

THE EIGHTH ANNUAL STARS (SURGICAL TRAINEES ADVANCING RESEARCH SYMPOSIUM)



Ord.	Time	Presenting Author	Title		
1	7:00	Michael E. Rezaee, MD, MPH	The Impact of Partial versus Complete BCG Intravescial Therapy on Bladder Cancer Outcomes in High-risk Non-muscle Invasive Bladder Cancer (NMIBC): Implications for Global BCG Shortages		
2	7:07	Daniel R. Calnan, MD	Detecting Ischemic and Hemorrhagic Lesions using a novel Bioimpedance Monitoring System		
3	7:14	Jenaya L. Goldwag, MD	Patient Perceptions of the Operative Experience: A Qualitative Analysis		
4	7:21	Eleah D. Porter, MD	Guideline-Directed Prescribing and Proper Disposal of Excess Opioids After Inpatient Surgery: A Prospective Clinical Trial		
5	7:28	Phillip Gray, MD	What are the Long-Term Changes to Bowel Function Patient-Reported Outcomes After Elective Sigmoidectomy for Diverticular Disease?		
6	7:35	Mark A Eid, MD	Differences in Surgical Quality and Patient Satisfaction between VA Hospitals and Hospitals Near VA Hospitals		
7	7:42	Prashanthi Divakar, MD	Factors Affecting Neck Dissection Lymph Node Yield in Head and Neck Squamous Cell Carcinoma		
8	7:49	Rob Allen, MD	Deep Sleep and Beeps: Inpatient Sleep Assessment in Elective Surgical Patients		
9	7:56	Andrew Lambour, MD	Work After Work: The Impact of the EHR on Burnout in Surgeons		
10	8:04	J Aaron Barnes, MD	Long-term Survival After Amputation Among Medicare Patients With Concomitant Diabetes And Peripheral Artery Disease		
11	8:11	Kevin Krughoff, MD	Botulinum Toxin Attenuates Ureteral PGE Synthase in a Rabbit Model		
12	8:18	Eleah D. Porter, MD	Reducing Unnecessary Chest X-Rays After Thoracic Surgery: A Quality Improvement Initiative		
13	8:25	Eric Eisen, MD	Age of Cochlear Implantation Predicts Sound Quality Perception		
14	8:32	Eileen R. Brandes, MD	Peri-Partum Acute Changes in 24-Hour Lithogenic Urine Measures		
15	8:39	Michael Davis, MD	Quantitative Analysis of Frozen Section Histology in Mohs Micrographic Surgery		
16	8:46	Libby Copeland-Halperin, MD	The Effects of Cannabis Use on Wound Healing: A Review of the Literature		

Co-Directors: Philip P. Goodney, MD, MS and Kari M. Rosenkranz, MD

Prizes: \$500/ \$200 (1st and runner up)

Judges: Alexandra Briggs, MD; Philip P. Goodney, MD, MS; Rian M. Hasson, MD; Jennifer Hong, MD; Andrew P. Loehrer, MD, MPH; Rachel A. Moses, MD, MPH; Kari M. Rosenkranz, MD; Sandra L. Wong, MD, MS 1. Michael E. Rezaee, MD, MPH

The Impact of Partial versus Complete BCG Intravescial Therapy on Bladder Cancer Outcomes in Highrisk Non-muscle Invasive Bladder Cancer (NMIBC): Implications for Global BCG Shortages

Michael E. Rezaee, MD, MPH, A. Aziz Ould Ismail, Chiamaka L. Okori, BS, John D. Seigne, MB, BCh, Kristine E. Lynch, PhD, & Florian R. Schroeck, MD, MS

Introduction: Repetitive global shortages of Bacillus Calmette–Guérin (BCG) have disrupted guidelinerecommended intravesical therapy practices for many high-risk non-muscle invasive bladder cancer (NMIBC) patients. The purpose of this study was to assess the association of partial vs. complete BCG therapy with cancer outcomes in high-risk NMIBC.

Methods: This was a retrospective cohort study of Veterans diagnosed with high-risk NMIBC (high grade (HG) Ta, T1, or Carcinoma in Situ) between 2005 and 2011 who received at least one dose of adjuvant BCG. Patients were categorized by partial BCG (< 5 instillations) versus complete BCG induction (>= 5 instillations). Propensity score adjusted regression models were used to assess the association of partial BCG induction with risk of disease recurrence, bladder cancer death, and progression to invasive disease.

Results: Among 540 patients with high-risk NMIBC, 114 (21.1%) received partial BCG induction, while 426 (78.9%) received complete induction. Partial vs. complete induction was not significantly associated with increased risk of disease recurrence for patients with HG Ta (cumulative incidence ([Cln] 46.6% vs. 53.9% at 5 years, p=0.38) or T1 (Cln 47.1% vs. 56.7% at 5 years, p=0.19) disease. Similarly, partial vs. complete induction was not significantly associated with increased risk of bladder cancer death for patients diagnosed with HG Ta (Cln 4.7%7vs. 5.4% at 5 years, p=0.87) or T1 (Cln 10.0% vs. 11.4% at 5 years, p=0.77) disease. Among patients with Ta disease, partial vs. complete induction was not significantly associated with risk of progression to invasive disease or bladder cancer death (Cln 13.1% vs. 19.0% at 5 years, p=0.37, Figure Panel 1).

Conclusion: High-risk NMIBC patients who underwent partial BCG induction experienced similar cancer outcomes compared to those who received complete induction. These findings suggest that a reduced number of induction BCG instillations may be an alternative treatment strategy for some high-risk patients.

Figure Panel 1: Cumulative incidence plots showing the probability of disease recurrence, bladder cancer death, and progression to invasive disease (T1/T2) by BCG induction status.



Detecting Ischemic and Hemorrhagic Lesions using a novel Bioimpedance Monitoring System

Daniel R. Calnan¹, Alicia Everitt², Brandon Root¹, Naser Jaleel¹, David Bauer¹, Ryan Halter²

¹Department of Surgery, Neurosurgery Section, Dartmouth Hitchcock Medical Center, Lebanon, NH,

²Thayer School of Engineering at Dartmouth College

Introduction: Rapid detection of stroke is increasingly important for first responders to facilitate appropriate triage to stroke centers. In addition, monitoring intervention with tPA or mechanical thrombectomy for hemorrhagic transformation is critical for appropriate care. To facilitate this, we have developed a novel bioimpedance monitoring (BIM) system with the aim of detecting and differentiating ischemic and hemorrhagic infarcts. Our results provide compelling evidence that a non-invasive, bioimpedance-based system could potentially be used to identify and triage patients in need of emergent neurosurgical intervention.

Methods: Yucatán pigs were anesthetized and a pterional craniotomy with zygomatic resection was performed to expose the ICA terminus (n=3). The vessel was coagulated and sharply transected. Bioimpedance data was collected using a custom BIM system. Intraoperative CT/CTA and MR imaging verified disruption of blood flow and the resulting ischemic infarct. In a separate set of experiments, a hemorrhagic lesion was mimicked using autologous blood injected through an intracranial catheter and compared to a model ischemic lesion (n=9).

Results: Impedance increased after transection of the vessels, as expected, and significantly differed from non-infarcted brain (p<0.001). In comparison to an ischemic model lesion, impedance decreased after injection of autologous blood, showing ability to differentiate the two etiologies (p=0.0039). This is consistent with expectations for ischemic and hemorrhagic lesions. Post-craniotomy/pre-ischemia measurements were used as a control to eliminate the effects of the craniotomy. CT imaging verified the absence of contrast in the transected vessels and MR imaging confirmed the presence of an early ischemic lesion.

Conclusions: The BIM system successfully detected a change in impedance after surgical transection of the ICA terminus and injection of autologous blood. This is the first bioimpedance-based system able to detect ischemic and hemorrhagic lesions. This system could potentially be used as a non-invasive way to detect infarcts in the field and provide post-intervention monitoring for hemorrhagic transformation.



Figure 1. Anterior cerebral circulation infarct detection by the BIM system (Left top) Operative view of MCA and ICA branches with bipolar ligation (Left bottom) Intraoperative MRI, ADC sequence confirming ischemic infarct (Right) Noninvasive detection of infarct by BIM system

Patient Perceptions of the Operative Experience: A Qualitative Analysis

Jenaya L. Goldwag, MD; Chloe N. Lee, BA, MPH; David A. Rogers, MD, MHPE; Louise Davies, MD, MS; Meredith J. Sorensen, MD, MS

Introduction: Although surgeons routinely describe operations during preoperative consultations and obtain informed consent from patients, it is unclear what patients understand about their surgical procedures. We aimed to identify patient perceptions of what it means to "do" surgery and their expectations of the operative experience.

Methods: Semi-structured interviews were held with patients scheduled for elective general surgery (25 patients undergoing 13 unique operations by 11 different surgeons) at a single institution after informed consent was obtained. Recordings were transcribed verbatim, coded independently by two coders, and an inductive thematic analysis was performed.

Results: Overall, patients anticipated the perioperative elements of their surgical experience, but did not understand what would actually happen during their operations. Several major themes emerged: 1. Most patients described the operative experience as preoperative preparation and care until the time of sedation, followed by some aspects of recovery, 2. Patients were limited in their ability to describe their scheduled procedures and often articulated that they did not fully understand the physical aspects, 3. Patients trusted their surgeons to "fix" their conditions, 4. Concerns about adequacy of anesthesia often superseded anxiety about surgery itself, 5. Patients had limited understanding of all operating room personnel and their roles during surgery.

Conclusion: Patients trust their surgeons to perform their operations even though they have a limited understanding of what will physically happen in the operating room. This brings into question what information patients need, want, and understand with regards to informed consent, and how they develop trust in their surgeons.

Guideline-Directed Prescribing and Proper Disposal of Excess Opioids After Inpatient Surgery: A Prospective Clinical Trial

Eleah D. Porter, Sarah Y. Bessen, Ilda B Molloy, Julia L. Kelly, Olivia C. Weale, Jessica R. Henkin, Anne K. McGowan, Jonathan D. Dupuis, Alexandra Fannin, Lisa L. Cotnoir, , Lindsay E. Bergmann, Loyd A. West, Srinivas J. Ivatury, Ivy Wilkinson-Ryan, John D. Seigne, Kerrington D. Smith, Lauren R. Wilson, Evelyn L. Fleming, Matthew Z. Wilson, Joseph D. Phillips, Andrew P. Loehrer, David J. Finley, Rian M. Hasson, Einar F. Sverrisson, Timothy M. Millington, Ilana Cass, Lawrence M. Dagrosa, Florian R. Schroeck, Christina V. Angeles, Sarah E. Billmeier, Sandra L. Wong, Richard J. Barth Jr.

Introduction: To lessen the chance for misuse of post-surgery prescription opioids, we implemented a prospective clinical trial at a single academic medical center. Our objectives were to 1) prospectively validate guidelines for discharge opioid prescriptions after inpatient surgery and 2) increase the proportion of patients who dispose of excess opioids using an FDA-compliant method, which previous studies have shown to be less than 20%.

Methods: Over 1 year, we prospectively enrolled 229 patients admitted for \geq 48-hours after elective general, urologic, gynecologic or thoracic surgery. Discharge opioid prescriptions were determined by number of pills used the day prior to discharge: if 0 oxycodone pill-equivalents (PE) used, then five (5mg) PE's prescribed; 1-3 pills used, 15 prescribed; \geq 4 pills used, 30 prescribed. We defined satisfactory pain control as no opioid refills obtained.

Interventions to promote FDA-compliant disposal of excess pills included: 1) patient education session, 2) reminder phone call, 3) convenient drop box located in hospital pharmacy, and 4) follow-up questionnaire. The proportion of FDA-compliant disposal was calculated.

Results: Our guidelines satisfied 93% (213/229) of patients' pain needs. For patients using no opioids the day prior to discharge, 5 oxycodone PE's satisfied 99% (99/100). For those using 1-3 pills, 15 pills satisfied 90% (92/102). For those using \geq 4 pills, 30 pills satisfied 81% (22/27).

Overall, 60% (138/229) of patients had leftover pills; 21% (48/229) never filled their prescription and 19% (43/229) used it entirely. 84% (116/138) of patients with leftover pills disposed of them; 83% (114/138) used an FDA-compliant method. Of those patients, 51% (58/114) utilized the hospital pharmacy drop box. Only 187 opioid pills (7%) out of 2,594 total prescribed pills were kept by patients.

Conclusion: Postoperative opioid use the day prior to discharge satisfactorily predicts outpatient needs. FDA-compliant disposal of excess pills can be optimized with easily actionable interventions.



What are the Long-Term Changes to Bowel Function Patient-Reported Outcomes After Elective Sigmoidectomy for Diverticular Disease?

P Gray, J Goldwag, M Eid, S Ivatury

Introduction: For patients with diverticular disease, the decision for surgery is often preference sensitive, based on preoperative symptoms. We previously showed that bowel function does not change in the perioperative period. We aimed to evaluate long-term changes to bowel function after elective sigmoidectomy for diverticular disease.

Methods: This was an observational study of patients that underwent elective sigmoidectomy for diverticular disease and completed the Colorectal Functional Outcome (COREFO) questionnaire prior to surgery. Patients were stratified into two groups based on presence or absence of a preoperative symptomatic score (i.e. total COREFO \geq 15). Long-term bowel function (> 1 year from surgery) was assessed using the COREFO questionnaire via telephone or subsequent clinic visit. Mean preoperative scores were compared to mean long-term scores using a paired t-test.

Results: Fifty-one patients met inclusion criteria for the study (30 asymptomatic, 21 symptomatic). All symptomatic patients had uncomplicated disease whereas 26 (86%) asymptomatic patients had complicated disease. Median time from operation to questionnaire completion was 23 months (IQR: 13-34). Asymptomatic patients demonstrated significant worsening in global bowel function, driven by changes in the social impact domain (Figure 1). Symptomatic patients demonstrated significant improvement in global bowel function, driven by improvements in the incontinence, social impact, stool-related aspects, and need for medication domains (Figure 1).

Conclusions: In the long-term after elective sigmoidectomy for diverticular disease, patients with symptomatic bowel function preoperatively have substantial improvement in bowel function, while those with asymptomatic preoperative scores demonstrate significant impairment. PRO-measured symptomatic patients likely benefit long-term from sigmoid resection.

5. Phillip Gray, MD



Fig. 1 Pre-op (Black) and Long-Term (Gray) Domains and Total COREFO Scores by Preoperative Symptomatic Total COREFO Score Status

Differences in Surgical Quality and Patient Satisfaction between VA Hospitals and Hospitals Near VA Hospitals

Mark A Eid, MD; Jonathan A Barnes, MD; Spencer W Trooboff, MD, MBA; Sandra L Wong, MD, MS

Introduction: The Veterans Health Administration (VA) is the largest integrated healthcare system in the US, delivering care to 9 million Veterans. The 2019 Maintaining Internal Systems and Strengthening Integrated Outside Networks (MISSION) Act established a permanent discretionary community care program to allow VA-funded care outside a VA medical center (VAMC). However, how surgical care at external sites compares to VAMCs is unknown. We evaluated patient safety and patient satisfaction in VAMCs and surrounding non-VA hospitals (non-VAs).

Methods: We identified 34 VAMCs in three distinct geographic regions (West/Southwest, New England, Deep South) which had at least one non-VA acute care hospital within 25 miles (median 7 non- VAs per VAMC, range 1-32). Children's hospitals, specialty hospitals and critical-access hospitals were excluded. Using publicly available hospital-level data (Hospital Compare, 2015-2017), we analyzed performance of each VAMC and their surrounding non-VA hospitals focusing on postsurgical Patient Safety Indicator (PSI) data and Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) patient satisfaction scores and hospital star ratings. The performance of VAMCs and non-VAs was compared using paired t-tests.

Results: The 34 VAMCs performed better than 329 non-VAs in rates of wound dehiscence, accidental cuts, and perioperative hemorrhage/hematoma and a composite PSI rating (Figure, all p<0.05). VAMCs also trended better for DVT/PE (p=0.08) and pressure sores (p=0.44). When focusing on surgery-specific PSIs together, VAMCs performed significantly better than non-VAs (0.8 v 1.58 per 1000 patients, p< 0.001). When comparing mean linear HCAHPS scores (0-100 scale), VAMCs trended towards better performance in communication about medications compared to non-VAs (79.0 v 77.8, p=0.06) and care transitions (82.0 v 81.4, p= 0.09). However, VAMCs performed worse than non-VAs satisfaction with discharge information (85.2 v 86.2%, p=0.05) and "would recommend" ratings (86.9 v 88.3, p=0.04). When compiled star ratings (1-5 scale) for patient satisfaction were compared, there was no difference (2.96 v 2.97, p=0.9). VAMC and non-VAs had equivalent overall hospital star ratings (3.32 v 3.31, p=0.9).

Conclusion: Across disparate regions of the US, VAMCs overwhelmingly match or outperform neighboring non-VA hospitals on surgical quality metrics and patient satisfaction ratings. Veterans electing care outside VAMCs may receive poorer care if they choose a non-VA hospital for surgery. This information may be important to Veterans as they consider where to receive care.



Patient Safety Indicators Among 3 Geographic Regions

Factors Affecting Neck Dissection Lymph Node Yield in Head and Neck Squamous Cell Carcinoma

Prashanthi Divakar MD¹, Mariah M Servos BA², Joseph A Paydarfar MD¹, Christiaan A Rees PhD², Allison L Matous BA², Michael T Sramek BS²

¹Dartmouth Hitchcock Medical Center, ²Geisel School of Medicine

Introduction: There are 380,000 deaths attributed to head and neck cancer annually. Neck dissection is integral to staging and treatment in head and neck squamous cell carcinoma (HNSCCa). Lymph node yield (LNY), the number of lymph nodes present in a lymphadenectomy specimen, is prognostically significant, but highly variable across the population. We hypothesize that the reason for this variability includes patient and treatment factors, surgical technique, and pathological processing.

Methods: We performed a retrospective analysis of neck dissections for HNSCCa performed at Dartmouth Hitchcock Medical Center between 2017-2019. Data abstracted included patient demographics, tumor characteristics, HPV status, prior treatment, neck levels removed, operating surgeon, and processing by pathology resident or assistant. Primary outcome measured was LNY. Multiple regression was used to predict LNY using the other covariates in the model. For the comparison of either continuous or categorical variables between groups either a two-sided t-test or chi-squared test was used, respectively.

Results: Results from 102 neck dissections were analyzed. Average LNY was 25, patient age was 63.5 years, BMI was 27.3; 75% of patients were male and 25% were female. No statistically significant relationship was identified between LNY and age (p=0.75), BMI (p=0.44) or gender (p=0.68). There was a statistically significant difference in LNY between surgeons, 32.0 vs. 14.4, p = 1.9×10^{-8} . However, there was no significant difference in the number of positive nodes between surgeons, 1.83 vs 2.82, (p = 0.43). There was no significant difference in LNY whether a pathology assistant or resident harvested the lymph nodes, 26.0 vs 23.8, (p = 0.50).

Conclusion: Findings suggest a potential relationship between surgical technique and LNY; however, patient gender, BMI, and age, as well as the individual harvesting the lymph nodes do not appear to impact LNY. Future studies will focus on survival outcomes as relates to LNY.

Deep Sleep and Beeps: Inpatient Sleep Assessment in Elective Surgical Patients

Rob Allen, MD, S. Joga Ivatury, MD, MHA

Introduction: Poor sleep leads to poor health outcomes including increased cardiovascular events, infection rates, and all-cause mortality. Sleep disturbance in the hospital is a common occurrence, well studied in ICU populations. There has been minimal research performed on inpatient, postoperative sleep disturbance.

Methods: 49 patients undergoing elective abdominal surgery wore Fitbit sleep trackers while inpatient to record total sleep time (recommendation=7hrs). At discharge, patients completed the Richards-Campbell Sleep Questionnaire (RCSQ) for inpatient sleep quality. The RCSQ combines five sleep domains into a cumulative score (0-100); a higher score means better sleep quality. Patients also completed the outpatient Pittsburgh Sleep Quality Index (PSQI) before surgery (>5=sleep disturbance) to assess baseline sleep. Main outcomes measured were RCSQ total sleep quality score and RCSQ domain scores. Secondary outcomes were pre-op PSQI score and Fitbit-measured total sleep time.

Results: 42 (86%) patients had pre-op PSQI scores suggesting baseline sleep disturbance. Mean (SD) RCSQ total sleep quality was 46.6 (\pm 20.6); mean domain scores included Awakenings (37.1 \pm 22.6), Sleep Quality (46.0 \pm 20.6), and Sleep Depth (46.6 \pm 25.8), and Noise Disturbance score was 56.3 (\pm 27.1). 19 (38%) patients had enough uninterrupted sleep the first postoperative night to accurately record sleep time, which averaged 3.6 hours. Through hospitalization, patients averaged 5.9 hours of sleep per night. Sleep barriers included nighttime noise pollution and awakenings for vital signs/phlebotomy.

Conclusions: Elective surgical patients experience severely poor sleep quality during inpatient stay. This is driven by nighttime noise pollution and frequent nighttime awakenings. We will design and pilot a set of healthcare delivery strategies and a Postoperative Pack (POP) for sleep to address these issues.



9. Andrew Lambour, MD

Work After Work: The Impact of the EHR on Burnout in Surgeons

Andrew Lambour, MD; Mark Eid, MD; Meredith Sorensen, MD; Sandra Wong, MD, MS

Objectives: Burnout has been described as a crisis among physicians. There are proposed relationships between burnout and electronic health record (EHR) use. To understand how to better manage burnout, we evaluated EHR work performed outside of work hours.

Methods: Work-after-work, defined as EHR notes signed outside "normal" work hours (1800-0600), was captured by timestamps from inpatient and outpatient notes. Outcomes included proportion of work-after-work and burnout assessment, captured by the abbreviated Maslach Burnout Index (aMBI).

Results: Surgeons from an academic department were surveyed (n=40, 35% female). All but one reported that they preferred charting in the hospital, yet 15% completed the majority of charting at home. 60% considered themselves note-writing perfectionists and 55% reported that they spend >5 hours/week on EHR documentation from home. 100% utilize dictation or dot phrases; 38% had ancillary help (e.g. scribes). Overall, 40% reported adequate work-life-balance, however 36% met burnout criteria based on aMBI scores. 40% reported EHR use as a source of burnout, supported by findings that 20% of notes (19% inpatient, 26% outpatient) were completed as work-after-work, though only 9% of outpatient notes were signed during weekends. We observed a linear relationship between proportion of work-after-work and depersonalization (burnout) scores (R2=0.04;Figure).

Conclusions: Surgeons perform a significant amount of their charting after hours. This work-after-work is correlated with burnout, indicating that better EHR management may be a target of wellness work.





Long-term Survival After Amputation Among Medicare Patients With Concomitant Diabetes And Peripheral Artery Disease

J Aaron Barnes, Mark A Eid, Zachary J Wanken, Barbara Gladders, Andrea M Austin, Richard J Powell, David H Stone, Mark W Feinberg, Marc P Bonaca, Mark A Creager, Philip P Goodney

Introduction: Major lower extremity amputation in the setting of diabetes and peripheral artery disease (PAD) is associated with poor long-term survival. Long-term survival following minor amputation, such as amputation of the toes or forefoot is less well characterized. This study examines and compares the long-term survival after minor and/or major lower extremity amputation in patients with concomitant diabetes and PAD.

Methods: We studied fee-for-service Medicare claims (2003-2016) using previously validated diagnosis codes specific for diabetes and PAD and identified major and minor amputations as well as death at the patient level. Kaplan-Meier analyses were used to create mortality curves for the amputation-type cohorts. Curves were compared using the Log-Rank test.

Results: Over the study period, 10,506,141 Medicare beneficiaries with concomitant diagnoses of diabetes and PAD were identified. Mean age was 73.3 years, 52.7% were women (5,532,032 of 10,506,141), 13.5% were black (1,421,237 of 10,506,141), and 5.9% were Hispanic (619,008 of 10,506,141). Within this cohort, 406,135 total amputations (151,785 major first, 194,773 minor only, and 59,577 minor followed by major) were performed. Kaplan-Meier mortality curves for each cohort are shown in Figure 1. Median survival following major amputation first was 1.62 years (95% CI: 1.60 – 1.64), 3.25 years (95% CI: 3.21 - 3.29) after minor followed by major amputation, 3.41 years (95% CI: 3.38 - 3.44) after minor amputation only, and 6.93 years (95% CI: 6.92 - 6.94) without amputation (Log-Rank p<0.0001).

Conclusion: Survival after minor, minor followed by major, and major amputations among patients with concomitant diabetes and PAD is limited. Patients undergoing minor amputations, though seemingly less significant than major amputation, carry an elevated mortality risk regardless of progression to major amputation and should be the focus of targeted prevention and care management strategies.

Figure 1. Kaplan-Meier mortality curves following major amputation first, minor followed by major amputation, minor amputation alone, and no amputation among patients with diabetes and peripheral artery disease.



Botulinum Toxin Attenuates Ureteral PGE Synthase in a Rabbit Model

Kevin Krughoff, MD¹; Scott Palisoul, BS³; Steven Tau, BS²; Faith L. Anderson, BS²; Alison L Young, MS²; Jason Pettus, MD³; Karen Moodie, DVM⁴; Rachel Moses, MD¹; Matthew C. Havrda, PhD²; David Chavez, MD¹;

1 Department of Urology, Dartmouth-Hitchcock, Lebanon, NH

2 Department of Molecular and Systems Biology, Geisel School of Medicine at Dartmouth and Dartmouth-Hitchcock Medical Center, Lebanon, NH

3 Department of Pathology, Dartmouth-Hitchcock, Lebanon, NH

4 Geisel School of Medicine at Dartmouth, Hanover, NH

Introduction and Objective: Clostridium botulinum toxin type A (BoNT-A) has been found to inhibit the release of several neurotransmitters and inflammatory modulators. The impact of intraureteral BoNT-A on the chemosensory functions of the ureter is unknown. Our goal was to determine the effect of BoNT-A instillation on the expression of prostaglandin E (PGE) synthase in an inflammatory state using a novel animal model.

Methods: Cystotomy and unilateral ureteral BoNT-A instillation with ipsilateral distal ureteral ligation was performed on 3 New Zealand white rabbits (2.4-2.8kg). A fourth rabbit underwent 4cc saline instillation to serve as a negative control. A fifth rabbit underwent direct periureteral BoNT-A injection in addition to ureteral instillation to serve as a positive control. Rabbits were survived for 7 days. Ureteral tissue was fixed in formalin and paraffin embedded. Ureteral sections underwent antigen retrieval (BOND epitope retrieval solution) followed by incubation with PGE synthase antibody (*Santa Cruz Biotechnology*) and DAB HRP secondary (Vector ImmPRESS-VR Kit).

Results: All rabbits survived 7 days with one exception which was euthanized on post-operative day five following wound complications. PGE synthase was detected in ureteral tissue of all specimens. BoNT-A exposure was associated with a decrease in PGE synthase signal in a dose-dependent fashion, with direct injection showing the greatest decrease in signal.

Conclusions: The feasibility of an in-vivo study of ureteral BoNT-A instillation is demonstrated herein, with preliminary results suggesting attenuation of ureteral PGE synthase expression following BoNT-A exposure. The ability of BoNT-A to exert chemosensory and/or inflammatory modulating effects without direct injection is possible under conditions of inflammation.

11. Kevin Krughoff, MD

Images



Figure 1. Left: Midline cystotomy with ureteral instillation followed by distal ligation. Right: Urethral catheterization and cystorrhaphy leak test



Figure 2. Normal unobstructed ureter stained for PGE synthase at 10X (left) and 40X (right) magnification.



Figure 3. Left and right ureter cross sections from individual rabbit. Left: No ligation or BoNT-A exposure. Right: 20U BoNT-A instillation followed by distal ligation.



Figure 4. 40X magnification of ureter sections with distal ligation from 3 separate rabbits: A) No BoNT-A exposure B) 20U BoNT-A ureteral instillation C) 5U BoNT-A ureteral instillation and 35U direct injection into periureteral tissue and bladder.



Figure 5. Hematoxylin and eosin (H&E) x 100. Representative sections of left and right kidneys from individual rabbit. *Left*: Non-obstructed control side cortical section with intact renal tubules and glomeruli, uniform tubules with single layer of epithelial lining. Right: Obstructed experimental side cortical section shows glomerular hyalinization and thickened mesangium. Protein casts occupying tubule lumens and vascular congestion confirming prolonged obstruction.



Figure 6. Sections of obstructed ureter on H&E (left) and Masson's trichrome (right) in axial (top and middle) and longitudinal (bottom). Lymphocytic infiltrate and edematous subepithelial connective tissue is seen on H&E. The arrangement of urothelium (pink), suburothelial collagen deposition (blue) and periureteral smooth muscle (red) can be appreciated on trichrome.



Figure 7. Transmission Electron Microscope images at $2\mu m$. Left: 4 urothelial cells with prominent nuclei. Tight junctions intact under normal conditions. Right: Urothelial cells with disrupted junctions under conditions of inflammation.

Reducing Unnecessary Chest X-Rays After Thoracic Surgery: A Quality Improvement Initiative

Eleah D. Porter, Julia L. Kelly, Kayla A. Fay, Rian M. Hasson, Timothy M. Millington, David J. Finley, Joseph D. Phillips

Introduction: The routine ordering of empiric chest x-rays (CXRs) following inpatient thoracic surgery is a common, costly practice. Previous work has identified that many of these x-rays are unnecessary. We implemented a quality improvement (QI) initiative to safely and systematically change this practice.

Methods: A 3-phase rapid cycle QI initiative was performed to reduce empiric post-thoracic surgery CXR use by 25% over one year at a single, academic center. We adapted evidence-based guidelines from internal medicine and implemented methodology of plan-do-study-act (PDSA) cycles. Each cycle lasted three months. CXR utilization was tracked in the post-anesthesia care unit (PACU) and also as a daily rate of other non-PACU CXRs. PDSA cycles included: 1) Education: section first presented with literature and pre-intervention statistics, then a monthly reminder email and daily discussion of CXR utility was incorporated into rounding 2) Electronic medical record modification: order-set CXRs were unselected, and 3) Audit and feedback: monthly status reports. Cost data were derived from institutional charges.

Results: During the QI initiative, 292 thoracic surgery inpatients were monitored. Prior to intervention, 99% (69/70) of patients received a PACU CXR and the daily rate of other CXRs was 1.6. Overall, there was a significant reduction in CXR utilization (p<0.001). PACU CXRs decreased from baseline by 42%, lowering to 89% (68/76) to 68% (50/74) to 57% (41/72) in PDSA cycles 1-3, respectively. The daily rate of other CXRs decreased by 38%, lowering to 1.4 to 1.3 to 1.0. Patient perioperative characteristics and health care quality measures including length of stay, morbidity and mortality were not different between cycles. After QI implementation, cost savings were estimated at \$449,680 per year.

Conclusion: Implementation of our QI initiative safely and systematically reduced empiric CXR use after inpatient thoracic surgery. Results will be used in future QI initiatives to reduce unnecessary postoperative testing.



EMR (electronic medical record), and Audit & Feedback. The chart demonstrates week-to-week variation but overall decline, with a shift below the center line (CL) at week 35.

Age of Cochlear Implantation Predicts Sound Quality Perception

Isabelle Magro, Sarah Bessen, Eric Eisen MD, James Saunders MD

Introduction: Cochlear implant (CI) research has primarily focused on speech understanding. This study aims to characterize the quality and enjoyment of sound by CI recipients and to identify predictors of outcomes of cochlear implantation.

Methods: Cross-sectional study characterizing the enjoyment and quality of sound over time by Cl recipients using survey questions based on the Hearing Implant Sound Quality Index (HISQUI₁₉) with reference to the perception of voices, music, and meditative sounds. Surveys were sent to all adult patients who received a Cl at a tertiary care hospital from 2000 to 2019. Survey responses were evaluated in the context of patient characteristics using linear regression models.

Results: Of the 339 surveys, 49 (14.5%) were returned with complete data. CI recipients had a mean age of 61.7 ± 18.3 years with a mean of 7.9 ± 6.2 years since CI surgery. As length of implantation increased, the quality of sound improved (r=0.3, p<0.05), but there was no change in the enjoyment. However, as age of implantation increased, the quality (r= 0.4, p<0.01) and enjoyment (r= 0.4, p<0.01) of sound worsened. There was also a negative correlation between the age of implantation and the change in enjoyment (r=0.3, p<0.05), and quality (r=0.4, p<0.05) over time.

Conclusion: As a whole, recipients who had CIs for a longer period of time had improved quality of sound perception, but not of enjoyment, suggesting a degree of adaptation. However, CI recipients who were implanted at an older age reported poorer sound quality and enjoyment as well as a worsening in their sound quality and enjoyment perception over time, indicating that age-related changes influence outcomes of cochlear implantation.

Peri-Partum Acute Changes in 24-Hour Lithogenic Urine Measures

Eileen R. Brandes, MD, Zita F. Ficko, MD, Elizabeth B. Johnson, MD, Vernon M. Pais, MD

Introduction: Urinary lithogenic changes during pregnancy have been hypothesized to contribute to stone formation during pregnancy and long term increased stone prevalence in multigravid women. While short-term lithogenic changes during pregnancy have been postulated, such changes have never been demonstrated in a prospective fashion controlling for diet. We sought to define peri-partum 24-hour urine values and assess acute, short term changes post-partum. To address potential dietary confounding, a standardized formula was utilized.

Methods: IRB approval was obtained for this prospective study. Women had singleton pregnancies. Those with gestational diabetes were excluded. Metabolic needs and standardized diet were assessed by an obstetrical dietitian. The diet consisted of boost and unlimited water. Vitamin supplements were held. Collections were obtained during the third trimester as well as at 6 weeks or greater postpartum. Subjects remained on the controlled diet for 48 hours – 24 hours preceding urine collection and the 24 hours of the urine collection. Statistical analysis were performed in STATA using T-test.

Results: Of the twenty participants currently enrolled, twelve have submitted pre- and post-partum urine collections. It was noted that there was no significant difference in known dietary-related factors of urinary volume, sodium, sulfate and urea nitrogen. Urinary calcium was found to be 302.5 pre-partum and 125.2 post-partum (p=0.001). Urinary pH was 6.59 pre-partum and 5.93 post-partum (p < 0.001). Urinary super saturation of calcium phosphate (ssCaP) was 2.1 pre-partum and 0.7 post-partum (p < 0.0001).

Conclusions: Hypercalciuria and alkaline urine are observed acutely during pregnancy. By implementing a standardized formula diet, for the first time, we have demonstrated these changes are independent of self-selected diet and thus intrinsic to pregnancy. Abnormally elevated urinary super saturation of calcium phosphate during pregnancy further suggests that these changes may have clinical importance.

Quantitative Analysis of Frozen Section Histology in Mohs Micrographic Surgery

Michael Davis, MD; Karen Bieber, Sherrie Cooper, Amanda Isenor Matthew LeBoeuf, MD, PhD.

Introduction: Mohs micrographic surgery (MMS) relies on complete frozen tissue sections for the unique combination of high cure rates and tissue preservation.

Objective: To quantify and characterize the tissue sectioning process in MMS.

Materials and Methods: Two hundred eighty-four tissue blocks were analyzed. The histotechnician measured the depth cut into the tissue block for every section placed on the slide. The surgeon identified complete sections.

Results: First-stage complete sections were achieved at 285 μ m. The ear and hair-bearing cheek required increased depth of sectioning compared with other sites. Small pieces of tissue achieved complete sections at a decreased depth compared with medium or large pieces of tissue. The methodology used in this study was able to identify statistically significant differences between histotechnicians.

Conclusion: More than 2,000 measurements on 284 tissue blocks provided quantitative data of the tissue sectioning process in MMS, confirming that MMS allows evaluation of both peripheral and deep margins within hundreds of microns of the margin. Results from this study indicate a methodology that is easily implemented providing interpretable data that can be used to assess and improve tissue sectioning ensuring MMS remains the gold standard for removal of challenging cutaneous tumors.

The Effects of Cannabis Use on Wound Healing: A Review of the Literature

Copeland-Halperin LR, Shank N, Herrera-Gomez LC, LaPier JR, Shin JH

Background: Cannabis use is prevalent. Cannabinoid (CBD) receptors are involved in regulating proinflammatory cytokines, and the >300 chemical compounds contained in marijuana exert diverse physiologic effects. As more patients use cannabis in various formulations and quantities, clinicians should recognize implications of cannabis use perioperatively. While the role of cannabis in perioperative pain control has been explored, little is known about its effect on wound healing.

Methods: We searched the PubMed database for English-language articles related to cannabis and wound healing or surgery. Titles and abstracts were reviewed, and relevant articles analyzed. Human, animal, and pathology studies were included. Editorials, case reports, and review articles were excluded.

Results: Of 2,549 articles identified, 5 human studies and 8 animal or pathology studies met inclusion criteria. Overall study quality was poor. Dose, route of administration, duration, outcome and follow-up were variably reported. One case series of patients with dermatologic wounds noted improved skin hydration, elasticity, and symptoms with varying frequency and duration of topical CBD. Another suggested subjective improvement in open wounds with topical CBD. A third study of bariatric surgery showed no difference in postoperative infections among users vs. non-users. However, database review of 2,718,023 patients undergoing total knee arthroplasty identified more revisions among marijuana users vs. non-users (12.8 vs. 9.1%, p<0.001). In 4 animal and pathology studies of injected CBD or tetrahydrocannabinol (THC), CBD-impregnated implants, inhaled THC, and cultured THC application, outcomes were conflicting with 4 demonstrating improved wound or bone healing and an equal number demonstrating impairment.

Conclusion: Surgeons should consider the effects of cannabis products in the perioperative setting. Despite several studies of cannabis on perioperative pain control, little is known about its effects on wound healing. Further research is needed to elucidate the impact of route of administration, dose, and timing of cannabis use among surgical patients.

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Table 1: Summary of all included articles

	Authors, Year	Wound Type	Total Number of Subjects	Total Number of Users	Drug	Administration Route	Dose	Outcomes
Human Studies								
	Palmieri, 2019	Psoriasis, atopic dermatitis, & scars	20	20	CBD	Topical	BID x 90 days	Improved hydration, tissue elasticity, transepidermal water loss. Subjective photographic improvement.
	Chelliah, 2018	Epidermolysis bullosa	3	3	CBD	Topical	BID-TID (variable duration)	Subjective improvement
	Dakour-Aridi, 2019	Lower extremity bypass grafts	50,976	372	Cannabid	NR	NR	Increased graft complications. No difference in overall complications.
	Bauer, 2018	Bariatric surgery	434	36	Marijuana	Inhaled	At least once in 30 days	No difference in surgical complications
	Law, 2018	ТКА	2,718,023	18,875	Marijuana	Inhaled	NR	Increased revision rate
Animal & Pathology Studies								
	Kamali A, 2019	Osteotomy defect	40		CBD	CBD-impregnated implant s. autograft	1mg CBD-PLGA	Promoted bone healing
	Klein M, 2018	Punch biopsy- induced tongue wounds	40	20	CBD	Injection	5mg/kg or 10mg/kg x 3 or 7 days	Impaired wound healing
	Solinas M, 2012	Subcutaneous tissue	40		CBD	CBD-impregnated Matrigel solution injected	Varying levels	Impaired wound healing & angiogenesis
	Kogan NM, 2015	Mid-diaphyseal femur fractures	5-13		THC vs. CBD vs. CBD+THC vs. control	Injection	5mg/kg CBD &/or 5mg/kg THC	CBD promoted bone healing; effect potentiated by THC. THC alone did not promote bone healing.
	Nogueira- Filho GR, 2008	Titanium bone implant	30	15	ТНС	Inhaled	Experimental group inhaled marijuana smoke for 8 min x 60 d	Impaired bone healing. 7 experimental group rats died from respiratory failure.
	Liu C, 2019	Human periodontal fibroblast cells	N/A	N/A	THC vs. control	Added to cell culture media	1µM THC in culture media	Promoted wound healing. Increased fibroblast migration & adhesion.
	Del Rio C, 2016	Subcutaneous wounds with Bleomycin- induced fibrosis	64		Novel CB2 or PPAR agonist CBD quinol	Injection	Daily 10mg/kg or 20mg/kg CBD or PPAR agonist	Impaired wound healing. Decreased fibroblast migration.
	Sido JM, 2015	Allograft & autograft skin graft	45		THC +/- CB1 antagonist vs. control	Injection	20mg/kg THC or 20mg/kg CB1 antagonist every other day x 14 days	Increased graft survival

THC: Δ^9 -Tetrahydrocannibinol; CBD: cannibidiol; CB: cannabinoid receptor; BID: twice daily; TID: three times daily; TKA: Total Knee Arthroplasty; N/A: Not applicable; NR: Not recorded; PPAR: Peroxisome Proliferator-Activated Receptor; PLGA: poly(lactic-co-glycolic acid); min: minutes; d: day