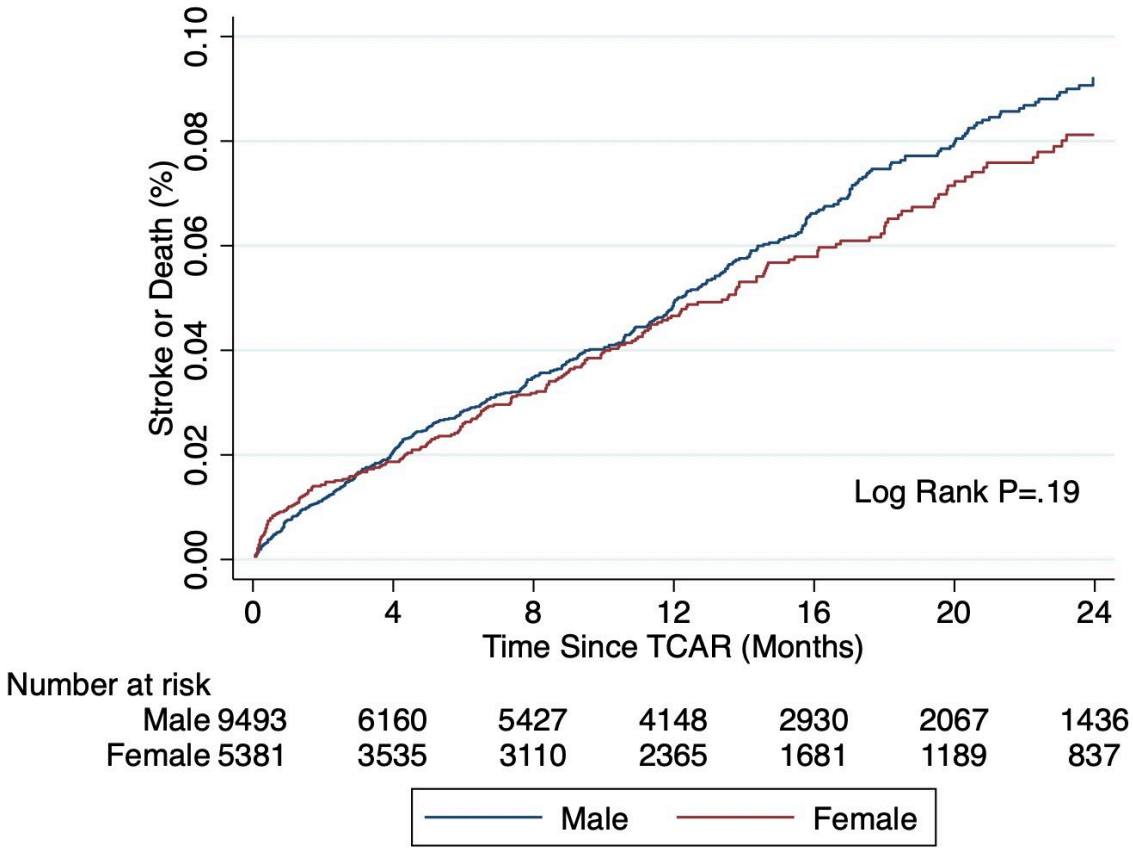
Conclusion: Female patients have comparable perioperative outcomes of stroke and death following TCAR compared with male patients. Furthermore, 2-year stroke/death rates are similar amongst female and male patients. However, the higher rates of prolonged length of stay and failure to discharge home in female patients warrants further investigation.

Table 1. Adjusted analysis comparing female versus male patients undergoing TCAR

	OR	95% CI	P-value
In-hospital			
Stroke/Death	0.99	.76-1.3	0.99
Stroke/Death/MI	0.97	.75-1.3	0.79
Stroke	0.99	.74-1.3	0.96
Death	1.40	.80-2.4	0.24
MI	1.08	.59-2.0	0.79
30-day Death	1.01	.94-1.1	0.70

Adjusted for age, race, symptomatic status, anatomic high risk, ipsilateral carotid artery stenosis stenosis >70%, contralateral carotid artery occlusion, hypertension, chronic obstructive pulmonary disease, GFR<60, smoking status, prior amputation, preoperative aspirin therapy, preoperative antiplatelet therapy, preoperative dual antiplatelet therapy, preoperative statin therapy.

Figure 1. Kaplan Meier estimated stroke or death in patients undergoing TCAR stratified by sex



*Standard error was >10% at 2 years for female and male patients

Title: Chronic Obstructive Pulmonary Disease Severity Effects Outcomes Following Endovascular Aortic Repair

Presenter: Priya B. Patel

Authors: Priya B. Patel MD, Ambar Mehta MD, Jeffrey Siracuse MD, Karan Garg MD, Samuel Schwartz MD, Marc L. Schermerhorn MD, Virendra I. Patel MD MPH

Institution: Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

Accepted for presentation: Society of Vascular Surgery Annual Meeting, 2021

ABSTRACT

Introduction: Endovascular aortic repair (EVAR) in patients with chronic obstructive pulmonary disease (COPD) has been associated with improved outcomes compared with open repair. However, the effect of COPD severity on outcomes following endovascular repair are not well defined. Therefore, we examined the effect of COPD severity – not medically treated, medically treated, and on supplementary home oxygen – on outcomes following EVAR.

Methods: We identified all patients undergoing elective infrarenal EVAR within the Vascular Quality Improvement registry between 2011-2020. The primary outcome was perioperative mortality. Secondary outcomes were reintubation, delayed extubation (>24 hours after repair), and 5-year mortality. Multivariable logistic regression and cox regression were utilized to account for baseline differences and to identify the independent effect of COPD severity on outcomes of interest.

Results: A total of 46,335 patients underwent infrarenal EVAR of whom 15,532 (33%) had COPD. Of the patients with COPD, 28.2% were not medically treated, 56.9% were medical treated, and 14.9% were on supplemental home oxygen. When compared to patients without COPD, patients with any severity of COPD had increased perioperative mortality (1.5 vs 0.9%; P<.001), reintubation (1.5 vs 0.7%; P<.001), and delayed extubation (0.9 vs 0.5%; P<.001). COPD that was not medically treated and COPD requiring supplemental home oxygen were independently associated with perioperative mortality, reintubation, and delayed extubation. (Table 1) However, COPD that was medically treated was independently associated with reintubation, but not perioperative mortality or delayed extubation. Furthermore, five-year survival was 86% for patients without COPD, 83% for patients with COPD but not medically treated, 80% for patients with COPD that was medically treated, and 70% for patients with COPD on supplemental home oxygen. COPD severity was also independently associated with adverse 5-year mortality. (Figure 1).

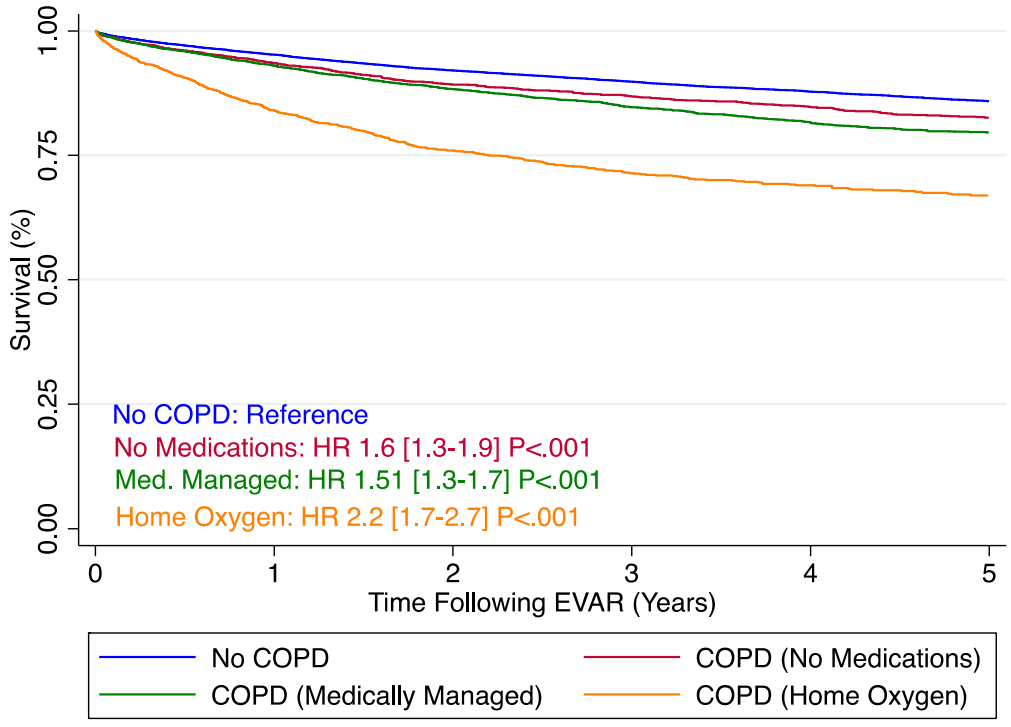
Conclusion: COPD is associated with increased perioperative mortality and respiratory complications following EVAR. While endovascular repair may offer improved outcomes compared to open repair, preoperative medical optimization of patients with COPD may improve perioperative outcomes following repair. Furthermore, COPD severity is associated with increased 5-year mortality following repair. Perioperative and long-term outcomes following repair in this patient population should be factored into pre-operative clinical decision making.

Table 1. Adjusted analysis for COPD severity on outcomes following EVAR

Perioperative Mortality	OR	95% CI	P-value
COPD			
Not on medication	1.3	1.1-1.6	0.009
Medically managed	1.1	.95-1.3	0.185
Home O2	1.9	1.6-2.4	<.001
Reintubation	OR	95% CI	P-value
COPD			
Not on medication	1.7	1.3-2.0	<.001
Medically managed	1.4	1.2-1.6	<.001
Home O2	2.7	2.1-3.3	<.001
Delayed Extubation	OR	95% CI	P-value
COPD			
Not on medication	1.3	1.1-1.7	.009
Medically managed	.98	.81-1.2	.87
Home O2	1.6	1.5-2.5	<.001

*Also adjusted for age, sex, smoking status, CAD, CHF, preoperative statin therapy, preoperative beta blocker therapy, and use of general anesthesia.

Table 2. Kaplan Meier 5-year mortality estimate stratified by COPD severity



Title: Sex Based Differences Following TEVAR for Penetrating Aortic Ulcer and Intramural Hematoma

Presenter: Priya B. Patel

Authors: Priya B. Patel MD, Christina L. Marcaccio MD, Livia E.V.M de Guerre MD, Virendra I. Patel MD, Marc L. Schermerhorn MD, Salvatore Scali MD

Institution: Beth Israel Deaconess Medical Center, Boston, MA

Accepted for presentation: Society of Vascular Surgery Annual Meeting, 2021

ABSTRACT:

Introduction: Although sex differences in outcomes for thoracic endovascular aortic repair (TEVAR) of degenerative and dissection-related pathologies are known, sex differences for penetrating aortic ulcer (PAU) and/or intramural hematoma (IMH) are poorly described. The purpose of this study was to evaluate the association between sex and outcomes after TEVAR for PAU or IMH.

Methods: All TEVARs for PAU or IMH in the Vascular Quality Improvement registry between 2010-2020 were analyzed. The primary outcome was in-hospital mortality between female and male patients. Multivariable logistic regression and cox regression modeling were used to adjust for baseline differences. Kaplan Meier life-table analysis was used to estimate 5-year mortality.

Results: A total of 881 patients underwent TEVAR for PAU, of whom 464 were females (52%). Female patients had higher perioperative mortality compared with males (7.3% vs 3.6%; P=.016) (Table 1). Female patients had higher frequency of postoperative blood transfusion (28.0% vs 18.4%; P<.001) and were more likely to be discharged to a skilled nursing facility (SNF) (27.6% vs 20.6%; P=.016). Following multivariable regression analysis, female sex was independently associated with increased perioperative mortality (OR 2.15; 95% CI [1.1-4.2]; P=.023) as well as discharge to SNF (OR 1.42; 95% CI [.99-2.0]; P=.05). Five-year mortality following TEVAR for PAU was 23.8% in female patients compared with 17.4% in male patients (Log Rank P=.04). (Figure 1) However, female sex was not independently associated with 5-year survival following cox regression (HR 1.3; 95 % CI[.93-1.9]; P=.12).

A total of 304 patients underwent TEVAR for IMH, of whom 175 were females (57%). No significant difference in perioperative mortality was observed between female and male patients (5.1% vs 4.7%; P=.84). (Table 1) Female patients were less likely to have post-operative cardiac complications (7.4% vs 17.1%; P=.009), respiratory complications (4.0% vs 12.4%; P=.006), or renal complications (3.4% vs 5.9%; P<.001). There was no significant difference in rates of discharge to SNF (32.6% vs 30.2%; P=.66). Multivariable regression was not completed for the IMH cohort as the analysis was underpowered. Five-year mortality following TEVAR for IMH was 14.3% in female patients and 19.0% in male patients (Log Rank P=.22). (Figure 1)

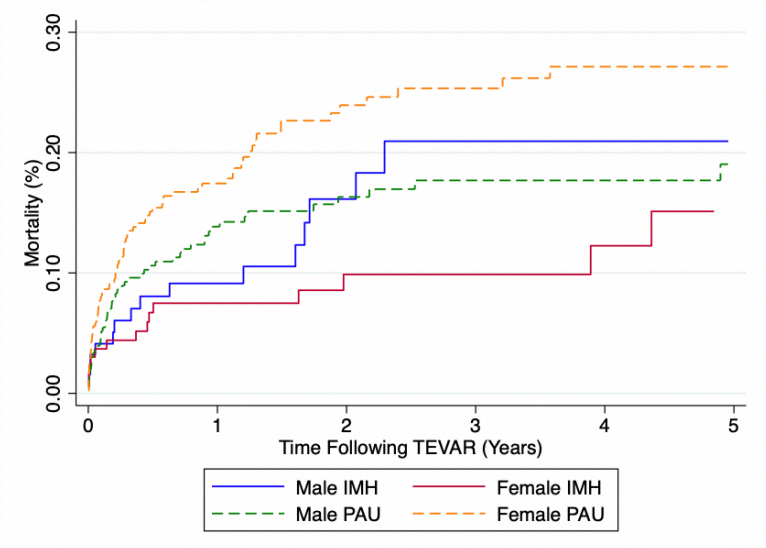
Conclusions: Unlike degenerative aneurysm and dissection-related pathology, rates of TEVAR for PAU and IMH were similar between female and male patients. Female patients had higher perioperative and 5-year mortality following TEVAR for PAU but not for IMH. Furthermore, female patients had higher postoperative resource utilization following repair for PAU.

Table 1. Postoperative outcomes following TEVAR for intramural hematoma and penetrating aortic ulcer, stratified by sex.

	Intramural Hematoma			Penetrating Aortic Ulcer		
	Male (N=129)	**Female (N=175)**	**p-value**	**Male (N=417)**	**Female (N=464)**	**p-value**
Perioperative Mortality	6 (4.7%)	9 (5.1%)	0.84	15 (3.6%)	34 (7.3%)	**0.016**
LOS, median (IQR)	5 (3, 10)	6 (4, 8)	0.78	3 (2, 6)	4 (2, 7)	**0.008**
ICU LOS, median (IQR)	3 (2, 6)	3 (2, 5)	0.49	2 (1, 3)	2 (1, 4)	**0.034**
Cardiac complications	22 (17.1%)	13 (7.4%)	**0.009**	31 (7.5%)	47 (10.2%)	0.16
Respiratory complication	16 (12.4%)	7 (4.0%)	**0.006**	29 (7.0%)	35 (7.6%)	0.73
Any Wound Infection	2 (1.6%)	1 (0.6%)	0.40	1 (0.2%)	2 (0.4%)	0.63
Transfusion	43 (33.3%)	63 (36.2%)	0.60	76 (18.4%)	130 (28.0%)	**<0.001**
Leg Ischemia or Emboli	1 (0.8%)	1 (0.6%)	0.83	3 (0.7%)	8 (1.7%)	0.18
Spinal Ischemia	4 (3.1%)	1 (0.6%)	0.087	11 (2.6%)	5 (1.1%)	0.083
New Dialysis	4 (3.1%)	0 (0.0%)	**0.019**	4 (1.0%)	4 (0.9%)	0.88
Renal complications	15 (11.6%)	4 (2.3%)	**<0.001**	24 (5.8%)	35 (7.6%)	0.30
Postoperative TIA/Stroke	5 (3.9%)	6 (3.4%)	0.84	17 (4.1%)	16 (3.5%)	0.62
Discharge to SNF	39(30.2%)	57(32.6%)	0.66	86(20.6%)	128(27.6%)	**0.016**

ICU, intensive care unit; IQR, interquartile range; LOS, length of stay; TIA, transient ischemic attack; SNF, skilled nursing facility

Figure 1. 5-year mortality following TEVAR for intramural hematoma and penetrating aortic ulcer, stratified by sex.



	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Male IMH	128	79	47	29	21	12
Female IMH	170	107	75	57	39	29
Male PAU	417	256	163	125	92	70
Female PAU	461	265	153	123	96	75

Standard error <10% for all groups at 5 years

Giant Inguinal Hernia: A Case Report of a Patient Who Successfully Underwent Laparoscopic Davinci Approach to Tension Free Transabdominal Pre-Peritoneal Repair

Saeed Tarabichi

Inguinal hernia repair is one of the most common surgical procedures performed in the field of General Surgery. While open repair remains common, the past two decades have seen a great increase in the number of laparoscopic and Davinci assisted TAPP (transabdominal pre-peritoneal) repairs with similar success rates. Giant inguinal hernias, defined as any inguinal hernia which extends below the mid-point of the thigh when standing, are significantly more challenging to repair. There is a paucity of data regarding which surgical approach to utilize when presented with this scenario.

Our case presents a unique scenario in which a 78-year-old man with a history of CAD status post PCI with coronary stents, on dual anti-platelet therapy, presents to the hospital with melena and vague abdominal pain. He has been living with a large left inguinal hernia for the past 30 years. The hernia has progressively increased in size, however the patient denied any significant symptoms related to the hernia. The patient was scheduled for an upper and lower endoscopy for further workup of the GI bleed, however a CT scan obtained in the hospital revealed a significant amount of redundant sigmoid colon herniating into the inguinal hernia sac, eliminating the possibility of performing a colonoscopy.

In this video presentation, we present an example of a Davinci approach to a tension free TAPP repair of a giant inguinal hernia, which has not been previously described. It is our conclusion that no inguinal hernia is too big for a Davinci TAPP repair.

Impact of Risk Factors on In-Hospital Mortality for Octogenarians Undergoing Cardiac Surgery

Lindsay Volk, MD, MPH,[1] Joshua Chao, MD, JD,[1] Viktor Dombrovskiy, MD, PhD, MPH,[1] Hirohisa Ikegami, MD,[1] Mark J. Russo, MD,[1] Anthony Lemaire, MD,[1] & Leonard Y. Lee, MD[1]

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Abstract:

Background: Octogenarians undergoing cardiac surgery have higher mortality than their younger counterparts.

Objectives: To determine if various risk factors have the same effect on mortality in octogenarians as in younger patients.

Methods: The National Inpatient Sample dataset from 2004 to 2014 was queried to select patients aged 65 years and older who underwent either coronary artery bypass grafting(CABG), valvular heart surgery(VHS), or both(CABG+VHS) within 10 days of hospital admission. The patients were divided into two groups 65-79 years and 80 years and greater. Hospital mortality, patient demographics, comorbidities, and type of hospital admission was evaluated and compared using Chi-square and multivariable logistic regressions.

Results: 397,713 patients were identified including 86,345(21.7%) aged 80 and above. Octogenarians had higher in-hospital mortality for all procedures: CABG(4.94% vs 2.39%, $p<0.001$), VHS(5.49% vs 4.08%, $p<0.001$), and CABG+VHS(7.59% vs 5.95%, $p<0.001$) and this relationship persisted when gender, race, comorbidities, and type of hospital admission were controlled for: CABG(OR=1.71; 95%CI 1.62-1.81); VHS(OR=1.18; 95%CI 1.11-1.27); CABH+VHS(OR=1.17; 95%CI 1.10-1.26). Female gender, renal or heart failure, non-elective admission, and CABG+VHS were associated with increased risk of in-hospital mortality. Octogenarians had higher rates of these factors($p<0.001$). The effect size of renal and heart failure and type of surgery was smaller for octogenarians.

Conclusions: Octogenarians undergoing cardiac surgery have higher rates of non-elective admissions, renal and heart failure, and female gender, which are most strongly associated with in-hospital mortality. Differing effect sizes suggest that certain risk factors, such as renal and heart failure, contribute more to mortality in younger patients.

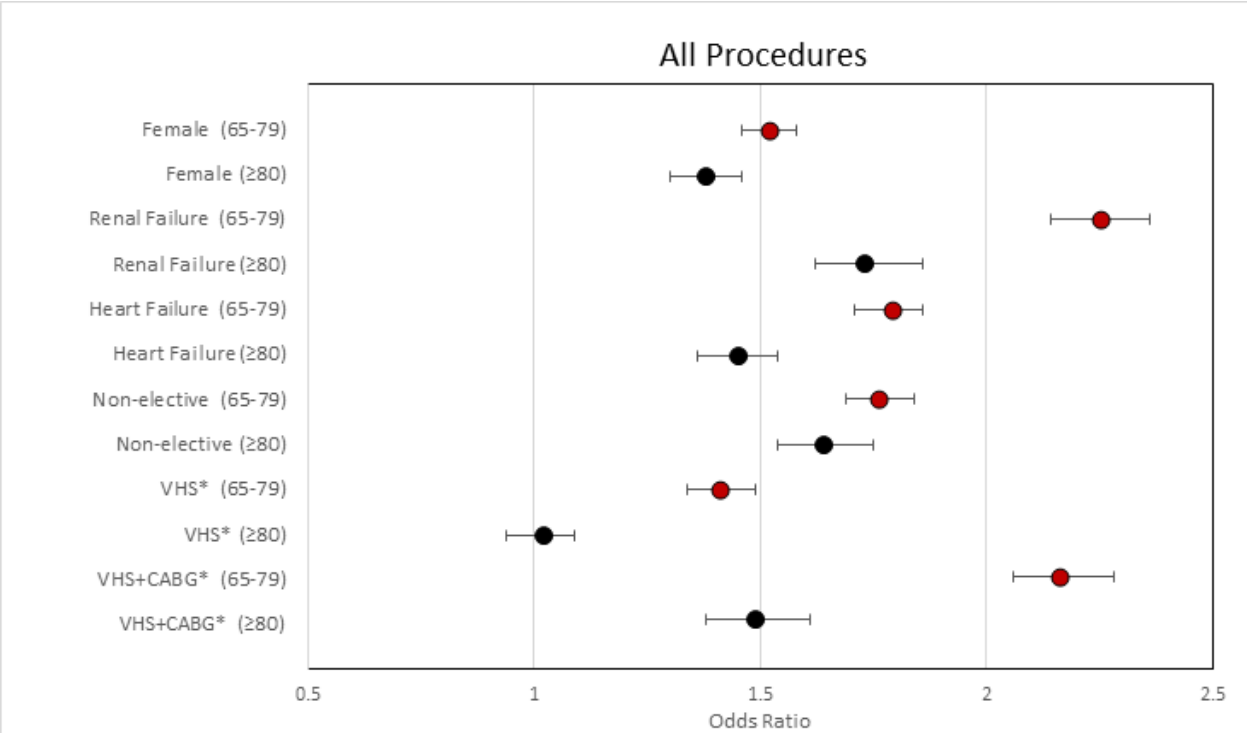

Figure 1. **Differential impact of risk factors for all patients in this study by age group**. Presented as odds ratios with 95% CI. Odds ratios for the younger cohort (65-79) are colored red, while those for the older cohort (≥80) are filled in black.

CABG: coronary artery bypass; VHS: valvular heart surgery; VHS+CABG: combined valvular heart surgery and coronary artery bypass; *Relative to CABG alone. Race, HTN, diabetes, and obesity were included in the multivariate analysis, but found to be insignificant.

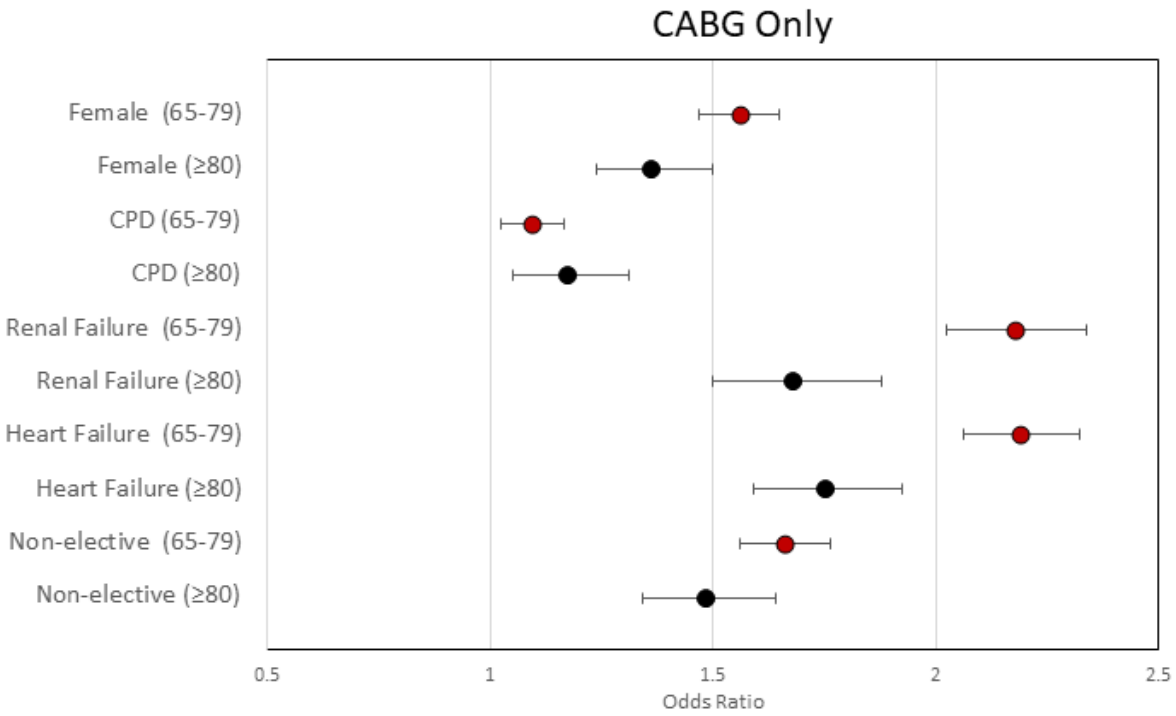

Figure 2 - **Differential impact of risk factors for CABG only by age group**. Presented as odds ratios with 95% CI. Odds ratios for the younger cohort (65-79) are colored red, while those for the older cohort (≥80) are filled in black.

CPD, chronic pulmonary disease; CABG: coronary artery bypass; Race, HTN, diabetes, and obesity were included in the multivariate analysis, but found to be insignificant.

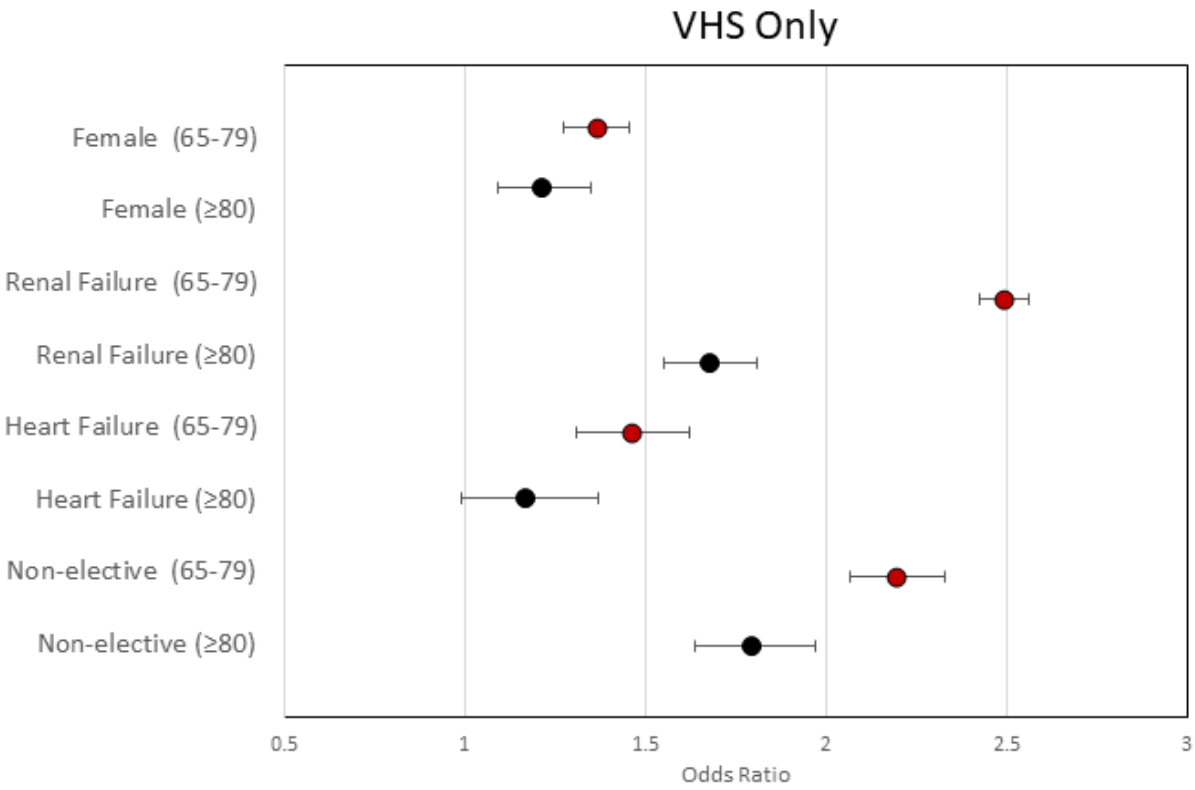

Figure 3 - **Differential impact of risk factors for VHS only by age group**. Presented as odds ratios with 95% CI. Odds ratios for the younger cohort (65-79) are colored red, while those for the older cohort (≥80) are filled in black.

VHS: valvular heart surgery; Race, HTN, diabetes, CPD, and obesity were included in the multivariate analysis, but found to be insignificant.

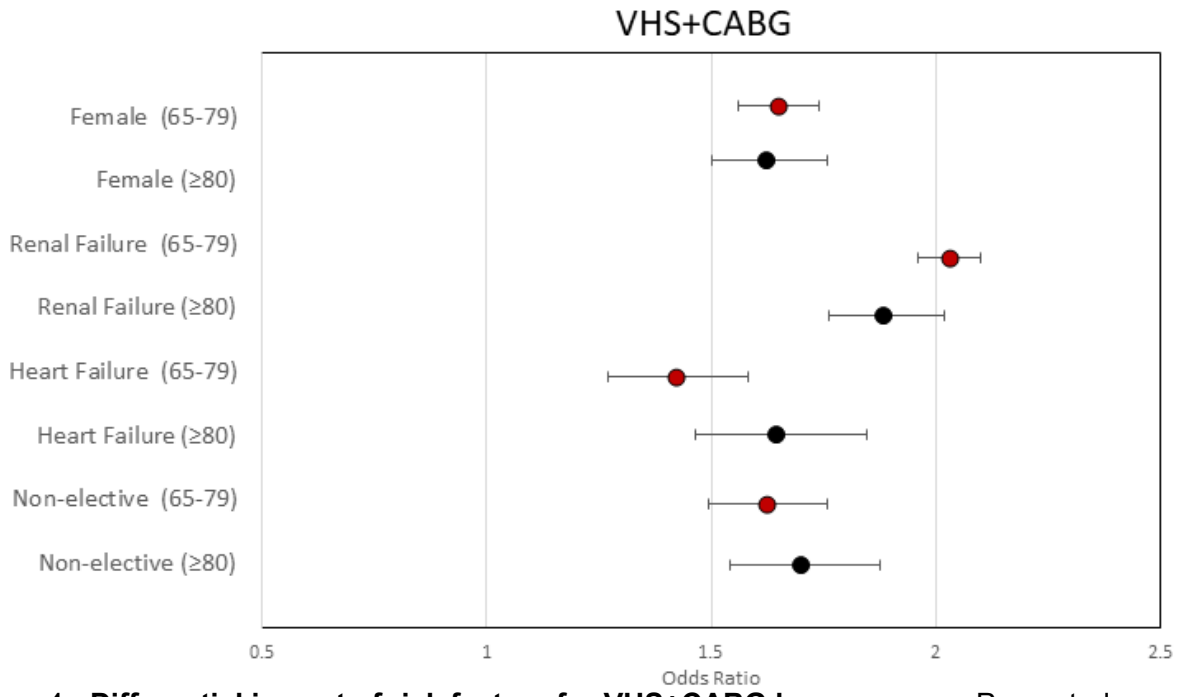

Figure 4 - **Differential impact of risk factors for VHS+CABG by age group**. Presented as odds ratios with 95% CI. Odds ratios for the younger cohort (65-79) are colored red, while those for the older cohort (≥80) are filled in black.

VHS+CABG: combined valvular heart surgery and coronary artery bypass; Race, HTN, CPD, diabetes, and obesity were included in the multivariate analysis, but found to be insignificant.

Deep Hypothermic Circulatory Arrest in Cyanotic Piglets is Associated with Increased Neuronal Necrosis

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Abstract:
Background: The contribution of neonatal cyanosis, inherent to cyanotic congenital heart disease, to the magnitude of neurologic injury during deep hypothermic circulatory arrest has not been fully delineated. This study investigates the impact of cyanosis and deep hypothermic circulatory arrest on brain injury.
Methods: Neonatal piglets were randomized to placement of a pulmonary artery to left atrium shunt to create cyanosis or sham thoracotomy. At day 7, animals were randomized to undergo deep hypothermic circulatory arrest or sham. Arterial oxygen tension and hematocrit were obtained. Neurobehavioral performance was serially assessed. The animals were sacrificed on day 14. Brain tissue was assessed for neuronal necrosis using a 5-point histopathologic score.
Results: Four experimental groups were analyzed (sham, n = 10, sham + deep hypothermic circulatory arrest, n = 8, shunt, n = 9, shunt + deep hypothermic circulatory arrest, n = 7). Cyanotic piglets had significantly higher hematocrit and lower partial pressure of oxygen at day 14 than noncyanotic piglets. There were no statistically significant differences in neurobehavioral scores at day 1. However, Shunt + deep hypothermic circulatory arrest piglets had evidence of greater neuronal injury than sham animals (median [range]: 2 [0-4] vs 0 [0-0], p = 0.02).
Discussion: Cyanotic piglets undergoing deep hypothermic circulatory arrest had increased neuronal injury compared to sham animals. Significant injury was not seen for either cyanosis or deep hypothermic circulatory arrest alone relative to shams. These findings suggest an interaction between cyanosis and deep hypothermic circulatory arrest and may partially explain the suboptimal neurologic outcomes seen in children with cyanotic heart disease who undergo deep hypothermic circulatory arrest.

Increased Cerebral Mitochondrial Dysfunction and Reactive Oxygen Species with Cardiopulmonary Bypass

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Abstract

Objectives: Neurodevelopmental injury after cardiac surgery using cardiopulmonary bypass (CPB) for congenital heart defects is common, but the mechanism behind this injury is unclear. This study examines the impact of CPB on cerebral mitochondrial reactive oxygen species (ROS) generation and mitochondrial bioenergetics.

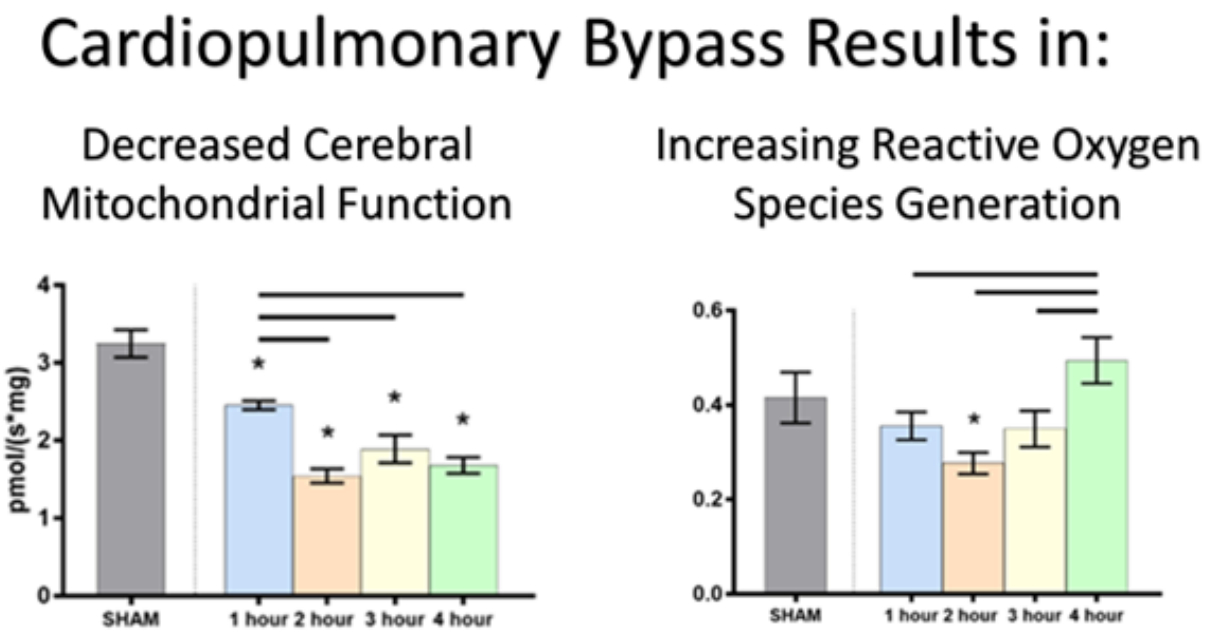
Methods: Twenty-three piglets (mean weight 4.2±0.5kg) were placed on CPB for either 1, 2, 3, or 4-hours (n=5 per group) or underwent anesthesia without CPB (Sham, n=3). Microdialysis was used to measure metabolic markers of ischemia. At the conclusion of CPB or four hours of sham, brain tissue was harvested. Utilizing high-resolution respirometry, with simultaneous fluorometric analysis, mitochondrial respiration and ROS were measured.

Results: There were no significant differences in markers of ischemia between sham and experimental groups. Sham animals had significantly higher mitochondrial respiration than experimental animals, including maximal oxidative phosphorylation capacity of complex I ($OXPHOS_{CI}$) (3.25±0.18 vs 4-hour CPB:1.68±0.10,$p<0.001$) and maximal phosphorylating respiration capacity via convergent input through complexes I and II ($OXPHOS_{CI+CII}$) (7.40±0.24

vs 4-hour CPB:3.91±0.20,p<.0001). At 4-hours, experimental animals had significantly higher ROS related to non-phosphorylating respiration through Complexes I and II (ETS_{CI+CII}) than shams (1.08±0.13 vs. 0.64±0.04, p=0.026).

Conclusions: Even in the absence of local markers of ischemia, CPB is associated with decreased mitochondrial respiration relative to shams irrespective of duration. Exposure to four hours of CPB resulted in a significant increase in cerebral mitochondrial ROS formation compared to shorter durations. Further study is needed to improve understanding of cerebral mitochondrial health and its effects on the pathophysiology of neurological injury following exposure to CPB.

Visual Abstract:



Residency Accommodations: Assessing Need in a General Surgery Program

Lindsay Volk, MD, MPH, Hanna Labiner, MD, Nell Maloney Patel, MD, & Cristan Anderson, MD

Introduction: Surgical residency can have a negative impact on resident health and wellness.[1] To combat this, many residencies are implementing programs and accommodations.[2-4] We present a needs assessment to evaluate resident wellbeing and barriers to accommodation use.
Methods: A survey was distributed to surgical residents at a large academic program to assess resident awareness of and satisfaction with existing accommodations, the impact that residency has had on their health, and barriers preventing them from utilizing accommodations.
Results: 25/37 residents(67.6%) responded to the survey. Awareness of existing resources was variable, but for the majority of resources at least 50% of the residents reported awareness. Only 4% of the residents reported being dissatisfied with the available accommodations, whereas 40% reported being satisfied or very satisfied. Surgical residents reported good overall health with 50% rating their health 8 or higher out of 10. Residents reported delaying medical treatment, reporting to work ill, and engaging in maladaptive coping mechanism at concerning rates(Table 1). The following barriers were identified that prevented the use of existing accommodations: fear of how they would be viewed by faculty (24%), fear of how they would be viewed by their peers (36%), privacy concerns (24%), concerns about making up the workload (44%), and concerns about increasing the workload for their peers (52%).
Conclusions: Despite the availability of accommodations and apparent satisfaction, there are apparent personal and systemic barriers preventing their use. Residency programs should work to assess and address barriers to accommodation use, in addition to instituting new wellness programs.

Admitted on Friday for Acute Cholecystitis. Can the Operation Wait until Monday?

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Introduction: Cholecystectomy is one of the most commonly performed abdominal surgical procedures in the United States. However, few studies have examined outcomes and complications associated with delay in performing cholecystectomy after hospital admission. The effect of immediate vs. delay in cholecystectomy was studied utilizing a national database.

Methods: The 2012-2016 National Surgical Quality Improvement Project was queried for patients undergoing cholecystectomy for confirmed acute cholecystitis. Exclusion criteria included elective or outpatient surgery, pre-operative length of stay (Pre-LOS) >7 days from admission and any performance of concurrent procedure. Patients were stratified into 3 groups undergoing operation: <24, 24-72, and >72 hours after admission. Variables studied included length of post-operative stay (Post-LOS), total hospital length of stay (Total-LOS), operative time, laparoscopic or open surgery and complications including venous thromboembolism (VTE), sepsis, surgical site infection, pneumonia, and readmission. Pre-LOS was compared to operative time, outcomes and complications using multivariate logistic and linear regression models, controlling for age, BMI, diabetes, ASA class, chronic steroid use and wound class.

Results:

Table 1. Complications and Outcomes after Cholecystectomy Stratified by Pre-LOS

Pre-op LOS	<24 hours (26.3%, n=12,968)	24-72 hours (54.3%, n=26,758)	>72 hours (19.5%, n=9,594)
Operative time, average mins(p-value)	54.0 (reference)	54.8 (p=0.15)	59.3 (p<0.01)
Post-LOS, average days(p-value)	0.95 (reference)	0.78 (p<0.01)	1.17 (p<0.01)
Total-LOS, average days(p-value)	0.85 (reference)	2.01 (p<0.01)	4.9 (p<0.01)
Open cholecystectomy, Odds ratio(p-value, 95% CI)	1.0 (reference)	0.91(p=0.02, 0.85-0.98)	1.28(p<.01, 1.17-1.39)
Venous thromboembolism, Odds ratio(p-value, 95% CI)	1.0 (reference)	1.30(p=0.25, 0.83-2.02)	1.83(p=0.01, 1.14-2.95)
Post-operative sepsis, Odds ratio(p-value, 95% CI)	1.0 (reference)	0.94(p=0.69, 0.68-1.29)	1.53(p=0.02, 1.08-2.17)
Organ space infection, Odds ratio(p-value, 95% CI)	1.0 (reference)	1.09(p=0.54, 0.83-1.43)	1.20(p=0.26, 0.87-1.65)
Pneumonia, Odds ratio(p-value, 95% CI)	1.0 (reference)	1.13(p=0.35, 0.87-1.46)	0.95(p=0.75, 0.71-1.28)

Conclusion: Patients undergoing operation for acute cholecystitis >72 hours after admission had significantly longer Post-LOS and Total-LOS, were more likely to have an open rather than laparoscopic procedure and were more likely to have complications including sepsis and VTE. They also had more readmissions. This study suggests that early cholecystectomy after admission seems warranted and that patients admitted on a Friday should not wait until Monday to undergo the operation.

Presented at ACS

Title: Automated Image Processing with Point-of-care Ocular Ultrasound for Real-time Intracranial Pressure Monitoring

Presenter Name: David J. You

Name of Co-authors: David J. You, Marc LaFonte, Ilker Hacihaliloglu, and Matthew Lissauer*

Institution: Rutgers-Robert Wood Johnson Medical School

Introduction:
The brain is enclosed by a rigid skull, thus creating a pressure-volume relationship that was first explained by Dr. Alexander Monro and Dr. George Kellie over 200 years ago. The major intracranial components consist of brain parenchyma (80%), blood (10%), and cerebral spinal fluid (10%), all of which exist in equilibrium. Intracranial pressure (ICP) is directly related to cerebral perfusion pressure (CPP) and mean arterial pressure (MAP) through the following relationship: CPP = MAP – ICP. Thus, if the intracranial pressure increases, the mean arterial pressure must also increase to maintain cerebral perfusion, typically through an increase in cardiac output. If the increase in intracranial pressure exceeds the ability for compensation through elevated mean arterial pressure, then cerebral ischemia may result.

The recognition of elevated ICP and subsequent preemptive management of secondary brain injury is paramount as damage is often irreversible. Intracranial pressure monitoring is the most widely used modality for recognizing this potential for impaired cerebral perfusion and subsequent tissue hypoxia and infarction[13]. The measurement and monitoring of ICP is widely considered standard practice, and amongst patients with severe traumatic brain injuries (TBIs) in the United States, 77.4% of patients undergo ICP monitoring during their hospital course. Extraventricular drains (EVD) and intraparenchymal devices are the two most commonly used and widely-adopted methods for invasive ICP monitoring. The most common complications are ventriculostomy-associated infections (VAIs). Placement of EVDs are associated with an average infection rate of 8.8% while quoted at 22% in some studies[9]. These include infected bone flaps, brain abscesses, subdural empyemas, ventriculitis, meningitis, and superficial wound infections[11]. The second most common complications related to invasive ICP monitoring devices are technical errors. A recent study found that EVDs placed in an ICU setting were suboptimal 6.5% of the time[9]. Furthermore, these devices are known to be inaccurate if an intraparenchymal gradient exists between fossas of the skull[7].

Methods for non-invasive ICP monitoring are continually being investigated, validated, and improved upon, including measurements of optic nerve sheath diameters (ONSD), optical coherence tomography, pupillometry, transcranial doppler ultrasonography (TCD), and tympanometry. The subarachnoid space between the dura and white matter of the optic nerve communicates with the subarachnoid space of the brain, establishing a linear relationship between perioptic CSF pressure and ICP[6]. Thus, measurement of optic nerve sheath diameters using ultrasound have been routinely found in multiple studies to demonstrate the strongest correlation with ICP, with sensitivities of 95% and specificities of 80%[1,5]. Furthermore, the use of ultrasound is considered non-invasive. There are no known complications in humans, hence why it is routinely used for fetal monitoring. Transcranial doppler ultrasonography is another popular non-invasive ICP monitoring modality. However, recent evidence demonstrates overall accuracy ranging around ±12 mmHg when compared to their invasive counterpart, making it a

poor comparison to ONSD measurements. Overall, the ability to detect ICP > 20 mmHg (when impaired cerebral perfusion becomes a significant concern) was highest for ONSD[1].
At this time, ultrasound measurements of optic nerve sheath diameters are not considered to be robust enough as a replacement for traditional invasive techniques for ICP monitoring[12]. ONSD measurements are often operator-dependent and vary by the type of ultrasound equipment being used. There is a need to implement high-quality signal processing algorithms to improve accuracy and reliability. The aim of this study is to validate the correlation between sonographic ONSD measurements with ICP values measured directly via gold standard invasive techniques, and to employ advanced imaging algorithms to reduce measurement errors and create an improved non-invasive intracranial pressure monitoring modality.

Methods:
Ultrasound (US) images were obtained using a Sonosite Export ultrasound system using a linear array probe to obtain images of the optic nerve sheath and ophthalmic vein diameter. The same machine and probe were used for all obtained images. A standard technique was created to obtain the images by positioning the optic nerve in the center of the monitor in an axial position and slowly changing the angle of the probe back and forth, approximately 30 degree sweeps, until the center of the nerve was determined by visual inspection. Optic nerve sheath diameter was then measured approximately 3mm posterior to the posterior optic globe margin. Training for obtaining images was carried out by the senior author for all involved study personel.

After manual recording of ONSD via ultrasound, blinded B-mode ultrasound data was subsequently analyzed by extracting the important anatomical features from the ultrasound images using a computational image analysis method developed by our group. Our proposed image processing framework enhances the B-mode ultrasound data using an L0-gradient minimization method which globally controls how many nonzero gradients are obtained in order to approximate prominent optic nerve boundary [14]. During the second stage we extract local phase image features by filtering the enhanced image using Log-gabor filter in frequency domain. The local phase images are processed using a fast-random walks based contextual regularization method which emphasizes uncertainty in the optic nerve region [15] resulting in the generation of a signal transmission map image. The final optic nerve sheath diameter was automatically calculated from the signal transmission map image and was correlated to the patient's measured ICP. The proposed method was implemented using MATLAB 2020 software package (The Mathworks Inc., Natick, MA) and run on a 2.3 GHz Intel(R) CoreTM i5 CPU, 16 GB RAM windows laptop.

Results:
A total of 61 images obtained from 16 patients were used in this study. Multiple images were acquired from the same patient over a period of their hospitalization if they had changes in their clinical status or intracranial pressure during direct monitoring. Of the 61 images obtained, 37 were a result of a traumatic injury, and 24 non-traumatic intracranial pathology requiring ICP monitoring. The traumatic injuries were categorized by either an admission from a trauma alert notification, or as a consultation to the Robert Wood Johnson on-call trauma team. Additionally, 48 of the 61 had an extraventricular drain, and 13 had subarachnoid bolts (Table 1).
The results from our algorithm-based ONSD measurements demonstrate a statistically significant difference between the ICP of 16-20 mmHg, and ICP of 21-25 mmHg groups (95% CI, 56.2 to 67.2, $P<0.05$). Additionally, the difference between the 11-15 and 16-20 group was

also significant (95% CI, 53.0 to 62.7, P<0.05). Thus, using our algorithm, we are able to correlate an ONSD greater than 61 mm with an ICP equal to or greater than 20 mmHg. The mean absolute error of manual measurements is 4.18 when compared to an automatic method. ONSD, when measured manually, can vary by ±4.18 mm.

Table 1. Characteristics of Patient Cohort

Index	No. of Patients
Involved trauma	
Trauma	37
Non-trauma	24
Intracranial injury	
Subarachnoid Hemorrhage	16
Subdural Hemorrhage	13
Intraparenchymal Hemorrhage	17
Intracranial Pressure Monitor	
Extraventricular drain	48
Subarachnoid Bolt	13

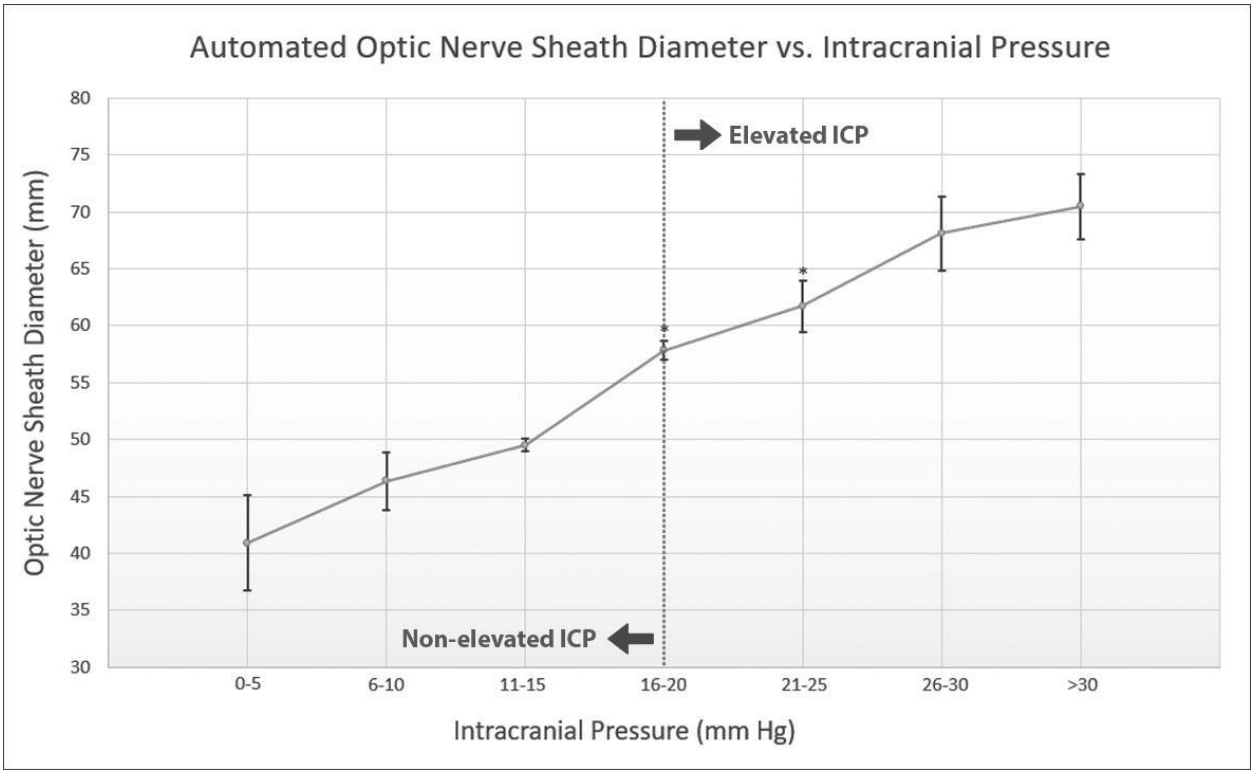

Figure 1. Optic nerve sheath diameter versus intracranial pressure using an automated image processing algorithm demonstrating statistically significant differentiating of elevated ICP (>20 mmHg) from non-elevated ICP (<20 mmHg).

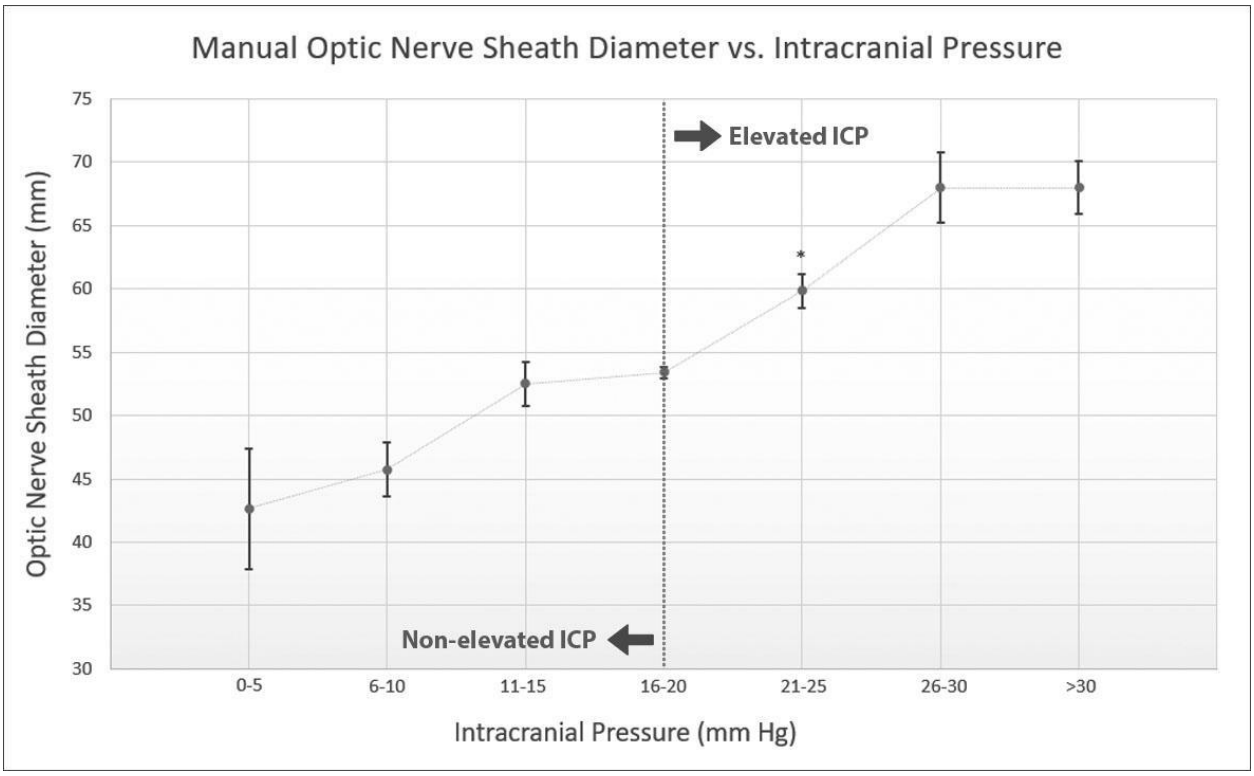

Figure 2. Optic nerve sheath diameter versus intracranial pressure using manual measurements with ultrasound measurement tool.

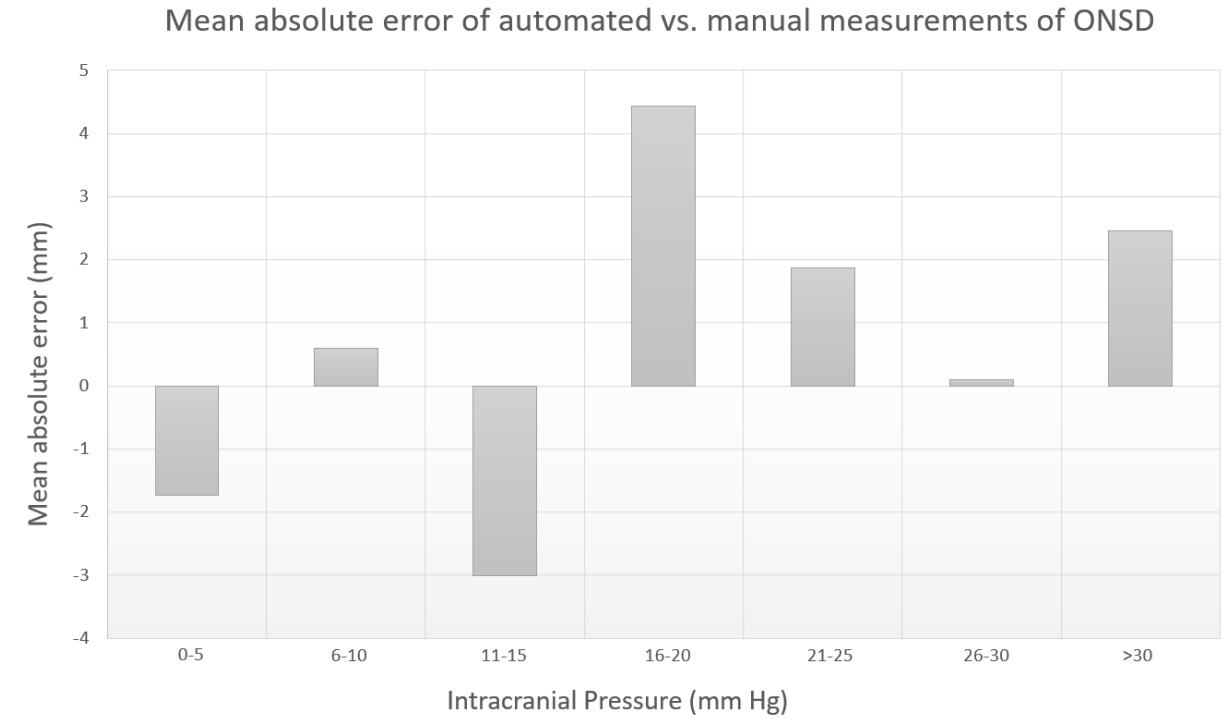

Figure 4: Mean absolute error of automated algorithm versus manual measurements.

Discussion/Conclusion:

The use of ultrasound technology is becoming increasingly popular in the treatment and management of critically ill patients. Ultrasound is cost-effective, widely available, non-invasive, adaptable to a variety of healthcare settings, and relatively quick in acquiring results. There is, however, a certain level of expertise required to obtain meaningful information from ultrasound imagery. Most ultrasound technologists require a minimum of 18 to 24 months of training before becoming effective ultrasonographers. Most physicians acquire their skill with ultrasound during their post-graduate years, with an emphasis on interpretation in addition to image acquisition. And even still, there are additional advanced training fellowships, such as the Emergency Ultrasound and Radiology Abdominal Imaging and Ultrasound Fellowships, that are an additional 1-2 years after residency training. With such a wide range in experience amongst ultrasound users, it is not surprising that the quality of information gathered using ultrasound is highly dependent on the experience of the operator. However, the rapid and non-invasiveness of ultrasound continues to expand its popularity, becoming more attractive in clinical situations that are high-stakes and time-sensitive, such as brain injuries in trauma.

The early identification and intervention of brain injuries is critical, as this type of injury pattern is generally irreversible, making the diagnosis urgent. Intracranial pressure monitoring is the most commonly employed methodology to recognize potential brain tissue hypoxia and is typically measured through invasive intraparenchymal or extraventricular drains placed by a neurosurgeon at bedside or in the operating room. Placement requires an extremely high level of expertise and carries an equally high level of risks and post-procedural complications when executed poorly. The ability for a treatment center to utilize direct ICP monitoring also requires an on-call neurosurgeon to be available. Placement of intracranial drains are both diagnostic and potentially therapeutic. More aggressive measures, such as craniotomies, are needed for more significant brain swelling to prevent the dreaded unrecoverable event of brain stem herniation. There are also hyperosmotic agents that can be given to help reduce intracranial swelling; their effectiveness depends on the extent of injury as well as earlier intervention. Thus, there exists a need for an adjunct approach to ICP monitoring that can help to initiate earlier intervention, both medically and surgically, towards the prevention of brain tissue hypoxia. Measuring optic nerve sheath diameters using ultrasound has the potential to fill this role. This methodology has been investigated in the past and shown to have potential, but hindered by a lack of robustness attributed to a large variation in operator ability and interpretation. We have demonstrated an improved method by eliminating operator variability through the use of automated image processing that is applicable both to patients with normal ICP and elevated ICP.

We are continuing to refine this method by implementing “3D” ultrasound. That is, not the actual use of a 3D ultrasound probe, as these are currently highly specialized and expensive, but rather having the operator acquire a sweeping image of the optic nerve by gradually changing the angle of the probe to the eyelid, while keeping the optic nerve in the center of the screen. Our automated algorithm quickly processes each of the images during the sweep and is then able to determine the center of the optic nerve sheath and obtain an accurate diameter before calculating the ICP. We hope that by utilizing this refined method, it will further minimize or perhaps eliminate any error introduced by the operator with variation in probe position on the patient.