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## A Paralyzing Consequence: Succinylcholine-Induced Hyperkalemia, a Rare but Dangerous Side Effect

Abstract

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## #53. A Paralyzing Consequence: Succinylcholine-Induced Hyperkalemia, a Rare but Dangerous Side Effect<sup>§</sup>

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<sup>§</sup>Abstract submitted but not presented

**Mentor:** Ryan Mullane

**Program:** Internal Medicine

**Type:** Case Report

**Background:** Succinylcholine is a depolarizing neuromuscular blockade agent used during general anesthesia. Succinylcholine use can cause hyperkalemia and cardiovascular instability in certain patients. We describe a case of succinylcholine-induced hyperkalemia with cardiac arrest.

**Case:** A 27-year-old male was admitted to the ICU for rhabdomyolysis and septic shock due to MRSA pneumonia requiring mechanical ventilation. Following extubation, the patient

had immobility due to weakness with an EMG demonstrating subacute mixed polyneuropathy. He also developed dysphonia; laryngoscopy was recommended. His serum potassium level was 3.9 mEq/L before laryngoscopy. Upon succinylcholine administration for intubation, he had a cardiac arrest. Labs revealed a potassium level of 9.2 mEq/L. Nephrology was contacted for emergent dialysis. Temporizing measures were administered, including insulin with dextrose and calcium gluconate. The repeat potassium level was 6.4 mEq/L, then 3.3 mEq/L thirty minutes later. The patient recovered without dialysis and was discharged to an acute rehabilitation facility.

**Conclusion:** Succinylcholine causes intracellular potassium efflux when binding to

acetylcholine receptors. Several pathologic states cause upregulation of acetylcholine receptors and predispose patients to critical hyperkalemia. These include severe infections, rhabdomyolysis, diffuse atrophy, immobilization, denervation injury or diseases, and trauma. If succinylcholine is required, close potassium and cardiac monitoring are necessary. The optimal treatment for patients with succinylcholine-induced hyperkalemia includes treatments that redistribute potassium back inside cells. Dialysis has a limited role in treatment and poses a greater risk and delayed time to treatment. Succinylcholine-induced hyperkalemia is a rare, life-threatening condition, and practitioners should be aware of predisposing factors and appropriate treatment.

## #54. Systemic Sclerosis Masquerading as Superior Mesenteric Artery Syndrome

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**Mentor:** Alexander Hewlett

**Program:** Internal Medicine

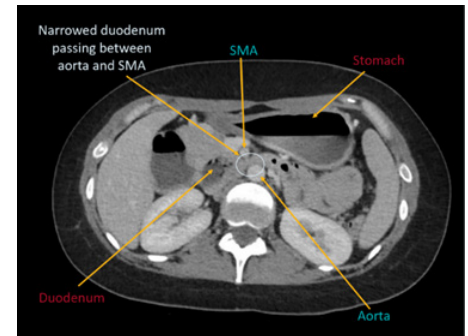
**Type:** Case Report

**Background:** Superior Mesenteric Artery (SMA) Syndrome is a rare condition characterized by compression of the third portion of the duodenum (D3) between the aorta and superior mesenteric artery. This compression often arises from abrupt weight loss or cachexia, leading to a reduction of the mesenteric fat pad between these two vessels, resulting in a narrower angle. Conditions causing diminished duodenal peristalsis, like connective tissue diseases and chronic idiopathic intestinal pseudo-obstruction, can mimic this and are collectively referred to as SMA-like syndromes. This case highlights an uncommon and diagnostically challenging case of intestinal pseudo-obstruction from systemic sclerosis (SSc) resembling SMA syndrome.

**Case:** A 24-year-old woman with a history of SSc presented with a four-day history of progressive nausea and vomiting. She had experienced a nine-pound weight loss in one month and had discontinued mycophenolate mofetil and prednisone two years prior. Computed tomography revealed D3

narrowing with upstream duodenal and gastric dilation without evidence of extrinsic obstruction, suggesting SMA syndrome (**Figure 1**). Esophagogastroduodenoscopy ruled out intrinsic obstruction, while an upper gastrointestinal series reaffirmed D3 narrowing and proximal dilation with slow contrast passage into the distal small bowel. The aortomesenteric artery angle was 45° by mesenteric duplex, and the gastric emptying study (GES) was normal, contradicting the SMA diagnosis.

**Conclusion:** Despite suggestive features, an aortomesenteric artery angle  $\leq 25^\circ$  and normal GES highlight SMA syndrome as a diagnosis of exclusion. This case underscores the diversity of gastrointestinal manifestations of SSc, emphasizing the need for nuanced differential diagnoses, particularly in patients with known autoimmune conditions.



**Figure 1.** Narrowing of the third portion of the duodenum with upstream dilation as it passes between the superior mesenteric artery (SMA) and aorta.

## #55. Robotic Assisted Bronchoscopy: An Institutional Correlation Between Cytopathology and Surgical Resection Diagnoses

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**Mentor:** Ana Yuil-Valdes

**Program:** Pathology

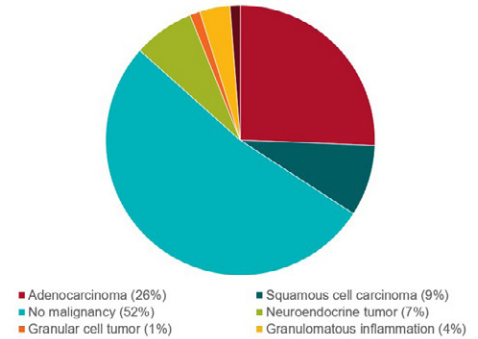
**Type:** Original Research

**Background:** Diagnosing peripheral pulmonary lesions (PPL) presents clinical challenges and, historically, multiple interventions for the patient. New robotic assisted bronchoscopy (RAB) platforms have emerged to address these concerns. Together with rapid on-site evaluation (ROSE), RAB has the potential to decrease passes required for adequate samples, reduce patient risk, improve diagnostic yield, and reduce costs to patients.

**Methods:** This study was a retrospective, single-arm, single-center study of 92 RABs for peripheral pulmonary lesions. Natural language search within CoPath software was used to generate the list of reports for the investigation's timeframe, allowing for the examination of all cytopathology specimens in which RAB and ROSE were used.

**Results:** Of the 92 RABs completed in a 12-month period at UNMC (March 25, 2022, through March 30, 2023), 82 had subsequent biopsy to measure concordance, which was defined as agreement between the cytology diagnoses and associated pathology results from biopsy (**Figure 1**). The cytology diagnoses with concordance to subsequent biopsies included 52.4% (43/82) with no malignant cells identified. Of those with malignant findings, 25.6% (21/82) were called adenocarcinoma, 7.3% (6/82) were called neuroendocrine tumors, and 8.5% (7/82) were called squamous cell carcinomas of varied differentiation. There was also the rare finding of a granular cell tumor (1/82).

**Conclusion:** This study shows that cytology taken by RAB and assessed with ROSE has a high concordance with final pathology diagnoses. The benefits of RAB expand the diagnostic potential of prior bronchoscopy methodologies, providing sufficient information for patient care increased cost-effectiveness.



**Figure 1.** Cytology diagnostic concordance to subsequent surgical biopsies.

## #57. Clinicopathologic and Molecular Characterization of Conjunctival Melanoma in a Multi-Institutional Study

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**Mentor:** Dinesh Pradhan

**Program:** Pathology

**Type:** Original Research

**Background:** Primary conjunctival melanoma (CM) is an unusual, highly aggressive malignancy with poor prognosis. The risk of metastatic disease is as high as 30% and the 10-year disease-specific mortality is 9–35%. CM is inherently distinct from other mucosal, uveal and cutaneous melanomas; however, the molecular pathogenesis of CM is poorly understood hindering the development of targeted therapy.

**Methods:** We identified 11 CM patients (pts) from our archives over a period of 30 years. In another large academic medical center, 7 CM and 3 benign conjunctival nevi (CN) were retrieved from the pathology archives. Next generation sequencing (NGS)

with customized targeted 32 gene panel was performed.

**Results:** The median age of the 18 CM and 3 CN pts was 70.5 years (range 39-94) and 52 years (range 31-56), respectively. The Male: Female ratio was 1.25:1 and 2:1 for CM and CN, respectively. The mean tumor thickness was 1.9 mm. Genomic alterations in BRAF and NRAS were the most frequent. All 3 CNs harbored activating NRAS codon. Additional mutations included EIF1AX, EGFR, PDGFRA, MET, ATM, NF1, ERBB4, GRIN2A, PREX2 and STK19. Interestingly, activating mutations in BAP1, KIT, SF3B1, GNAQ, and GNA11 were not identified in any of the studied cases.

**Conclusion:** Mutational analysis of CM reveals a distinct mutational profile from uveal and other mucosal melanomas and shows some similarity to cutaneous melanomas. Similar NRAS mutations in CNs and

some CMs suggest a possibility of common precursor pathway. Molecular profiling of CM may be valuable in strategizing management in metastatic CMs.

## #59. Effect of Biallelic TP53 Mutations in Changing the Subclassification of Myelodysplastic Neoplasm

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**Mentor:** Neha Gupta

**Program:** Pathology - Hematopathology

**Type:** Original Research

**Background:** TP53 mutation confers a poor prognosis in myelodysplastic neoplasms (MDS). A new subtype of MDS with biallelic TP53 inactivation (MDS-biTP53) was introduced in the 5th edition of the WHO classification. The goal of this study was to determine the impact of the new molecular based classification on the morphologic subtypes of MDS.

**Methods:** Our Next Generation Sequencing (NGS) database from 2017-2023 yielded

49 cases of MDS with TP53 mutations. The cases were reclassified as MDS-biTP53 if they fulfilled the WHO criteria: variant allele frequency (VAF) of >49% for TP53 mutation, >1 mutation in the TP53 gene, or TP53 deletion by Fluorescent in-situ hybridization (FISH) with at least one TP53 mutation.

**Results:** The distribution of 49 cases of MDS with TP53 mutations is listed in **Table 1**. Thirty-three cases were reclassified as MDS-biTP53 based on NGS data. Of these, 17 cases had TP53 mutation with a VAF of >49%, and 16 cases had two TP53 mutations. Five additional cases were reclassified as MDS-biTP53 based on combined NGS and FISH results. Out of 38 cases of

MDS-biTP53, cytogenetic findings were available for 35 cases, 29 of which had complex karyotype. Four out of 11 cases of monoallelic TP53 mutation had complex cytogenetics (p-value 0.0058). The median overall survival (OS) was poor, at 13.8 months for MDS-biTP53 and 17.7 months for MDS with monoallelic TP53 mutation, but there was no significant difference between subgroups (p-value 0.12).

**Conclusion:** Applying new molecular criteria for MDS subtyping resulted in the change of morphologic subclassification in 77% of the cases. Complex cytogenetics was significantly associated with MDS-biTP53.

**Table 1.** Case distribution of MDS with TP53 mutations.

Morphologic subtypes original diagnosis	Therapy related							Not therapy related							Total
	MDS-EB1	MDS-EB2	MDS-MLD	MDS-SLD	MDS-5q	MDS-U	MDS-RS-MLD	MDS-EB1	MDS-EB2	MDS-MLD	MDS-SLD	MDS-5q	MDS-U	MDS-RS-MLD	
MDS-biTP53	5	3	6	0	0	1	3	5	11	5	2	1	0	7	49
MDS with monoallelic TP53 mutation	5	3	5	0	0	1	1	3	10	3	2	1	0	4	38
MDS with monoallelic TP53 mutation	0	0	1	0	0	0	2	2	1	2	0	0	0	3	11

MDS-EB1=Myelodysplastic syndrome with excess blast 1; MDS-EB2= Myelodysplastic syndrome with excess blast 2; MDS-MLD= Myelodysplastic syndrome with multilineage dysplasia; MDS-SLD= Myelodysplastic syndrome with single lineage dysplasia; MDS-biTP53= Myelodysplastic neoplasm with biallelic TP53 inactivation; MDS-5q= Myelodysplastic syndrome with 5q deletion; MDS-U= Myelodysplastic syndrome- unclassifiable; MDS-RS-MLD=Myelodysplastic syndrome with ring sideroblasts and multilineage dysplasia

## #61. Credit or Debit? Comparison of Local Prices for Common Gastroenterology Procedures

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**Mentor:** Fedja Rochling

**Program:** Internal Medicine

**Type:** Original Research

**Background:** In 2021, the Hospital Price Transparency Final Rule was passed, requiring hospitals to post prices for all services, including tests and procedures, to increase price transparency for patients. Variation and transparency of standard gastroenterology tests and procedures have yet to be evaluated in the Upper Midwestern United States. This study aimed to investigate the cost variation of standard gastrointestinal procedures in the Upper Midwestern United States and amongst private and academic hospitals.

**Methods:** A cross-sectional study was performed by investigating chargemasters of academic and community-based hospitals. An academic hospital was defined as any hospital with a residency program that the Accreditation Council for Graduate Medical Education (ACGME) recognizes. A community-based hospital was defined as any hospital that does not retain an ACGME-recognized program, nor does the institution commonly maintain academic teams. Mean, standard deviation and interquartile range (IQR) were calculated from the collected data.

**Results:** Mean colonoscopy cost was \$4617 with a standard deviation of \$4518. Cost was available in 18/19 hospitals. The mean EGD cost was \$3141 with a standard deviation of \$1446. Cost was available in 18/19 hospitals.

The mean liver biopsy cost was \$6717 with a standard deviation of \$4298. Liver biopsy was available in 7/19 hospitals. In total, 4/19 (21%) hospitals reported all costs of interest (**Table 1**).

**Conclusion:** We found a large cost discrepancy across many gastroenterology procedures and tests in the upper Midwest. Moreover, only 21% of hospitals reported all tests and procedures of interest. No significant differences were identified between private and academic institutions.

**Table 1.** Mean, standard deviation, and IQR of common gastroenterological procedure costs comparing all, academic, and private hospitals.

	<b>US Complete</b>	<b>CT Abdomen with Contrast</b>	<b>MRI Abdomen with Contrast</b>	<b>Liver Elastography</b>	<b>EGD (outpatient)</b>	<b>Colonoscopy Screening</b>	<b>Liver Biopsy IR</b>	<b>Liver Biopsy Percutaneous</b>
<b>All Hospitals</b>								
Mean	742.13	2579.98	3494.29	172.76	3141.28	4617.89	952.68	6717.58
Standard Deviation	602.41	1772.17	1793.03	48.09	1446.46	4518.85	524.26	4298.29
IQR	513.63	1296.03	2532.48	25.74	2564.17	2280.58	454.03	5675
<b>Academic Hospitals</b>								
Mean	971.49	3001.66	3608.17	162.35	3665.42	4416.29	952.68	9907.5
Standard Deviation	626.50	2555.68	2093.95	53.09	1584.54	2163	524.26	2741.45
<b>Private Hospitals</b>								
Mean	673.69	2211.02	3394.66	204	3050.18	4994.16	N/A	5441.61
Standard Deviation	574.66	591.04	1627.06	N/A	1390.85	5594.19	N/A	4325.64

## #62. The GIPP Never Lies: A Case of Refractory Ulcerative Colitis

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**Mentor:** Kathryn Hutchins

**Program:** Internal Medicine

**Type:** Case Report

**Background:** *Listeria Monocytogenes* is a rare infection with approximately 800 confirmed cases per year. The pathogen can present as a mild infection but can be more severe in immunocompromised patients. We present a case of invasive listeriosis in an ulcerative colitis patient.

**Case:** A 58-year-old male with a past medical history significant for refractory ulcerative colitis (UC) presented to the emergency department after 3-days of worsening

hematochezia and abdominal pain. Patient had transitioned to ustekinumab from infliximab and started a 40 mg prednisone taper two weeks prior due to refractory UC symptoms. On admission, the heart rate was 125, blood pressure was 82/55, and temperature was 102.1. Pertinent labs included white blood cell count 20.8, procalcitonin 0.37, lactic acid 1.7, and CRP <0.5. Patient was given fluids and broad-spectrum antibiotics along with methylprednisolone. CT significant for mild to moderate mural thickening in distal colon and rectum. Gastrointestinal pathogen panel (GIPP) was negative. Flexible sigmoidoscopy revealed diffuse disease consistent with active ulcerative colitis the following day. Two days after admission, 2/2 blood cultures

were positive for *Listeria Monocytogenes*. Infectious disease was consulted, and the patient was treated with ampicillin and gentamicin. Following treatment initiation, hematochezia decreased, and abdominal pain subsided. Patient was discharged on amoxicillin with a continued prednisone taper and mesalamine suppositories without recurrence of symptoms.

**Conclusion:** Patients on immunosuppressive therapy are at higher risk of developing listeriosis. Clinicians should be aware that listeria is not a tested pathogen on GIPP and can present as invasive diarrhea.

## #63. Exploring the Efficacy of Pulmonary Artery Pressure Monitoring in Rural LVAD Patients: A Retrospective Cohort Study on Clinical Outcomes

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**Mentor:** Scott Lundgren

**Program:** Internal Medicine

**Type:** Original Research

**Background:** Rural healthcare challenges impede equitable care of advanced heart failure patients with left ventricular assist devices (LVAD) due to poor access to specialized resources. Remote pulmonary artery pressure (PAP) monitoring offers a potential solution to improve clinical outcomes in these patients.

**Methods:** A retrospective cohort study was conducted at an academic tertiary care center on adults 19 years or older implanted with LVADs between January 2015 and May 2022. Participants included resided in counties with populations under 50,000 as per the 2020 census. The study used the CardioMEMS PAP monitor by Abbott Laboratories in Abbott Park, Illinois. The primary outcome was the rate of right heart failure hospitalizations, with secondary outcomes including time-to-event of first right heart failure hospitalization post-LVAD implantation and overall survival.

**Results:** A total of 156 patients underwent LVAD implantation during the study period. Twenty-four patients had concurrent PAP monitors in place. The PAP monitor group showed a higher mean hospitalization rate for right heart failure (1.1383 per patient year) compared to the non-PAP monitor group (0.5024 per patient year) with a significant p-value of 0.0481. The PAP monitor group had a significantly shorter time-to-event of first right heart failure hospitalization (p=0.0162) (**Figure 1**). No statistically significant difference in survival was noted between the groups (p=0.2849).