EM Resident
Official Publication of the Emergency Medicine Residents' Association
October/November 2020
VOL 47 / ISSUE 5

25 UNDER 45

INFLUENCERS IN EMERGENCY MEDICINE

Heart of EM: Losing a Pediatric Patient

Acute Hyperkalemia Masking Flecainide and Metoprolol Toxicity

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#PetsOverCOVID19

Priyanka Lauber, DO
Editor-in-Chief, EM Resident
Lehigh Valley Health Network
@PriyankaLauber

Hard to believe that another year has flown by and ACEP *Scientific Assembly* 2020 is right around the corner. Scientific Assembly has often been the time to celebrate many emergency medicine advancements and achievements, as well as a time to connect with our co-residents and emergency physician friends, new and old.

To say I am going to miss seeing and connecting with people during the conference is an understatement. However, I am so genuinely grateful and thankful to be part of the organization that put together such remarkable virtual programming. Check out our website here to get a full review of the schedule.

This lack of interconnectedness secondary to COVID-19 has left not only me, but a lot of people feeling disjointed. The prevalence of anxiety and depression has been on the rise since COVID-19 started to make its presence known.[1] We all see the physical health concerns of COVID-19, but I fear we have neglected to appreciate the physiologic effects of the virus.

The downstream effects have been apparent. According to an analysis by Express Scripts, who serve close to 32 million commercially insured Americans, there was a 21% increase in the prescriptions filled for anti-anxiety and anti-depression mediations just between February 16, 2020, and March 16, 2020.[2] However, there has also been an increase in another industry — animal adoption!

Incidentally, the number of animal adoptions in the country has increased substantially. Shelters have been cleared out and breeders are now experiencing waitlists, sometimes into the year 2021. According to the Society for the Prevention of Cruelty to Animals Los Angeles, a nonprofit shelter, adoptions have been double what they were compared to last year. This is a trend reported at shelters around the country. Foster-turned-adoptions have also increased from an average of 10% to 25% across the United States. Shelters have also reported lower than average return of adopted animals.[3]

All of this makes sense as animal companionship has been shown to provide real benefits to those suffering from mental health conditions such as anxiety or depression, which have both been on the rise since COVID19 made its emergence. Human beings are, at our core, social beings with the need to experience satisfying social relationships as one of our cornerstones for physical and mental well-being. When this falls apart, loneliness sets in.[4]

COVID-19 has brought upon a lot of negatives and challenges, so I will look for and take a positive wherever I can find it. Combating depression is multifold. Reach out to friends and family, your residency administrators, and your PCP. Also, reach out to friends with pets and set up play dates in a socially distant environment if you are unable to support one of your own right now.

I would love to start a #PetsOverCOVID19 to help get the word out about the positive impact animals and pets have on our mental health, especially during these times of decreased social interaction. To start out, here is my picture with our dogs — Tina and Bailey. Share on social media using our hashtag to show off how your pets have positively impacted your mental health during this time of COVID19. ✶

References available online

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HIPPO EDUCATION EM Board Review

as of September 20, 2020

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EMRA Fiscal Year 2020 Annual Report

Membership: 16,813

97% of EM residents are EMRA members

220 EMRA*fied* programs with 100% membership

$3.12M annually invested into EMRA members

9.6% growth in revenue from operations

EMRA helps you become the BEST DOCTOR you can be

53,678 total EMRA*Cast downloads

34,807 unique *EM Resident* monthly online views and print distribution of >16k

7,000+ views/downloads of EMRA Hangout

8 brand-new/updated publications for a total of **34**

381 fellowships in EMRA Match with nearly **1,000,000** searches since launch

1,900+ downloads of MobilEM

EMRA helps you become the BEST LEADER you can be

14 **Board Members** representing EMRA's most diverse [gender, ethnicity, LGBTQ, MD/DO] leadership in its history

831,000+ **45 Under 45** social media impressions

138 funded national leadership positions for members

400+ nominations received for EMRA Awards

481 meetings, events, and webinars hosted by 20 EMRA Committees

July 1, 2019 - June 30, 2020

EMRA helps EM become the BEST SPECIALTY it can be

68 COVID-19 specific programming sessions

Advocated for **O-SLOE** rotation recommendations

Led the multi-organization collaboration on the **2020 - 2021 Residency Application** Consensus Statement

Celebrated 45 Years of Serving Emergency Medicine Residents

Partnered with **Vot-ER** to promote civic engagement

25 UNDER 45

INFLUENCERS IN EMERGENCY MEDICINE

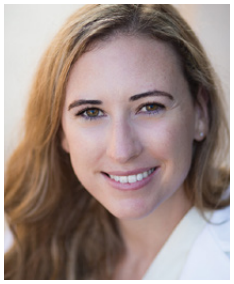
EMRA is honored to celebrate young influencers in emergency medicine who are shaping the future of our communities, our hospitals, and our specialty. Their contributions range from tech innovations to stellar medical mentorship and education to outreach that changes the care their communities receive.

We are proud to introduce the 25 Under 45 Influencers of EM for 2020. Learn more about them at emra.org.

More than 200 applications were reviewed by the selection committee, comprising Chair Omar Maniya, MD, MBA, with Hannah Hughes, MD, MBA; RJ Sontag, MD; Venkat Subramanyam, MD; Erik Blutinger, MD, MSc; Sophia Spadafore, MD; Karina Sanchez, MD; and Jazmyn Shaw, MS-IV. The selection committee was blinded to EMRA and/or ACEP membership status. Care was taken to ensure both a diverse applicant pool and awardee group. For any questions, contact Cathey Wise at cwise@emra.org.

Ashely Alker, MD, MSc

@aalkerMD
Chief Medical Media Officer, Doctorpedia
Medical technical consultant, television and film



Ashely Alker channels her passion for health education into not only public speaking and publishing, but also consulting for the TV and film industries. Dr. Alker studied at Harvard School of Public Health's International Institute in Cyprus, where she lived near the UN Green Zone and worked at the Unit for the Rehabilitation of Victims of Torture.

Jacob Avila, MD

@coreultrasound
Associate Professor, Medical Director of POCUS
University of Kentucky

Along with Ben Smith, Jacob Avila founded 5minutesono.com a mere 5 years ago. Today he has taken ultrasound education to the next level with his latest project, the Core Ultrasound website, combining 5 Minute Sono, the Ultrasound Podcast and Ultrasound of the Week into one comprehensive site.

Jennifer Beck-Esmay, MD

@jbeckesmay
Assistant Residency Director
Mount Sinai Morningside-Mount Sinai West

Have you ever seen Jenny Beck-Esmay on the stage? She puts her degree in drama from NYU to good use as a pre-eminent medical educator. A proud proponent of FOAMed, Dr. Beck-Esmay is Editor-In-Chief of FemInEM, Associate Editor of R.E.B.E.L. EM, Co-Host of the R.E.B.E.L. Core podcast and a contributor to EM:RAP and UC:RAP.

Jordan Celeste, MD

Emergency Physicians of Central Florida
Four Corners Freestanding ED, Medical Director

Reimbursement runs medicine today, and Jordan Celeste is at the forefront of efforts to improve it for patients and colleagues alike. Since residency, she has worked tirelessly to understand, explain, and influence the way emergency care is reimbursed, through her leadership as an EMRA president, then ACEP leader, a chair of the Emergency Medicine Foundation, and an advisor to the AMA RVS Update Committee.

> *She is an influencer, an advocate, an educator, and inspiration. Her work improves the specialty for her colleagues and her patients alike.*

Keegan Checkett, MD, MSc

@kcheckett
Assistant Professor, EM
Director, International EM Medical Education Fellowship Program, University of Chicago

From Africa to Haiti, Keegan Checkett works to ensure quality emergency care for anyone, anywhere, anytime. As a pioneer in international EM medical education, she has helped establish EM residencies and ongoing medical training around the globe. Additionally, Dr. Checkett is a consultant for the World Health Organization regarding COVID education materials.

EMRA's 25 Under 45 Influencers in EM

Sandra Coker, MD

*@_BGWC_*
Founder, Black Girl White Coat
EM PGY1, University of Chicago

As soon as she entered medical school, Sandra Coker began working to make it a more diverse, robust community. She established the nonprofit Black Girl White Coat organization as a medical student, and now, as a resident, she has educated, inspired, and connected peers with mentors through her BGWC platform. This year she joined the EMRA Diversity & Inclusion Committee as a vice chair, continuing her work for URM students and residents.

> *"She has infectious enthusiasm for her work; she has unbridled energy; she is professional, personable, and an outstanding role model."*

Ross I. Donaldson, MD, MPH, CTropMed, FACEP

@WikEM_org
President/CEO, Critical Innovations LLC
Associate Professor, UCLA Schools of Medicine and Public Health

Well-known for creating WikEM, Ross Donaldson has carved a niche in medical design while advancing emergency, trauma, and disaster medicine worldwide. He led efforts to develop pre-hospital and hospital-based EM and trauma systems in Iraq, and he has written The Lassa Ward, a memoir about international humanitarian work.

Mohamed Hagahmed, MD

@HagahmedMD
Assistant Professor, Assistant Clerkship Director
UT Health San Antonio

When Mohamed Hagahmed's family fled their native Sudan, they became citizens of the world before settling eventually in Germany, where Dr. Hagahmed became a professional athlete before turning to medicine. As a medical student, he worked to counteract community violence. In residency, he led the Minority House Staff Association, and as an attending he is an SNMA faculty mentor striving for equity and opportunity for all.

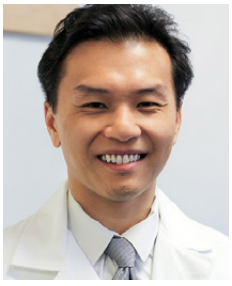
Kathryn Hawk, MD, MHS

@kathryn_hawk
Assistant Professor, Emergency Medicine
Yale University

Kathryn Hawk's trailblazing research pushes the scientific boundaries of both emergency and addiction medicine by focusing on ED-initiated buprenorphine and linkage to treatment for opioid use disorder. She has worked to expand the implementation of best practices for ED patients with addictions nationwide and has been highly influential in driving the development of ACEP's content and vision to improve the care of ED patients with OUD.

Shuhan He, MD

@ShuhanHeMD
Center for Innovation in Digital HealthCare, Massachusetts General Hospital
GetUsPPE.org



Shuhan He is a national voice for emergency physicians and digital health in medicine. Notably, Dr. He is also the co-founder of GetUsPPE.org and a nationally recognized voice for PPE. He is the inventor of the anatomical heart and lung emojis, part of the ALIEM.com, COVIDactnow.org teams, and founder of Conductscience.com.

> *He has dedicated his career to advocating and caring for the underserved. His work has helped shape, and continues to shape, the future of emergency medicine.*

Dennis Hsieh, MD, JD

@countyeddoc
Director, Social Medicine and Population Health/ Core Faculty
Harbor-UCLA Medical Center

Dennis Hsieh paused his medical training to earn a law degree and complete an Equal Justice Works fellowship. Now he uses that knowledge and influence to address the social determinants of health for vulnerable patients. As a leader of Whole Person Care Los Angeles, he advocates for those at risk, tackling substance use disorders, psychiatric conditions, homelessness, justice-involved, and more.

Zachary J. Jarou, MD, MBA

@zachjarou
St. Joseph Hospital

Through his work on EMRA Match, Zach Jarou has changed the way EM-bound medical students search for residency programs (and now, for clerkships and fellowships). It's only one way he has demonstrated how to leverage data science to improve this specialty. A prolific leader, Dr. Jarou's interests include EHR optimization, health information exchange and interoperability, value-based healthcare, operations management, data science, machine learning, and decision modeling.

Aditi U. Joshi, MD, MSc, FACEP

@draditijoshi
Assistant Professor
Department of Emergency Medicine
Thomas Jefferson University Hospital

Aditi Joshi is working to ensure the ED of the future will incorporate telehealth and digital health — which has become vital in the era of COVID-19. By building a unique fellowship program and advocating for digital innovation via national leadership service, Dr. Joshi is shaping the specialty for years to come.

Danya Khoujah, MBBS, MEHP, FACEP, FAAEM

@DanyaKhoujah
Adjunct Assistant Professor,
University of Maryland School of Medicine
Attending Physician,
MedStar Franklin Square Medical Center

With 120+ lectures, 75 podcasts, and 50 publications (and counting), Danya Khoujah's quest to simplify guidance for emergency medicine physicians worldwide is well underway. Making medical education accessible and easily understood is Dr. Khoujah's global contribution to better care for patients.

Michelle D. Lall, MD, MHS, FACEP

@LallMichelle
Associate Professor, Director Well-being, Equity and Inclusion
Emory University School of Medicine

Michelle Lall is working to improve medicine by improving its culture: Her passions are physician well-being and the negative impact of gender and racial bias on equity and inclusion in medicine. As an award-winning educator, Dr. Lall also contributes as a speaker, author, and leader in the house of medicine.

EMRA's 25 Under 45 Influencers in EM

Adaira Landry, MD, MEd

@AdairaLandryMD
Assistant Program Director, HAEMR
Assistant Professor, Harvard Medical School
Ultrasound Faculty, Brigham Women's

Leadership cannot be a passive pastime, and few people model active leadership like Adaira Landry, who's working to increase diversity in medicine for the ultimate benefit of patients. Despite wearing many hats at Harvard Medical School, HAEMR, ALiEM, and various other groups in the house of medicine, Dr. Landry is known as a generous mentor who shares her time, insights, and support.

Brit Jeffrey Long, MD, FACEP

@long_brit
Assistant Professor, Military and Emergency Medicine
Uniformed Services University of the Health Sciences

emDocs.net has become a leader in FOAMed, and Brit Long has helped make that happen. As editor-in-chief of clinical content for emDocs.net, assistant PD of research at Brooke Army Medical Center, and associated editor of the American Journal of Emergency Medicine, his primary focus is improving knowledge translation for academic and community medical practice.

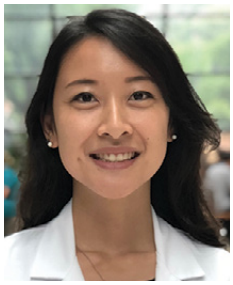
Kito Lord, MD, MBA

@ERdocLord
Medical Director, Department of Emergency Medicine
Regional One Hospital

Do you know how business intelligence can help a sickle cell patient in crisis? Kito Lord does. He believes in not just participating in the health care system, but working to improve it. Dr. Lord became the first Administrative Fellow at Yale EM while earning an MBA, and he has applied that experience to the benefit of patients ever since.

Alicia Lu, MD

Emergency Medicine Residency Class of 2022
Icahn School of Medicine at Mount Sinai



The COVID pandemic evoked an outpouring of support – which Alicia Lu has harnessed to help health care workers long-term. As co-founder of Frontline Suits, Dr. Lu led efforts to donate 2,000 reusable coveralls and 1,000 face shields for frontline workers this year. At the same time, she is completing the Copello fellowship with Doctors for America, Physicians for Criminal Justice Reform, building on her background of advocating for vulnerable populations.

Mizuho M. Morrison, DO

@mizuhomorrison
Clinical Faculty, LAC+USC
Senior Director Medical Education, Hippo Education

Mizuho Morrison has served as the Editor-in-Chief of Hippo Education podcasts; Lead Editor for Urgent Care Reviews and Perspectives, and is now the Senior Director of Medical Education at HIPPO Education and Co-Director of Essentials of Emergency Medicine. She is involved in leadership for FeminEM, having developed their speaker-coaching program, and is an advocate for medical educator development.

> *"In the era of Free Open Access Medical Education and knowledge translation, he continues to stand out as a prime influencer among a myriad of extraordinary clinicians."*

Kari Sampsel, MD, MSc, FRCPC, DipForSci

@KariSampsel
Assistant Professor, University of Ottawa

Kari Sampsel serves a uniquely vulnerable population as Medical Director of the Sexual Assault and Partner Abuse Care Program at the Ottawa Hospital. She has been active in the fields of forensic medicine and medical education, with multiple international conference presentations, publications, and committee work. This work has led to multiple national awards in recognition of her commitment to education and awareness.

Theresa Q. Tran, MD, MBA, FACEP

@TheresaTranMD
Associate Medical Director, Baylor St. Luke's
Program Director, MD/MBA Dual Degree Program,
Baylor College of Medicine and Rice University

Theresa Tran's ability to understand and explain how the business of medicine affects patient care has raised the bar in EM. Her work on surprise billing, scope of practice, tort law, and more has elevated the collective knowledge of the specialty, and her role as an educational leader and mentor ensures progress will grow exponentially.

> *She has found a way to combine what people are clamoring for with what people don't know they need.*

Jordan M. Warchol, MD, MPH

@ActuallyDrJ
Assistant Professor, Department of EM
University of Nebraska Medical Center

As the founder of the AMA's Rural Health Caucus, Jordan Warchol is committed to creating policy that makes a difference for patients. As an assistant professor, author, and health policy advocate, she is teaching others how to have an impact as well. She is the 2019 Nebraska Young Physician of the Year and an emerging national leader in health policy.

Lauren Westafer, DO, MPH, MS

@LWESTAFER
Assistant Professor, Department of EM
Co-director, EM Research Fellowship
University of Massachusetts Medical School-Baystate

In an era when FOAMed is pandemically important, Lauren Westafer remains at the forefront, working to ensure solid research translates not just to understanding but also to practice. Dr. Westafer lectures internationally on social media in medical education, critical appraisal and journal club design, pulmonary embolism, and advancing the quality of health carefor LGBTQI+ patients.

George Willis, MD

@DocWillisMD
Assistant Program Director, Director of
Undergraduate Medical Education
University of Maryland

As a medical student, George Willis was advised to avoid emergency medicine because "there were too many African American physicians in the specialty." As an attending and director of undergraduate medical education, Dr. Willis works constantly to dispel that and other bad advice. He hopes to elevate the culture of medicine by improving medical education and mentorship.

EXCELLENCE IN EM

Honoring EMRA's Fall Awards Recipients

In a year when everyone working in emergency medicine has demonstrated compassion, selflessness, and excellence, we want to show our gratitude and appreciation to all — and special recognition to these EMRA award recipients.

Joseph F. Waeckerle, MD, FACEP, Alumni of the Year
Andrew Little, DO | AdventHealth Orlando

Faculty Mentor of the Year
Adaira Landry, MD, MEd | Harvard University/Brigham and Women's Hospital

Faculty Teaching Excellence Award
Laura Welsh, MD | Boston Medical Center

Steve Tantama, MD, Military Excellence Award
Capt. Joshua Lowe, MD | San Antonio Military Medical Center

Augustine D'Orta Humanism Award
Sheri-Ann Kaltiso, MD | Emory University School of Medicine
Alicia Lu, MD | Icahn School of Medicine at Mount Sinai

Be The Change Project Grant
Herman Lee, DO | University of Nevada-Las Vegas

Clinical Excellence Award
James H. Williams, MD | Harbor UCLA Medical Center

FOAM(er) of the Year
Adam Gottula, MD | University of Cincinnati

EMRA Simulation Research Grant
Yasamin Soltanianzadeh, MD | Icahn School of Medicine at Mount Sinai

Honorary Members
Bryan D. Hayes, PharmD, DABAT, FAACT, FASHP
Nicole Harrington, PharmD
Jamie M. Rosini, PharmD, MS, BCCCP, BCPS, DABAT

TRAVEL SCHOLARSHIPS

EMRA/ACEP Medical Student Elective in Health Policy
Kenneth Kim | David Geffen School of Medicine at UCLA
Emily Shearer | Stanford University School of Medicine

EMRA/ACEP Resident-Fellow Health Policy Elective in Washington, D.C.
Nishad Rahman, MD | St. John's Riverside Hospital

EMRA/EDPMA Scholars
Arnab Sarker, MD, MBA | New York University/Bellevue Medical Center
Nicholas Stark, MD, MBA | University of California – San Francisco General Hospital
Anisha Turner, MD | Baylor College of Medicine

International EM Rotation Scholarship
Alex Wang, MD | University of Connecticut

EDDA Travel Scholars
Monisha Dilip, MD | SUNY Downstate
Jared Ditkowsky, MD | Icahn School of Medicine at Mount Sinai
Kumar Gandhi, MD, MPH | Northwestern University
Tehreem Rehman, MD, MPH | Advocate Christ Medical Center
Vineet Sharma, MD | New York Presbyterian Hospital
David Weech, DO, MBA | Kingman Regional Medical Center

CORD Academic Assembly Travel Scholars
Jonathan Karademos, MD | Oregon Health & Science University

LAC Travel Scholars
Charles Sanky, MPH | Icahn School of Medicine at Mount Sinai

EMRA @ ACEP20 UNCONVENTIONAL

Leaving behind the limitations of travel, we're going big!
Join EMRA at ACEP20 for our regularly scheduled programming, with a twist:

EXCLUSIVELY FOR OUR MEDICAL STUDENTS

EMRA Residency Program Fair
for medical students seeking to match at an EM residency
September 26 - October 2
Register at **www.emra.org/acep**
Sponsored by Laurel Road

Virtual Mock Interview Practice
October 3, 4, 10, 11
Visit Visit **www.emra.org/acep** for information

Medical Student Case-Con Competition
October 25 @ 9 am
Check **www.emra.org/case-con** for event details

Follow @emresidents for programming updates!

ALL-EMRA PROGRAMMING

Mix and mingle with residents and faculty by taking part in our all-EMRA programming!

JOB SEEKERS

Nobody predicted this current climate, and it's an ever-changing landscape. We're here to help you navigate it, whether that means finding your first job out of residency or your new job after a career change.

EMRA and ACEP Job & Fellowship Fair
October 26 - 29
Free for EMRA Members
Visit **www.emra.org/acep** for updates
Sponsored by Vituity

COMMITTEE PROGRAMMING

For a full schedule of our committee programming, visit **www.emra.org/acep**

EMRA ELECTIONS & REPRESENTATIVE COUNCIL

October 26
Participate in our Representative Council and elect members of the EMRA Board of Directors.
See **www.emra.org/repco**
Sponsored by ACEP/PEER

COMPETITIONS & *MEDU*TAINMENT

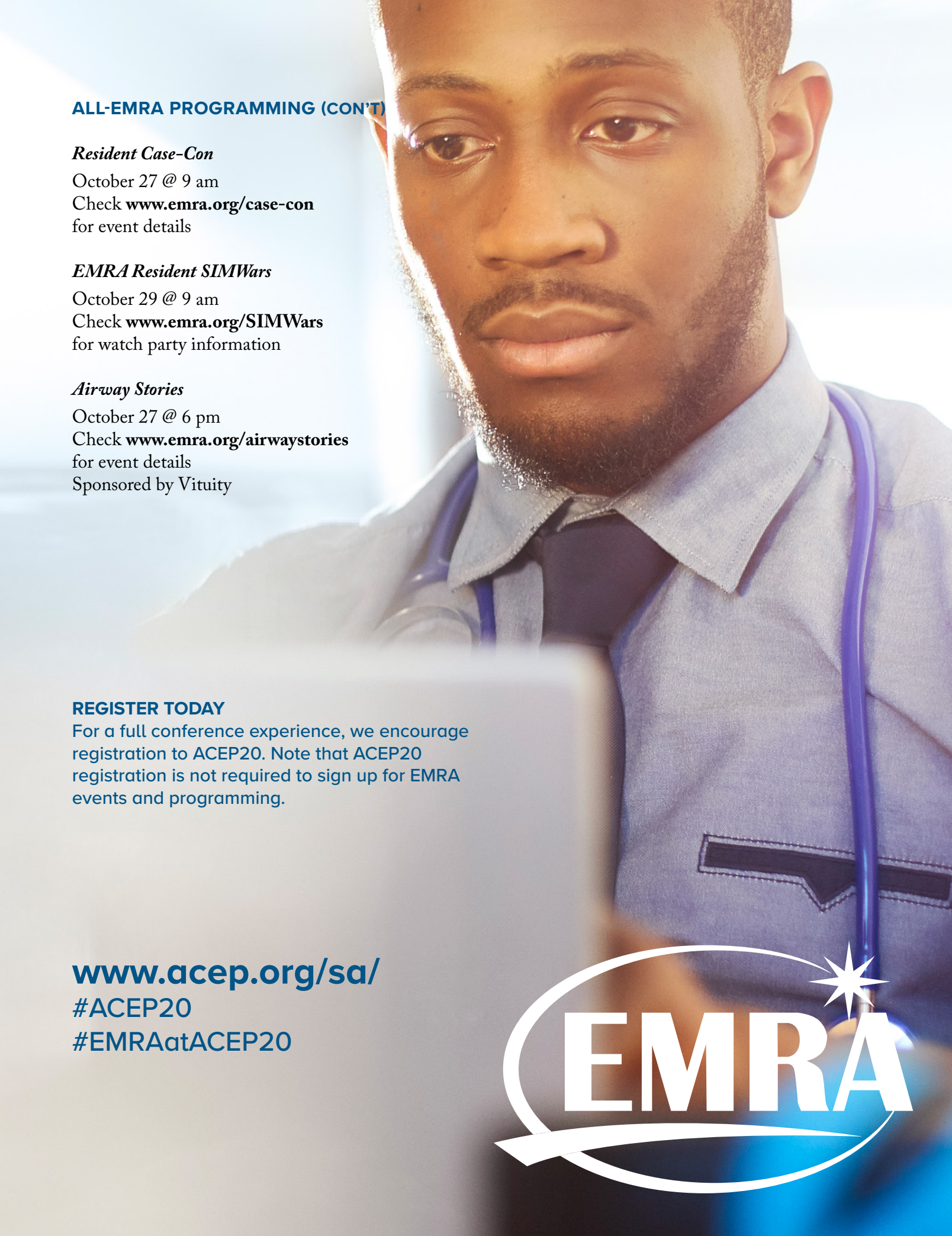
EMRA 20 in 6 Resident Lecture Competition
October 28 @ 9 am
See **www.emra.org/20in6** for watch party information
Sponsored by Hippo Education

Sponsors as of September 22, 2020.

Times and dates are subject to change.

All times listed are Central Time.

For more information, visit
https://www.emra.org/acep



ALL-EMRA PROGRAMMING (CON'T)

Resident Case-Con

October 27 @ 9 am
Check **www.emra.org/case-con**
for event details

EMRA Resident SIMWars

October 29 @ 9 am
Check **www.emra.org/SIMWars**
for watch party information

Airway Stories

October 27 @ 6 pm
Check **www.emra.org/airwaystories**
for event details
Sponsored by Vituity

REGISTER TODAY

For a full conference experience, we encourage registration to ACEP20. Note that ACEP20 registration is not required to sign up for EMRA events and programming.

www.acep.org/sa/
#ACEP20
#EMRAatACEP20

EMRA

Venous Air Embolism Rare but Fatal

Prevention, Clinical Manifestation, Diagnosis, and Checklist for Management

Walid Malki, MD, MS
AMITA Resurrection Medical Center
@wandering_er
Kayla Castellani, DO
Ultrasound Fellow
AMITA Resurrection Medical Center

While rotating in the emergency department and in the intensive care unit, residents are responsible for inserting and removing an assortment of central venous catheters (CVC) for various reasons, whether it is for emergent dialysis, rapid infusion of large resuscitation volumes, or for continued support of medical therapy.

Although the Accreditation Council for Graduate Medical Education (ACGME) requires the application of at least 20 CVCs by the time of residency completion, this procedure is relatively common, allowing for residents to place a significant more during their training, thereby allowing them to become increasingly proficient. While the techniques involved can be monotonous, it is critical for the operator to remain cognizant of the complications that can occur with catheter insertion and removal, including one of the most feared, which is a venous air embolism (VAE).

What is a venous air embolism (VAE)?

VAE occurs when air or gas is introduced to the venous system. The volume and the infusion rate both determine severity of symptoms and presentation.[4] While 300-500 mL of gas introduced at a rate of 100 mL/sec can be acutely fatal for humans, volumes as low as 50 mL have been reported to be fatal.

Large air bubbles cause obstruction of pulmonary outflow tract and pulmonary vessels; this obstruction causes decreased blood return from right ventricle, increase central venous pressure (CVP), decrease pulmonary artery (PA) pressure, resulting in obstructive shock. Smaller air bubbles obstruct pulmonary arterioles and microcirculation causing vasoconstriction and increasing pulmonary vascular resistance, PA pressure and RV pressure. In addition, venous air may leak through pulmonary capillaries into arterial circulation and cause arterial embolization and end organ ischemia.[8]

Incidence

It is estimated that the incidence of VAE with CVC placement is about 0.2%-1%. Interventional radiology literature suggests 0.13% in CVC placement while it is estimated that incidence in cardiac bypass surgery is between 0.003% and 0.007%. VAE are most common following otolaryngological and neurosurgical procedures, due to incisions being above the level of the heart at a distance greater than the CVP.[4]

Risk Factors[1,2,7]

- CV access, especially in situations of hypovolemia (decreased CVP)
- Pressurized infusions, including IV contrast injections for imaging
- Trauma (blunt or penetrating)
- Surgical: sitting craniotomy, spinal surgery, posterior fossa surgery, C-section, laparoscopic surgery (CO_2 embolism)

Prevention of VAE[1,7,8]

- Trendelenburg (head-down body tilt) position for placement & removal of internal jugular and subclavian CVC, while supine position for femoral CVC placement and removal.
- Positive-pressure mechanical ventilation reduces risk.
- Prepare and flush CVC prior to insertion, making sure no air bubbles remain in the catheter.
- Occlude the needle hub and/or catheter during insertion or removal.

FIGURE 1. Massive Air Bubbles in RV 20 minutes after CVC Removal

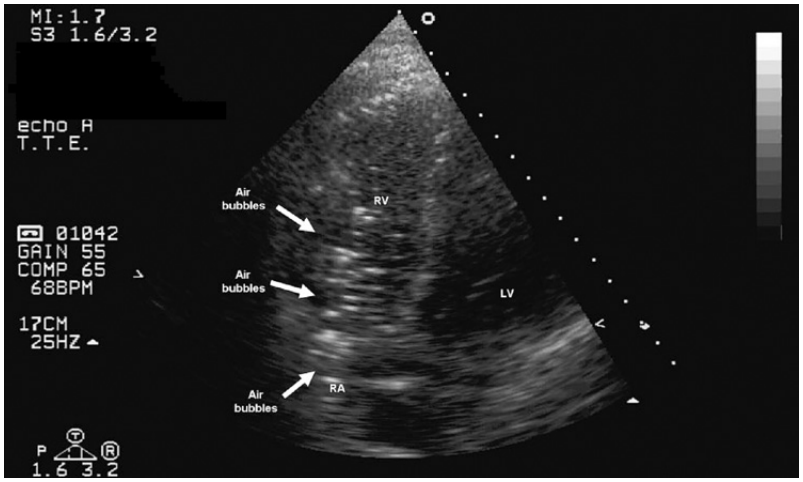
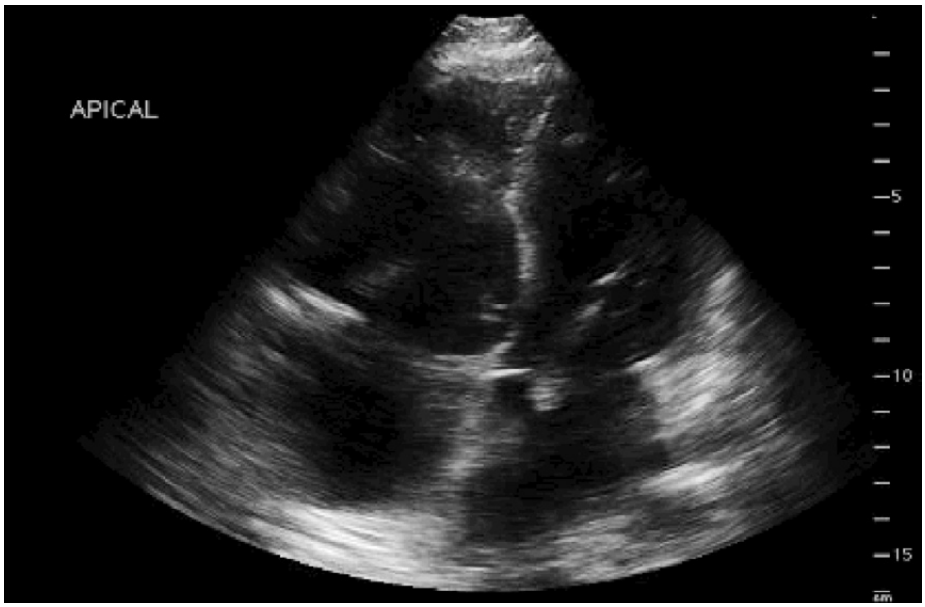


IMAGE COURTESY OF DECEUNINCK ET AL.

FIGURE 2. Dilation of the RV with RV:LV ratio >0.6:1.0

FIGURE 3. "D sign," septal bowing into the left ventricle



- Keep all connections to the CVC closed when not being used.
- During removal, if the patient is following command, ask the patient to valsalva during expiration. Apply firm pressure for approximately 1 minute, without massaging site.

Clinical Manifestation

- Symptoms include acute onset dyspnea, cough, syncope, altered mental status and "mill wheel murmur" (which is specific but not sensitive).[2,7]
- Signs include hypoxia, hypotension, tachycardia.[2,7]
- Patients can exhibit signs of acute right-sided heart failure, cardiogenic shock (hypotension, oliguria, JVD) and acute embolic stroke (air bubbles pass through patent foramen ovale).[8]

It is a clinical diagnosis based on a high index of suspicion and exclusion of other life-threatening processes. Findings suggestive of VAE:

- End-tidal carbon dioxide ($EtCO_2$) will fall due to increased physiological dead space and worsening V/Q mismatch.[7]
- EKG can show signs of right-heart strain (right axis deviation, RBBB, peaked P waves), non-specific ST changes and T-wave changes, ST depression or elevation consistent with acute myocardial ischemia or infarction.[8]
- Transthoracic Echocardiogram (TTE) or Transesophageal Echocardiogram (TEE) can show air in cardiac chambers, right ventricular dilation and dilated PA.[6] RV:LV diameter ratio in a non-pathologic state should be 0.6:1.0. As right sided pressures start to exceed left sided pressures, you will get dilation of the RV and septal bowing into the left ventricle known as the "D-sign". On a more quantitative level, you can measure a tricuspid annular plane systolic excursion (TAPSE), which is a proxy for RV function, or tricuspid regurgitation, which will give you an estimate of mean pulmonary arterial pressure.
- Chest X-ray can show pulmonary edema[8]
- Elevated CVP, PA pressure[8]

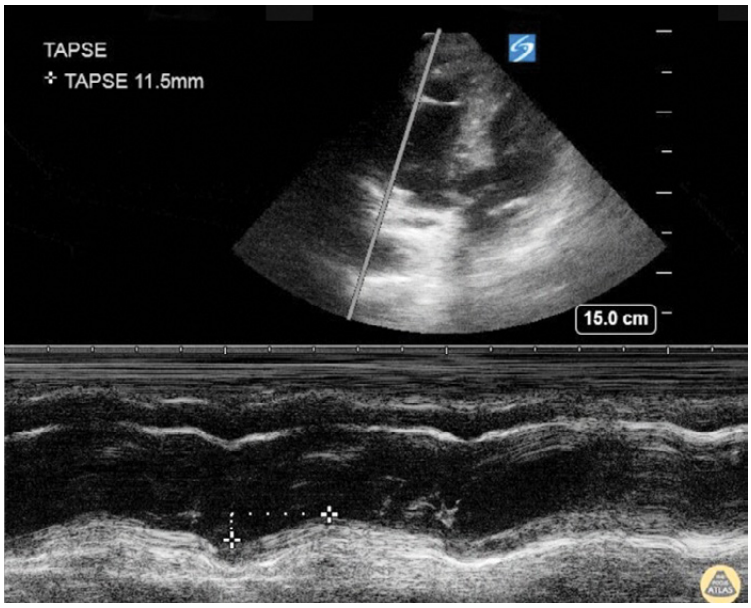
TABLE 1. RV Dilation on Echo

Symptoms
Ideal view on Apical 4 Chamber (can be seen on PSL)
RV:LV diameter ratio > 0.6:1.0
Septal bowing into the left ventricle or "D-sign"
TAPSE
Tricuspid Regurgitation

Management Checklist[1]

- Ventilate at 100% O2 on ventilator or NRB. If hemodynamically unstable, intubate and consider increasing PEEP. These measures may speed air resorption however, they remain unproven.
- Place the patient in head down, left lateral decubitus to prevent air blocking RV outflow tract (unproven).
- Attempt to aspirate air from CVC.
- Chest compressions, again unproven but are thought to force air out of pulmonary outflow tract and break up large volumes of air in cardiac chambers.
- Increase IV fluids and add inotropic support if needed (epinephrine, norepinephrine, dobutamine).
- Hyperbaric oxygen for up to 6 hours once stabilized. ✶

FIGURE 4. Tricuspid annular plane systolic excursion (TAPSE) measurement, which is a proxy for RV function.



TAPSE can be measured by placing a cursor at the tricuspid lateral annulus and measuring the distance to systolic annular RV excursion. A distance of 17 mm or less is suggestive of RV strain.

References available online

ED Psychiatric Petitioning

AN UNVARNISHED GLANCE

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The patient beds are lining the hallway; another code is underway. The list of patients to be seen is growing. The next patient is a 20-year-old male, a first-time patient, presenting with hand pain. He is disheveled and while talking under his breath, he paces back and forth. Initially, he is oblivious to anyone else's presence but upon approach, he turns and says that the FBI is following him, and that he came here so they could not find him. He is unwilling to answer medical history questions and continues to be internally preoccupied. The patient complains of no pain or recent head trauma. He is oriented to self, time, and place but is uncooperative with the remainder of the mental exam. The musculoskeletal and neurological exams are unremarkable. His urine drug screen is negative and TSH, B12, CMP, and CBC are within normal limits. While reviewing his chart, he becomes agitated, begins screaming at the wall, and says the FBI is present in his room. He receives 5 mg IM Haldol and begins to relax. The differential diagnosis includes but is not limited to ingestion, schizophrenia, major depressive disorder with psychosis, schizophreniform disorder, and brief psychotic disorder.

Other patients are seen and workups and treatment plans pursued. Weighing the options for disposition, it is determined that he must be petitioned for an involuntary inpatient psychiatry hospitalization. **As providers on the front line in the emergency department, resident physicians need to pause and understand this process of petitioning patients as this is essential to better treat patients with psychiatric diagnoses. It is also vital to keep patients and staff safe, all while pursuing best practice when treating psychiatric patients in the ED.**

Prevalence in the ED

Throughout the United States (US), for every 100,000 people, there are 10.5 psychiatrists.[1] This lack of psychiatrists and subsequent difficulty accessing care leads those suffering from psychiatric disorders to present to the emergency department. According to the National Alliance on Mental Illness, one in five adults in the US experience mental illness and one in every 25 from serious mental illness.[2] Many patients with mental health symptoms will be seen by their primary care doctor, but many will be seen with decompensated psychiatric illness in the emergency department. The challenge of disposition presents with lack of psychiatric beds and facilities across the nation leading to psychiatric holding in the ED, an issue that has national attention with novel solutions pursued. Along with the lack of trained mental health staff, these patients fill our emergency department beds, leading to limited flow and efficiency.

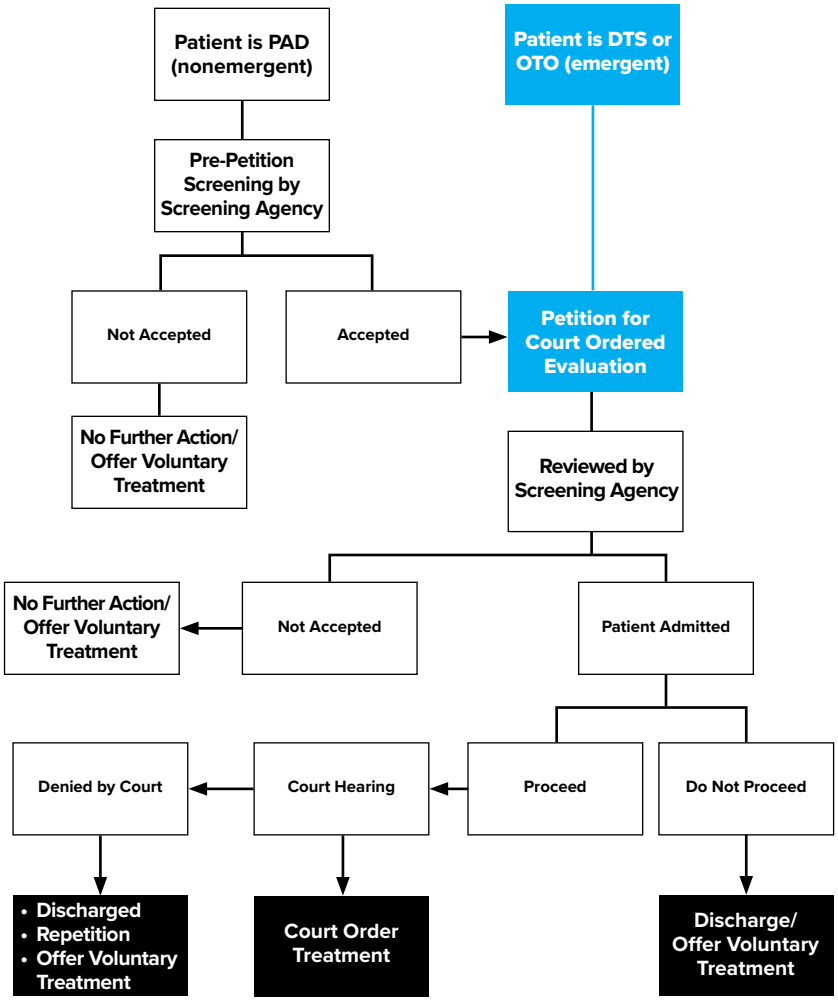
The Agency for Healthcare Research and Quality states that one in eight ED visits involves a psychiatric emergency.[3] Assuming a physician works a 12-hour shift, she or he is highly likely to see at least one patient per shift for a psychiatric emergency. Residents across the country likely can think no further than their last shift where they treated a patient with a psychiatric complaint. Due to the shortage of inpatient and outpatient mental health treatment options, the ED often becomes the only resort for these patients to obtain some intervention. A 2016 online survey of 1,700 ED physicians showed that less than 17 percent of those providers surveyed had a psychiatrist on call to respond to psychiatric emergencies.[4] Regardless of whether the patient is held in the ED or transferred to a psychiatric facility, the ability of the ED provider to know and understand the petition process for an involuntary patient for care is paramount. Telemedicine is beginning to fill this role as well as emergency departments opting to use their observation areas to have a psychiatrist evaluate these patients.

Petitioning the Patient

Each state has different policies for petitioning patients for involuntary psychiatric hospitalization. Being aware of these procedures can improve the quality of care for these patients and decreases stress for the provider and staff. Petitioning patients who meet the criteria allows for the initiation of care either in the ED or in a psychiatric facility. Arizona was ranked the second-highest of all states for the prevalence of mental illness in 2017 by Mental Health American, yet has some of the most liberal involuntary commitment statutes in the US. Arizona laws will be used as an example of the petitioning process.[5] We encourage each resident to review his or her state for more information on the petition process. **More information can be found here: https://www.treatmentadvocacycenter.org.**

If a patient is deemed to require inpatient psychiatry treatment due to a mental disorder and is unwilling or incapable of consent, is a Danger to Self (DTS), Danger to Others (DTO), Persistently or Acutely Disabled (PAD), or Gravely Disabled (GD), then he or she has met the criteria for Court Ordered Evaluation (COE), also known as a **petition.**[6] (See key terms list for definitions.) COE allows for an involuntary evaluation by psychiatrists within 72 hours, excluding holidays and weekends. If the patient meets the aforementioned criteria, then the recommendation of Court Ordered Treatment (COT) will be made to the probate court. COT lasts a minimum of one year with both a period of inpatient and outpatient treatment. If a patient is

FIGURE 1. Schematic of Court Ordered Evaluation in Arizona
Blue boxes show steps likely to be completed by EM providers.



DTS or DTO the petition is considered "emergent" and he/she will be taken to a designated psychiatric facility within a prescribed time frame (in Arizona that is 72 hours). If the patient falls under the other two categories (called standards), the patient is considered "non-emergent" and authorities (ie, local police) have up to 14 days, in Arizona, to be transferred.

Key Words and Legal Definitions[6]

1. **Mental Disorder:** A substantial disorder of emotional processes, thought, cognition or memory distinguished from
   a. Conditions which are primarily those of drug abuse, alcoholism or intellectual disability, unless, in addition to one or more of these conditions, the person has a mental disorder.
   b. The declining mental abilities that directly accompany impending death.
   c. Character and personality disorders characterized by lifelong and deeply ingrained antisocial behavior patterns, including sexual behaviors that are abnormal and prohibited by statute unless the behavior results from a mental disorder.
2. **Danger to Self (DTS):** Behavior that, as a result of a mental disorder, constitutes a danger of inflicting serious physical harm upon oneself, including attempted suicide or the serious threat thereof and is substantially supportive of an expectation that the threat will be carried out. Behavior that will, without hospitalization, result in serious physical harm or serious illness to the person, except that this definition shall not include behavior which establishes only the condition of gravely disabled.
3. **Danger to Others (DTO):** The judgment of a person who has a mental disorder is so impaired that he/she is unable to understand his/her need for treatment and, as a result of his mental disorder , his/her continued behavior can reasonably be expected, on the basis of competent medical opinion, to result in serious physical harm to others.
4. **Persistently or Acutely Disabled (PAD):** A severe mental disorder that meets all the following criteria: If not treated has a substantial probability of causing the person to suffer or continue to suffer severe and abnormal mental, emotional or physical harm that significantly impairs judgment, reason, behavior or capacity to recognize reality.
5. **Gravely Disabled (GD):** A condition evidenced by behavior in which a person, as a result of a mental disorder, is likely to come to serious physical harm or serious illness because he/she is unable to provide for his/her basic physical needs. ✶

TAKE-HOME POINTS

- With the growing prevalence of mental health illnesses, finding solutions to more effectively handle the burden placed on providers in the ED is a necessity. Many proposed solutions have been offered by the American College of Emergency Physicians, including additional inpatient psychiatric beds, psychiatric education training to ED personnel, increasing availability of outpatient mental health services, creating tele-psychiatry services, and incorporating EmPath units (hospital rooms with home settings including a recliner instead of a hospital bed) in the ED.[7]
- With continued collaboration between specialties on an inpatient and outpatient basis, mental health crises might be mitigated and patients will receive the appropriate care outside of the ED. Being educated on and advocating for proper petitioning and placement is one important tool to understand in able to assist patients.

References available online

Cervical Cancer as a Cause of Acute Renal Failure

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Cervical cancer is the second leading cause of cancer-related death in women aged 20-39 years.[1,2] Though cervical cancer is largely preventable with adequate screening and administration of the HPV vaccine, 13,170 women will be diagnosed with cervical cancer this year and 4,250 will die. Women in areas of lower socio-economic status are disproportionally affected by cervical cancer.[5] In later stages of cancer an enlarged tumor burden and metastasis may cause urinary obstruction. This case describes a previously healthy woman who presented to the ED with symptoms of abdominal pain and vaginal bleeding who was found to have a urinary obstruction from a metastatic mass.

Case

A 37-year-old female patient presented to the ED with leg swelling and abdominal pain for the past 6 weeks that was causing difficulty with ambulation. She denied weight loss, chest pain, shortness of breath, nausea or vomiting, urinary symptoms, or paresthesia. Past history was significant for previous intravenous drug use. Physical examination revealed a female with normal vital signs. Her cardiopulmonary exam was normal. The vaginal exam showed a friable, bloody, painful cervix with loss of normal anatomy. Examination of her extremities showed pitting edema of the left lower extremity up to the thigh with normal pulses and tenderness to palpation. Testing showed a urinalysis positive for nitrites and leukocyte esterase, negative for bacteria, with too numerous to count red blood cells and white blood cells. A doppler study showed an acute DVT of the left lower extremity. A CT of her abdomen showed right sided mild hydronephrosis secondary to a suspected mass. She opted for outpatient follow up and was sent home with antibiotics for her urinary tract infection and anticoagulation for her DVT.

She returned 2 weeks later with increasing shortness of breath, decreased urination, and excruciating back pain. She had not filled her prescriptions, but did follow up with the tertiary care OB oncologist, who confirmed a diagnosis of cervical cancer. Physical examination revealed tachycardia and increased lower left extremity pitting edema with pain to palpation. Her creatinine was 8.8 mg/dL with a GFR of 6. A VQ scan was performed and read as low probability for pulmonary embolism. A CT of her abdomen showed anasarca, high grade bilateral hydronephrosis and an enlarged bladder mass. She was admitted for further treatment workup.

FIGURE 1.

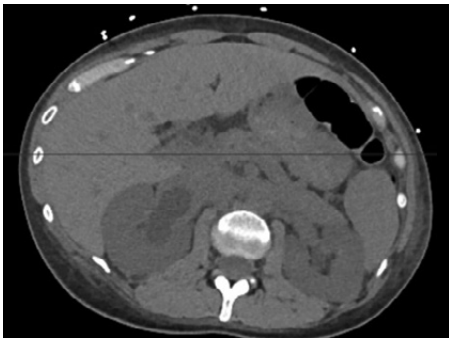

FIGURE 2.

Discussion

Cervical cancer is most frequently diagnosed between the ages of 35 and 44, with only 15% diagnosed in women over the age of 65.[5] The American College of Gynecology recommends screening beginning at age 21 with a Pap smear every 3 years.[3]

Survival is 66% at 5 years, but is impacted by race, ethnicity, and age. The 5-year survival rate for women with invasive cervical cancer is 92%; once the cancer has metastasized to surrounding tissues, or organs and lymph nodes, the 5-year survival rate drops to 56% and with distal metastasis, the 5-year survival is only 17%.

The most frequent strains of HPV associated with cervical cancer are strains 16 and 18. Women with lowered immune function, such as patients with HIV/AIDS or chronic steroid use, are noted to have less ability to fight off early cancer cells. Women who have herpes, smoke, lower socioeconomic status, or poor access to screening have an increased risk of invasive disease. Oral contraceptives have also been shown to increase the risk of cervical cancer.[4]

If cervical cancer invades into the urinary system, obstruction to the renal collecting system can occur with subsequent development of hydronephrosis. Continued lymph node encroachment, inflammation, and scarring of the pelvic rim often worsens hydronephrosis. Treatment of post-obstructive renal failure in cervical cancer patients typically includes stent placement, or urinary diversion procedure, such as percutaneous nephrostomy tubes, which aids in the recovery of renal function in 61.7% of patients.[1]

Case Conclusion

Bilateral nephrostomy tubes were placed to relieve the obstruction. PET scan found metastatic lesions in the sacral and hip bones, as well as to the lungs. The patient was discharged on hospice with home health. ✶

References available online

Can Urine Color Guide Management?

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Case

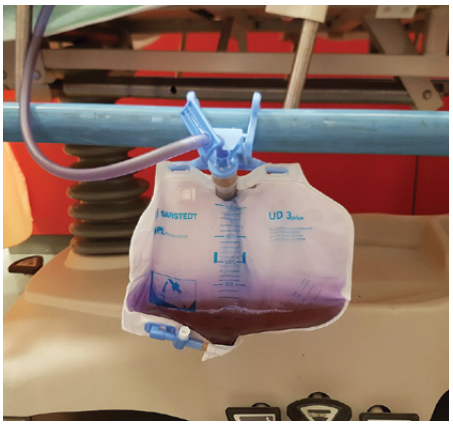
A male in his 70s with a past medical history of prostate cancer with metastases to his thoracic and lumbar spine presented to the emergency department with acute on chronic lower back pain. He underwent a laminectomy 3 weeks prior and has urinary outlet obstruction with bilateral nephrostomy tubes and an indwelling urinary catheter.

His physical exam is remarkable for tachycardia and baseline lower extremity deficits which include decreased sensation and motor function of the bilateral lower extremities. The differential diagnosis includes post-operative complications or infection from his recent laminectomy, pathologic fracture, epidural hematoma, catheter-associated urinary tract infection (CAUTI), nephrostomy tube dysfunction, and worsening structural back pain from his malignancy.

His laboratory workup was significant for leukocytosis of 15,000, C-reactive protein of 280, and a urinalysis (UA) showing large leukocyte esterase, 73 WBCs, and 507 RBCs. CT abdomen and pelvis with IV contrast showed properly functioning nephrostomy tubes without emergent or acutely significant findings. Given the patient's recent intervention neurosurgery was consulted. There was low suspicion for post-op complication after their evaluation and further infectious work-up was recommended.

On re-examination his pain and tachycardia had improved with acetaminophen. Shortly thereafter the nurse drew our attention to a previously unrecognized bag of purple urine. This finding prompted several questions:

- What is the diagnosis?
- Does it represent CAUTI?
- What is the management strategy?



Discussion

This case demonstrates a rare condition known as Purple Urine Bag Syndrome (PUBS). An unmistakable visual, PUBS represents an uncommon side effect of urinary tract infections occurring most commonly in those with chronic indwelling urinary catheters.

Though not fully understood, the purple discoloration is believed to be created by a unique microbiologic and biochemical interplay. Metabolites of tryptophan get broken down by bacteria in the gastrointestinal (GI) tract and produce indoles. These compounds get absorbed in the blood and ultimately renally excreted. In the presence of an alkaline environment such as urine, bacterial flora commonly associated with colonization (ie, *Klebsiella*, Proteus, *E. coli*) produce sulphatases and phosphatases that convert the indoles to indigo (blue) and indirubin (red).

Risk factors for this phenomenon include those which increase bacteria in the GI tract (constipation) and urinary tract (female anatomy, elderly population, chronic catheterization).

Management

After clinching the diagnosis, the next step in management is to differentiate CAUTI from catheter-associated asymptomatic bacteriuria (CA-ASB). According to the most recent guidelines from the Infectious Disease Society of America, CA-ASB in patients with indwelling urethral catheterization is defined by the presence of $\geq 10^5$ cfu/mL of $\geq$1 bacterial species in a patient without symptoms compatible with UTI, regardless of whether the urine is cloudy or malodorous. CA-ASB is typically managed conservatively and without antibiotics.

Alternatively, CAUTI is characterized by urinary symptoms and the presence of $\geq 10^3$ cfu/mL of $\geq$1 bacterial species with no other identified source. As it pertains to our case, signs and symptoms of CAUTI in a patient with a spinal cord injury also include increased spasticity, back pain, autonomic dysreflexia, and/or sense of unease.

By definition PUBS is a subset of CAUTI. Treatment of CAUTI and PUBS are similar and typically include antibiotic therapy tailored to sensitivities derived from a urine culture. In the case of PUBS, the five most commonly cultured bacteria are *E Coli, Enterococcus spp., Proteus spp., M. morganii, and Klebsiella spp.* Since the majority of these bacteria are gram negative, ciprofloxacin is the most frequently cited antibiotic of choice. As an exception, fluoroquinolones are not recommended as a first-line therapy against *enterococcus*, and broader coverage should be provided initially. As a rule of thumb, best practice dictates antibiotic coverage guided by your hospital's microbial resistance patterns and antibiogram.

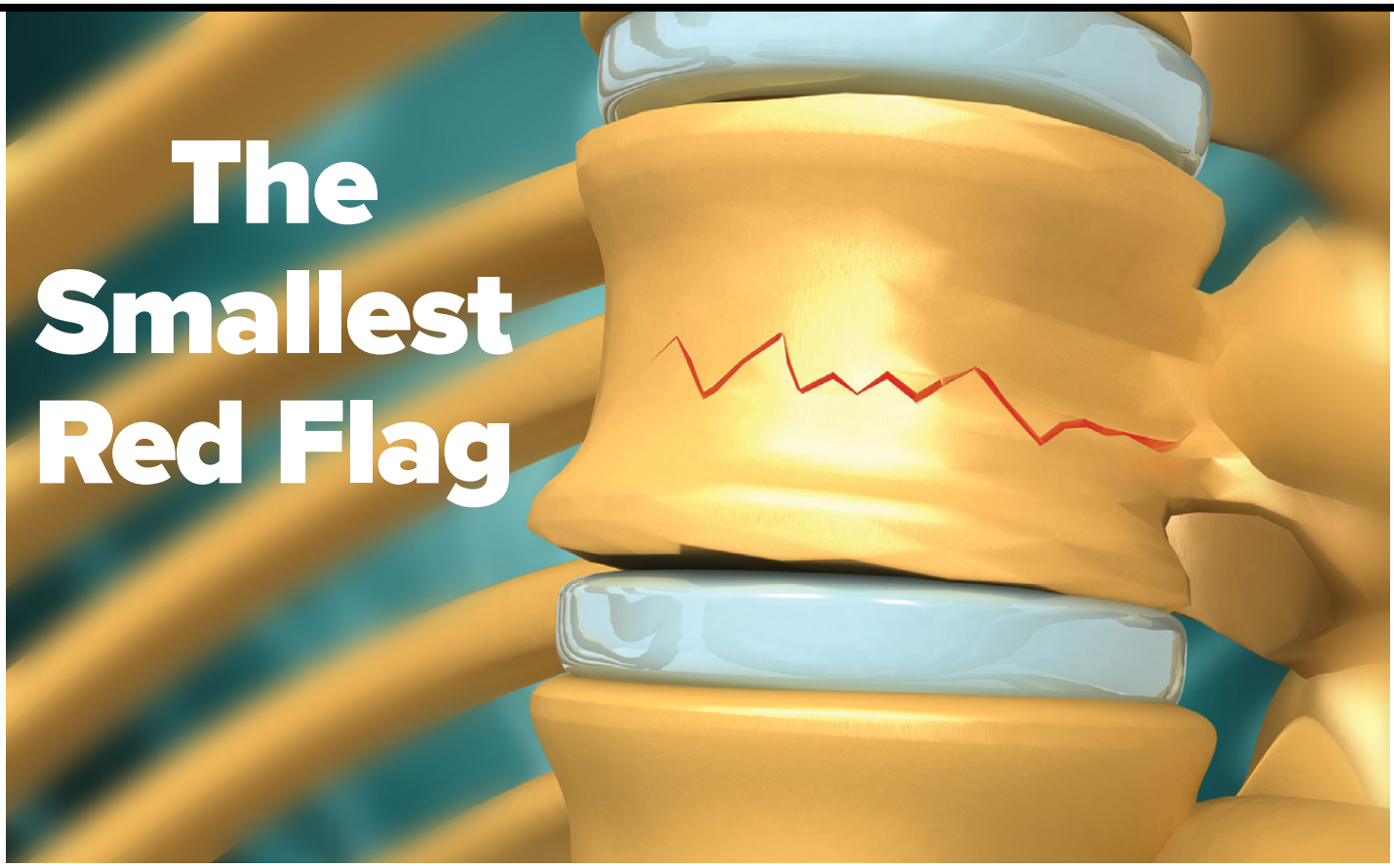
Case Resolution

The patient's urine culture grew *Enterococcus faecalis* that was sensitive to and successfully treated with a course of fluoroquinolones. ✶

PUBS FAST FACTS

- ✓ First reported in 1978
- ✓ Associated with women, chronic indwelling catheters, constipation, institutionalization
- ✓ Require treatment when patient experiencing symptoms of UTI
- ✓ Common bacterial causes: *E. coli, Enterococcus spp., Proteus spp., M. morganii*, and *Klebsiella spp.*
- ✓ Ciprofloxacin is a good choice if a culture is not yet available.

References available online



A Case of Non-Urologic Urinary Retention

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Case

A 65-year-old female with a past medical history of borderline personality disorder, bipolar I disorder, and chronic obstructive lung disease presented to a community ED with bilateral flank pain. She reported discomfort ongoing for 2 weeks and progressively worsening over the past 3 days. She had not urinated in 2 days and had not had a bowel movement in over 7 days. She denied fevers, chills, lower extremity weakness, or new medications. Her initial physical exam was notable for a distended and diffusely tender abdomen, bilateral flank tenderness, and no midline spinal tenderness. Bladder scan at bedside revealed a significantly distended urinary bladder. Neurologic exam demonstrated equal strength and sensation to the bilateral upper and lower extremities, no saddle anesthesia, and normal rectal tone. Her genitourinary exam was also normal. A Foley catheter was inserted and resulted in over 2 L of urine within the first hour. Catheter insertion relieved the patient's abdominal distention, but not her flank pain. Labs were significant for leukocytosis of 17.0 with a neutrophil predominance, hypokalemia of 3.2 mmol/L, and a mildly elevated alkaline phosphatase of 132 IU/L. The remainder of her labs and imaging, including lactate, urinalysis, and CT abdomen and pelvis, were unremarkable. CT lumbar spine reconstruction was ordered after it was revealed the patient had slipped and fell onto her back two days prior while attempting to sit down on a chair. Ultimately her reconstruction images were unremarkable. Due to concern for spinal pathology causing her new-onset urinary retention, the patient was transferred to the nearest academic center for neurologic evaluation and emergent MRI.

At the academic medical center neurology was consulted and again noted a normal neurologic exam. Additionally, reflexes were normal and symmetric in all extremities, without clonus, except for the right patellar reflex, which was absent in the setting of a prior knee replacement. Plantar reflexes showed withdrawal response bilaterally. Cervical and thoracic spine CT imaging revealed an acute burst-morphology fracture of the T8 vertebral body with involvement of the bilateral facets, making it an unstable 3-column injury (Image 1).

IMAGE 1. Unstable 3-column injury in urinary retention patient

Radiology noted severe fragmentation with retropulsion of fracture fragments into the spinal canal. MRI showed retropulsion resulting in severe spinal canal narrowing, advanced T8-T9 neural foraminal narrowing, and cord compression at this level with evidence of developing myelopathy (Image 2).

Additionally, there was found to be marrow edema within the anterosuperior and posterior T9 vertebral body and bilateral pedicles indicating additional injury sites. There was also presumed disruption of the anterior and posterior longitudinal ligaments at the T8 level with evidence of interspinous ligament strain from approximately T6-T10. MRI found no evidence of distal cord or cauda equina compression. Given the unstable nature of the patient's fracture she was taken emergently for T6-T10 posterior spinal fusion, T8 laminectomy, and left trans-pedicular open reduction of fracture and ventral cord compression.

Discussion

Acute urinary retention (AUR) is rare in women, with an occurrence rate estimated at 3 cases per 100,000 women per year.[1] Similar to men, outflow obstruction is the most common cause. Obstruction in females typically manifests secondary to pelvic organ prolapse or pelvic mass. Medications can induce AUR; while anti-cholinergic and sympathomimetic medications are most common, the list includes anti-depressants, muscle relaxers, and anti-psychotic medications.[1-2]

As evidenced by this case, AUR can also have a neurologic etiology; spinal cord injuries from trauma, epidural abscess or metastasis, stroke, or demyelinating disease. In a recently published systematic review of the diagnostic accuracy of 84 red flag signs and symptoms, new urinary retention or bladder/suprapubic fullness on physical exam were shown to have positive likelihood ratios of 7.0 (95% CI: 1.9-26.0) and 40.2 (95% CI: 1.6-979.1), respectively, for serious spinal pathologies (e.g. vertebral fractures, cauda equina compression, cancer, and infectious disorders).[3]

We commonly remember to evaluate for saddle anesthesia when seeking to identify spinal pathology, and for good reason, as the study identified a positive likelihood ratio (7.0; 95% CI: 1.4-36.0) associated with disturbance of saddle sensation on physical exam. However, as this case demonstrates, serious spinal pathology can present in the absence of saddle anesthesia, with the presence of smaller red flag symptoms. As such, it is important to consider that acute urinary retention can be a subtle clue of a neurologic process warranting emergent CT imaging to rule out vertebral fracture and MRI to rule out spinal cord compression. ✶

IMAGE 2. MRI showing developing myelopathy

References available online

Acute Hyperkalemia Masking Flecainide and Metoprolol Toxicity

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Case

A 60-year-old female with a past medical history notable for atrial fibrillation, chronic alcoholism, and hypertension presents to the ED with 4 days of nausea and vomiting progressing to full-body weakness and malaise on the day of presentation. Upon arrival, the patient was hypotensive with a wide-complex, sinusoidal pattern noted on the monitor. The patient received calcium gluconate emergently for presumed hyperkalemia with subsequent narrowing of the QRS complex, after which the usual therapy for hyperkalemia was initiated. Additional history revealed the patient continued to take her home benazepril and metoprolol despite poor oral intake and gastrointestinal losses. She was recently started on flecainide by her cardiologist for atrial fibrillation one week prior. A repeat ECG, shown below, was obtained after the treatment above. What other etiologies should be considered in this patient?

Discussion

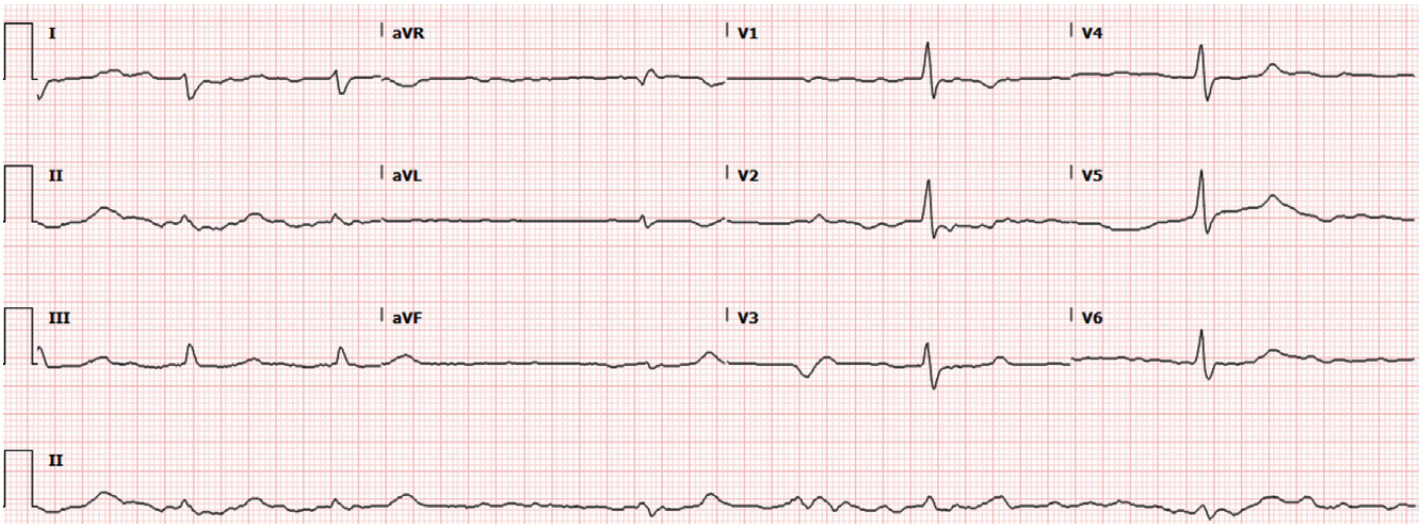
Electrocardiogram Case Discussion

This ECG rhythm is interpreted as atrial fibrillation with a slow ventricular response. The heart rate is irregularly irregular with a rate of approximately 36 beats per minute (BPM). There is no measurable PR interval secondary to the patient's underlying atrial fibrillation, but the QRS complex is widened at 140 milliseconds (ms). The corrected QT (QTc) interval for the patient's heart rate is prolonged at approximately 490 ms. ST segment duration is 240 ms. ST segments and T-waves are unremarkable without clear ischemic changes and unremarkable morphology.

The Cardiac Action Potential and the Electrocardiogram

Although an in-depth discussion of the cardiac action potential is beyond the scope of this paper, a review of the physiology of cardiac myocyte conduction aids in the understanding of the ECG above and will be discussed in context. The cardiac action potential is divided into five sequential phases: Phase 0, Phase 1, Phase 2, Phase 3, and Phase 4. The healthy cardiac myocyte maintains a resting negative electrical potential (Phase 4) by an electrochemical gradient of ions. Intricately regulated ion transporters and channels allow passage through the relatively impermeable cellular membrane and coordinate the action potentials of cardiac myocytes. The action potential begins with a rapid influx of sodium ions triggering a rapid depolarization (Phase 0) of the cardiac myocyte. Once these sodium channels inactivate, there is a brief efflux of potassium from the cell causing a rapid, self-limited repolarization or "overshoot" (Phase 1).[1,2]

On the ECG, the QRS complex primarily reflects Phase 0 and, to a lesser extent, Phase 1 of cardiac myocyte depolarization across the surface of the heart.[1] A normal QRS duration is between 60 and 120 ms. Widening of the QRS complex can be due to a myriad of causes including conduction system disease, electrolyte abnormalities, hypothermia, or blockade of the fast-acting sodium channel during Phase 0 of the cardiac action potential delaying the depolarization. Common culprits for the latter involve antidysrhythmic medications, cyclic antidepressants, phenothiazines, amantadine, diphenhydramine, carbamazepine and cocaine.[3] In this case, the QRS remained prolonged despite normalization of extracellular potassium and stabilization of the cardiac membrane, and given the patient's history, this was suspicious for flecainide toxicity.



The plateau (Phase 2) of the action potential is orchestrated by sustained changes in the permeabilities of potassium and calcium ions through the cell membrane via numerous mechanisms. Finally, a delayed outward current caused by a rapid potassium efflux results in repolarization of the cell (Phase 3) with an eventual return to the Phase 4 resting potential. The ST segment on the ECG reflects the sustained depolarization (Phase 3) and the T-wave represents repolarization of the myocardium (Phase 4).[1] The myocardium is susceptible to ventricular dysrhythmias if an unexpected depolarization occurs during this time. The QT interval varies with heart rate and is prolonged with bradycardia and may be corrected mathematically (QTc), yet remains prolonged in this case. The QT interval reflects ventricular systole and truly is an incorporation of multiple electrophysiological periods but in a simple model is primarily affected by increasing the duration of Phase 2 or 3 of the action potential. The factors are numerous but include physiologic modification, medication effects, genetic channelopathies or electrolyte abnormalities.[3]

Antidysrhythmic Therapy and its Effects

Broadly, antidysrhythmic therapies can be classified by the Vaughan-Williams classification system by the primary effect of each class on different targets in the heart.[4] The major groups are labeled as classes I, II, III and IV with class I medications further subdivided into class IA, 1B and 1C based on additional electrophysiologic effects.[2] It is important to note that this classification is far from perfect and there is significant cross-reactivity towards receptors targeted by other classes. Class I medications are defined primarily by their ability to block the rapid inward sodium current which defines Phase 0.[2,4] Class IC medications, which include flecainide and propafenone, have the slowest dissociation from the activated receptor.[4,5] Class IB medications, which include lidocaine and mexiletine, have the most rapid dissociation from the receptor and also preferentially bind to the inactivated or "closed" form of the channel which predominates at the end of Phase 0. In contrast to class IC medications, this causes electrocardiographic effects typically only seen at faster heart rates by a mechanism termed "use-dependence."[5] Class IA medications such as procainamide, quinidine and disopyramide, have intermediate pharmacologic properties between class IB and class IC. Additionally, class IA medications exert an effect on the outward potassium channels in Phase 3 as well.[4,5]

TABLE 1. Summary of antidysrhythmic targets and electrocardiographic effects

Vaughan-Williams Class	Common Examples	Primary Target	Ecg Effect
Class IA	Quinidine, procainamide, disopyramide	Sodium channel, intermediate dissociation. Potassium channel.	QRS and QT prolongation
Class IB	Lidocaine, mexiletine	Inactivated sodium channel, rapid dissociation	Minimal, QRS prolongation at rapid heart rates
Class IC	Flecainide, propafenone	Activated sodium channel, slow dissociation	PR, QRS, and QT prolongation. Bradycardia with flecainide
Class II	Propranolol, metoprolol	Beta-adrenergic receptor	PR prolongation and bradycardia
Class III	Amiodarone, sotalol, ibutilide	Potassium channel (Phase 3)	QT prolongation
Class IV	Verapamil, diltiazem	Calcium channel	PR prolongation and bradycardia

As alluded to previously, the electrocardiographic effects of class I medications manifest with prolongation of the QRS complex via the mechanism above, along with other sodium channel blocking medications.[2,5,6] With xenobiotics that affect sodium channel conduction, the right bundle of the cardiac conduction system is preferentially affected resulting in a delay of right ventricular activation. The associated ECG findings include an R wave in the terminal portion of the QRS complex in lead aVR and an S wave in leads 1 and aVL.[3] The prolongation of the QRS complex by sodium channel blockade lengthens the QT interval, however it does not affect the ST interval duration as the ST interval generally reflects the duration of potassium efflux in Phases 2 and 3. This is in contrast to potassium channel blockade causes prolongation of both the QT interval and the ST segment duration.[3]

The medication in this case, flecainide, is a class IC medication indicated in the restoration of sinus rhythm in atrial fibrillation and the suppression of supraventricular tachycardia in structurally normal hearts.[5] As a class IC antidysrhythmic, it primarily binds to activated sodium channel receptors with a slow dissociation, and there is likely some blockade of potassium channels as well.[4,5] Flecainide's strong affinity to activated sodium channels with slow dissociation leads to greater efficacy but also greater risk of adverse effects.[5] Prolongation of the QT interval may lead to dangerous dysrhythmias such as ventricular fibrillation. As well, flecainide toxicity can also cause bradycardia.[2,5] If P waves are present, flecainide may also prolong the PR interval on the ECG. Toxicity is suggested with a 50% increase in QRS duration, 30% prolongation of the PR interval or 15% prolongation of QTc interval.[5,6] Flecainide also causes decreased inotropy which can lead to hypotension.[5]

Class II medications, which include beta-blockers, are defined as antagonists of the beta-adrenergic receptor. There are numerous examples of this class of antidysrhythmic. The beta-adrenergic receptor does not contribute to the cardiac myocyte action potential, but it aids in modulating heart rate primarily via effects on the conductivity of the atrioventricular (AV) node.[1] Electrocardiographically, this is reflected by a slowing of the ventricular

response and lengthening of the PR interval. In the case above, the patient was also prescribed metoprolol which likely contributed to the AV nodal blockade (i.e., the slow ventricular response) along with the flecainide induced bradycardia. In general, class II antidysrhythmic medications have a minimal effect on the QRS interval or QT interval electrocardiographically.[4]

Class IV medications, which include verapamil and diltiazem, cause similar electrocardiographic changes as class II medications. These medications block slow, inward calcium channels in specialized pacemaker cells which slow AV node conduction causing prolonged PR intervals, nodal blocks, and bradycardia with minimal effect on the QRS or QT duration.[4]

Class III medications, which include sotalol, ibutilide, and amiodarone, exert their effect at the outward rectifying potassium current responsible for repolarization in phase 3. This is reflected electrocardiographically as an increase in the QT interval and ST segment.[4] It is important to note that although the Vaugh-Williams classification system attempts to neatly classify these medications, the specific compounds or their active metabolites may share mechanisms seen in other classes.[4]

Management

This discussion will focus primarily on class IC toxicity as seen in this case. Flecainide is renally excreted and excretion is improved with urinary acidification. As flecainide is a potent sodium channel inhibitor, hypertonic sodium bicarbonate may be useful in mitigating the widening of the QRS complex. Continued sodium bicarbonate infusions can cause alkalization of the urine so there is a theoretical benefit to utilizing sodium chloride infusion instead. Of note, there is no benefit for hemodialysis in flecainide toxicity.[5] The patient in this case was also on a class II medication which can cause bradycardia and AV nodal blockade. Atropine can be trialed initially, and intravenous glucagon and calcium may be pursued for more severe cases. High-dose insulin euglycemia protocols can also be effective. Hypotension due to beta-blocker toxicity is preferentially treated with catecholamine vasopressors followed by phosphodiesterase inhibitors.[7] Intralipid therapy may be useful in both class IC and class II toxicities. Ultimately, in both cases, refractory hypotension and shock can be temporized with cardiopulmonary bypass or extracorporeal membrane oxygenation.[5,7]

Case Conclusion

This patient was admitted to the Medical Intensive Care Unit with a diagnosis of acute renal failure secondary to hypovolemia secondary to suspected alcoholic pancreatitis. The patient's hypotension, thought to be due to flecainide and metoprolol toxicity, was treated with norepinephrine and epinephrine infusions, aggressive volume resuscitation, and intralipid therapy. She was also given hypertonic bicarbonate with improvement in the duration of the QRS complex. The patient was ultimately discharged in stable and improved condition with normalization of her renal function and resolution of the abnormal findings seen on her initial ECG. ✶

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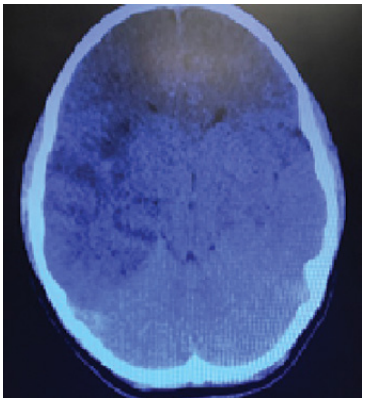

Altered Mental Status in the Pediatric Patient

A Potentially Dangerous Diagnosis

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Meningitis is typically a clinical diagnosis commonly found in younger patients based on symptoms of fever, headache, photophobia, nuchal rigidity, and often with nausea and vomiting.[1] The peak incidence occurs in infants and decreases with age.[2] A lumbar puncture is ideal to distinguish its etiology; however, most cases of meningitis alone are now caused by enteroviruses.[3] Other viruses are implicated based on vaccination status, travel history, or immunosuppression. The following case describes an adolescent male presenting with persistent symptoms after a head injury, who was ultimately found to have HSV meningoencephalitis.

Case

A 12-year-old male was brought to the emergency department by his parents for headache and intermittent fevers that began 13 days prior, now with new symptoms of sleepiness, difficulty standing, and decreased oral intake and urine output. The patient had no past medical history and was allergic to penicillin. Symptoms began one day after a head injury sustained while playing football and included one episode of vomiting. The patient was evaluated twice since symptoms began, had a negative head CT and positive genetic probe strep test, and was discharged with clindamycin.

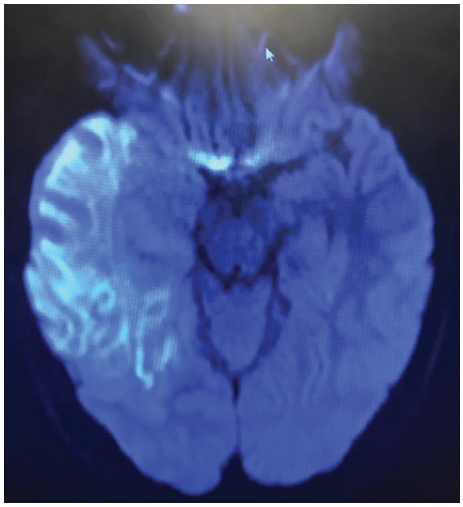
Physical exam on the third hospital visit revealed an ill-appearing, lethargic 12-year-old male with normal vital signs. Cardiopulmonary exams were unremarkable, and neurologic exam was significant for mild global weakness with normal reflexes, no tremor, and intact cranial nerves and sensation. Skin exam revealed no rashes or diaphoresis.

Testing revealed a CBC, BNP, CRP, and fibrinogen within normal limits. Urinalysis was unrevealing for infection. LFTs and ammonia were normal. Blood cultures were drawn. CT of the head showed extensive temporal involvement as well as impending uncal herniation. MRI demonstrated temporal lobe enhancement consistent with HSV encephalitis. The patient was admitted and started on vancomycin, ceftriaxone, and acyclovir for meningitis coverage. Mannitol was started for osmotic diuresis to lower intracranial pressure. The patient subsequently was taken to the operating room for craniotomy. Brain biopsies were positive for HSV.

Discussion

Herpes simplex virus is the second most common cause of meningitis in adolescents and adults and is often associated with genital lesions.[4] In the normal healthy patient, viral meningitis is typically self-limiting and only requires supportive care to manage symptoms and maintain euvolemia.[5] However, meningitis may progress to meningoencephalitis, which involves neurologic dysfunction.[6] Symptoms range from impaired reflexes and cranial nerves to altered mental status or seizures. HSV encephalitis can be life-threatening and requires timely antiviral therapy.[7] Neuroimaging of these patients may or may not reveal abnormalities, however typically temporal lobe lesions are indicative of HSV involvement.[8]

While most children with viral meningitis recover completely with minimal short-term sequelae, there is limited data on the neurologic prognosis of those who also develop encephalitis.



The diagnosis of meningitis and encephalitis requires high clinical suspicion, and not all classic symptoms need to be present. Lumbar puncture is most useful to delineate etiology, however immediate empiric treatment is the best approach to managing these patients.

Case Resolution

The patient remained intubated in the pediatric intensive care unit for nearly two weeks. He regained neurological function, however, was noted to have many deficits. He had a prolonged hospital course without further complication. ✶

TAKE-HOME POINTS

- Meningitis is a clinical diagnosis; however, invasive diagnostics are required to optimize therapy and lumbar puncture is the gold standard
- Patients concerning for meningitis of unclear etiology should be treated empirically
- Aseptic meningitis is often self-limiting requires only supportive care
- Encephalitis is a distinct entity evidenced by neurologic dysfunction and requires targeted therapy.

Septic Thrombophlebitis as a Consequence of Intravenous Drug Use Disorder

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Lemierre's syndrome is defined as internal jugular vein septic thrombophlebitis, typically preceded by pharyngitis or the presence of a central venous catheter. It is a disease that was more prevalent in the 20th century, however, presentations have declined as a result of the discovery and widespread use of antibiotics. We report a unique case of Lemierre's syndrome in a person who injects drugs (PWID) without a history of recent oropharyngeal infection or the presence of a central venous catheter.

Background

Septic thrombophlebitis of the internal jugular vein, or Lemierre's Syndrome, is a diagnosis that is rarely encountered today. Clinicians must maintain a high index of suspicion for this potential disease state as delay or outright failure to detect and treat it appropriately sharply increases morbidity and mortality. This condition most often presents as the sequelae of bacterial pharyngitis but other etiologies have been reported. Affected individuals typically exhibit systemic signs of infection such as fevers and/or rigors. Nearly all patients will have positive blood cultures. The most commonly isolated bacterium isolated is *Fusobacterium necrophorum*, though others such as *Staphylococcus* and *Streptococcus* species have been implicated. Nearly all patients with Lemierre's syndrome will also have findings concerning for septic emboli.[1] The discovery and widespread implementation of antibiotics in the early 20th century has been pivotal in decreasing the number of cases seen today. Nevertheless, Lemierre's Syndrome remains a relevant disease today as rare cases still do occur. One such case will be discussed in this presentation.

Case

A 52-year-old female with a past medical history of untreated hepatitis C virus, intravenous opiate use disorder, alcohol use disorder, and COPD presented to the emergency department (ED) for evaluation of fever, altered mental status and an open left neck wound. The wound was located in an area where the patient frequently injected heroin and fentanyl into her external jugular vein.

On initial evaluation, the patient's vital signs were T 39.6C (103.2F), HR 205, BP 124/73mmHg, RR 28, and SPO2 89% on room air. The patient was placed on supplemental O2 and an electrocardiogram (ECG) was obtained revealing supraventricular tachycardia. The patient was given Adenosine 6mg IV push with successful conversion to sinus tachycardia. Examination revealed a large left-sided neck wound with copious purulent drainage as well as a left postauricular wound (Figure 1). Despite the patient's high acuity, there was a lack of leukocytosis or lactic acidosis.

Intravenous fluid resuscitation as well as broad spectrum antibiotics, vancomycin and piperacillin/tazobactam, were initiated early in the course of the patient's management. Despite these measures, the patient became hypotensive requiring central venous catheter placement and vasopressor support. With these measures, the patient's hemodynamic parameters improved. Contrast-enhanced computed tomography scans (CT) of the neck and chest were subsequently obtained, revealing a 12cm area of superficial and deep soft tissue swelling involving the left neck, extensive deep vein thrombosis (DVT) extending from the internal jugular vein to the superior vena cava, innumerable heterogeneous pulmonary nodules/opacities and mediastinal stranding worrisome for mediastinitis (Figure 2, Figure 3).

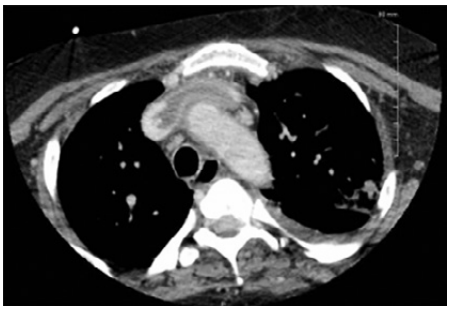
After stabilization in the ED, the patient was admitted to the intensive care unit (ICU) for further management. On the evening of admission, the patient developed worsening respiratory distress which ultimately necessitated endotracheal intubation and mechanical ventilation. The vascular surgery service was then consulted and recommended heparin

IMAGE 1

infusion due to the large size of the left intrajugular thrombus. Otolaryngology was also consulted, who performed a bedside incision and drainage of the neck abscess, followed by an intraoperative wound washout and rotational skin flap procedure.

Blood cultures were positive for Streptococcus mitis and wound cultures revealed Streptococcus viridans, for which the infectious disease service recommended treatment with vancomycin, cefepime, and clindamycin. The patient remained on mechanical ventilation for several days and was successfully extubated on hospital day 8. She was subsequently downgraded to the intermediate care unit on hospital day 10 where her care was continued. On hospital day 17, the patient was found to have anisocoria, left upper extremity pronator drift, and right-sided tongue deviation. Emergent CT scan of the brain was obtained and revealed an acute right lentiform nucleus parenchymal hematoma with surrounding vasogenic edema. The neurosurgery service was consulted and recommended non-surgical management. Follow up magnetic resonance imaging (MRI) revealed a hemorrhagic mass with surrounding vasogenic edema in the right basal ganglia with ring enhancement as well as multiple additional ring enhancing lesions within the brain. These findings were concerning for an infectious process, likely septic emboli. Due to this, the patient's anticoagulation was reversed and she was again upgraded to the ICU. After several days, the patient's neurologic symptoms improved and she was subsequently discharged to a subacute rehabilitation center.

IMAGE 2



Discussion

Lemierre's syndrome is a unique condition defined by septic thrombophlebitis of the internal jugular vein. Historically, this condition has been preceded by oropharyngeal infection with *Fusobacterium necrophorum* as the most common bacterium. More recently, however, drug resistant pathogens such as methicillin resistant *Staphylococcus aureus (MRSA)* have been reported, particularly in PWID and those with HIV. In PWID, superficial distal veins can become damaged or scarred due to repeated injection. As a result, attempts are often made to access more proximal or central vessels. Access to these sites can result in direct inoculation of bacteria into the skin and vasculature, predisposing the individual to bacteremia and subsequent septic thrombophlebitis.[2] Skin flora such as *Staphylococcus* and *Streptococcus* species are common causes of these infections. Oral flora such as *Fusobacterium necrophorum* can be introduced to the site when PWID lubricate needles with saliva, and various mixing agents can predispose PWID to atypical pathogens such as *Pseudomonas aeruginosa*, *Burkholderia cepacia,* and fungal species.[2]

The diagnosis is typically made with computed tomography (CT) imaging as it is readily available. Ultrasonography can also be used but visualization is often impaired by bony structures such as the mandible or clavicle.[1] If internal jugular vein thrombosis is an incidental finding on imaging, it is important to take the patients clinical context into consideration, as imaging alone cannot reliably distinguish between septic and non-septic thrombophlebitis.

Prompt antibiotic treatment should be provided to those with high clinical suspicion for Lemierre's syndrome and those with confirmed diagnosis. Initial treatment should include either a beta-lactamase resistant beta-lactam, such as piperacillin/tazobactam, or a carbapenem. Vancomycin should be added to those at risk for catheter associated septic thrombophlebitis or those at risk for MRSA infection. Previous reviews have found a wide range of treatment duration, but the mean duration is 4 weeks, including 2 weeks of intravenous antibiotics followed by 2 weeks of oral antibiotics.[1]

IMAGE 3

The role of anticoagulation in the treatment of Lemierre's syndrome remains controversial as there are no controlled studies on this topic. Previous reviews have shown that 21-23% of patients are treated with anticoagulation with treatment duration varying between 2 weeks and 6 months. Factors such as thrombus extension and risk of bleeding often impact this decision, but further studies are needed to clarify the role of anticoagulation in these patients.[1] ✶

TAKE-HOME POINTS

- ✓ Although relatively rare, Lemierre's syndrome should be suspected in patients with a preceding oropharyngeal infection, septic emboli and in those with evidence of proximal or central vein access.
- ✓ People who inject drugs are at increased risk for serious infections due to direct bacterial inoculation. Atypical pathogens should be suspected in individuals who lubricate needles with saliva or use mixing agents.
- ✓ Prompt diagnosis and antibiotic administration will result in decreased morbidity and mortality.
- ✓ The role of anticoagulation remains controversial.

References available online

Strong Enough for a Giraffe, But Made for a Human

Alpha 2-adrenergic Agonist Overdose

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A 51-year-old female presents to the ED after being found unresponsive with concern for overdose. En route EMS reported Glasgow Coma Scale 3, hyperglycemia with blood glucose level 360 mg/dL, heart rate 68 bpm, hypotension with blood pressure (BP) 78/54 mmHg, pinpoint pupils, poor oxygenation with pulse oximetry < 70% initially, and respiratory rate < 5 bpm requiring bag-valve-mask ventilation and supplemental oxygen. She was given naloxone with a partial response including increase of pupil size, transient improvement of blood pressure, and very limited movement in response to painful stimuli. She received repeat dosing of naloxone, 5 mg total, without further response.

EMS reported finding the patient in bed next to open pill bottles containing oxycodone, celecoxib, naproxen, hydrochlorothiazide, gabapentin, and tizanidine. Last known well was 11 hours prior to arrival. Notably she was approximately 280 mg (70 tablets) short of the appropriate tizanidine amount.

On initial ED evaluation the patient was bradycardic and required bag-valve-mask ventilation to maintain adequate oxygenation. She was unresponsive to painful stimuli and pupils were 4 mm and sluggish to respond. Her corneal reflex was noted to be absent bilaterally. She was given an additional 2 mg dose of naloxone, which resulted in increased size of her pupils but no other improvement.

The decision was made to endotracheally intubate the patient; ketamine and rocuronium were administered for induction and paralysis. Initial labs were notable for mild acute kidney injury, lactate of 3.3 mmol/L, and no evidence of osmolal or anion gap. Post-intubation arterial blood gas showed pH 7.34, pCO2 39 mmHg, pO2 407 mmHg, HCO3 21.1 mEq/L, and oxyhemoglobin 99.4%.

The EKG demonstrated sinus bradycardia and a complete right bundle branch block. QTc interval was prolonged at 472 ms. After the airway was secured, the patient was taken for emergent imaging to rule out basilar infarct and hemorrhage. Non-contrast head CT and CT angiogram head and neck were unremarkable. The patient remained bradycardic with a low but adequate blood pressure. Her pupils were persistently constricted with minimal reactivity and she remained unresponsive to painful stimuli.

After excluding common etiologies such as hypoglycemia and opioid

overdose and ruling out serious etiologies such as hemorrhagic stroke or basilar occlusion syndromes, the diagnostic focus turned toward a toxidrome.

Discussion

In the setting of overdose, the findings of bradycardia and hypotension suggests a concise list of entities, including beta-blockers, calcium channel blockers, digoxin, opioids, benzodiazepines, organophosphates, ethanol, gamma hydroxybutyrate (GHB), and alpha 2-adrenergic agonists (eg, clonidine, guanfacine, tizanidine, etc). After initial stabilization and interpretation of labs and imaging, we felt this presentation was most consistent with alpha 2-adrenergic agonist toxidrome from tizanidine overdose.

What are Alpha 2-adrenergic Agonists?

Alpha 2-adrenergic agonists (alpha 2-agonists) are a class of molecules that bind and activate alpha 2-receptors, a class of inhibitory G protein-coupled receptors found in vascular smooth muscle, platelets, central, and peripheral nervous systems. When administered systemically, the central effects predominate and lead to decreased norepinephrine release and sympathetic tone.[1] Long before FDA approval of clonidine for hypertension in 1974 or dexmedetomidine for short-term sedation in 1999, the powerful sedating effects of these medications were well-known and utilized by the veterinary community.[2] As early as 1962, the clonidine analogue xylazine was discovered and utilized for its CNS depressant effects as an animal tranquilizer.[3] Interestingly, these medications are so powerful they're routinely used as chemical restraints in adult giraffes.[4] In humans these medications have historically been used to treat hypertension, opioid withdrawal, attention deficit hyperactivity disorder (ADHD), muscle spasticity, and glaucoma. Common medications include:

- Clonidine
- Apraclonidine
- Brimonidine
- Guanfacine
- Tizanidine
- Dexmedetomidine

Despite various indications and effects at therapeutic dosing, in the setting of overdose these medications produce powerful and reliable effects directly related to their underlying mechanism. Overwhelming alpha 2-agonism initiates a signaling cascade resulting in bradycardia, vasodilation, hypotension, decreased cardiac output, neurologic impairment, hypoventilation, and miosis.[5] Cognitive effects can range from mildly depressed levels of consciousness to complete unresponsiveness with absent brainstem reflexes. Sedative effects are related to the high concentration of alpha 2-receptors in the locus coeruleus and its role in the reticular activating system.[6]

To avoid confusion, it should be mentioned that alpha 2-agonists are distinct from alpha 1-agonists, the latter representing a class of medications utilized for their vasoconstrictive properties (eg, phenylephrine, midodrine, and pseudoephedrine).

Tizanidine and clonidine are additionally classified as imidazoline compounds based upon their chemical structure. Though poorly understood, at therapeutic doses these compounds have demonstrated the ability to reduce muscle spasm. In experimental studies tizanidine reduced muscle spasticity at lower doses and with fewer cardiovascular side effects than dexmedetomidine or clonidine.[1] This is the pharmacologic underpinning for tizanidine as a spasmolytic.

Recognition and Management

Recognizing alpha 2-agonist overdose and distinguishing it from other etiologies of bradycardia and hypotension is critically important. Severe presenting symptoms include:[7]

- Hypotension
- Bradycardia
- Miosis
- Hypoventilation
- Depressed level of consciousness
- Partial response to naloxone
- Euglycemia or hyperglycemia > hypoglycemia

Diagnosis requires a broad differential, careful history and physical examination, and appropriate evaluation of competing diagnoses. In our case, laboratory work-up, neurologic imaging, and re-evaluation were performed prior to further consideration of the toxidrome.

The cornerstone of management hinges on basic supportive care and ruling out alternative etiologies in order to clinch the diagnosis. Early and definitive management demands consideration of the following:

1. Airway, breathing, and circulation. Deal with immediate life-threats first. In the case of severe alpha 2-agonist toxicity, this may include endotracheal intubation for respiratory depression and/or altered mental status. Interventions such as IV fluid boluses, atropine, and vasopressors may be required to maintain adequate perfusion.
2. As with all cases of an altered or obtunded patient consider administering glucose, thiamine, and naloxone. The evidence for using naloxone as treatment for severe alpha 2-agonist toxicity is primarily based on experiences with overdoses of clonidine and the results are mixed, at best.[8,9] A trial of naloxone at 0.1 mg/kg, up to 2 mg total single dose for a cumulative total of 10 mg can be attempted.[10]
3. Evaluate for co-ingestions. Consider serum levels of common ingestions such as salicylates, acetaminophen, digoxin, anti-epileptics, and lithium. Don't forget the electrocardiogram. It is an inexpensive yet useful screening tool.
4. Consult with your local toxicologist or poison center. The American Association of Poison Control Centers can be reached at (800) 222-1222.

Case Conclusion

The patient was subsequently admitted to the intensive care unit for 1 day and extubated less than 24 hours after admission. Post-extubation, she denied intentional overdose and stated she had been "trying to sleep" secondary to worsening stress at home. There was complete neurologic recovery to previous baseline. Ultimately, she was discharged from the hospital with follow-up from outpatient psychiatry and her primary care physician. ✶

References available online

A Case of Severe Malaria in the Emergency Department

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Case

A 19-year-old male presents with a friend to your metropolitan emergency department with 4 days of intermittent fevers, chills, body aches, vomiting, and now altered mental status. The patient's friend thinks he has been otherwise healthy but tells you that the patient recently returned from a trip to Uganda building wells. The patient appears ill on initial assessment, with a heart rate of 123 bpm, blood pressure of 95/68 mmHg, an oxygen saturation of 95% on room air and febrile to 104.5°. On exam he repeatedly asks where he is but is unable to answer questions. Other than tachycardia and slight tachypnea he has a normal cardiopulmonary exam. His abdomen is non-tender but you do note a palpable liver edge lower than expected. He is moving all extremities but non-compliant with an in-depth neurological exam. The rest of his physical exam was unremarkable and his friend did not know of any other past medical history. Laboratory workup revealed a significant leukocytosis, mild anemia, and elevated creatinine as well as AST and ALT.

Background

Malaria is a rare diagnosis in the U.S. As such, providers outside of infectious disease specialists or those with experience in travel medicine or global health may not be familiar with the disease. Malaria is caused by several *Plasmodium* species including *P. falciparum, P. vivax, P. ovale, P. malariae,* and *P. knowlesi*. The parasite itself is carried and transmitted through bites from the *Anopheles* mosquitos, often occurring at night. While malaria was previously found across the globe, including in the United States and Europe, currently it is only endemic to tropical and equatorial countries in Africa, Asia and South America.

In the U.S., malaria is rare with the CDC reporting roughly 2,000 new cases in 2016. However, the number of cases in the US has slowly risen since the 1970s, in large part due to increased international travel. Many of those who are traveling are visiting friends and family living abroad; this group was the majority of new cases in 2016. Often those visiting friends and family in malaria-endemic countries may have grown up there and even had malaria as children.

TABLE 1. Key Diseases Causing Fever in the Returning Traveler

Malaria
Dengue
Chikungunya
Rickettsial Diseases (ie, Scrub Typhus)
Enteric (Typhoid) Fever
Meningitis
Pneumonia (including Legionellosis)
Influenza
Melioidosis
Leptospirosis
Schistosomiasis
Acute HIV Infection
Viral Hemorrhagic Fever
Tuberculosis
Urinary Tract Infection

Of the 2,000 cases in the U.S. in 2016, 14% were severe and 7 of the cases (<0.5%) died. While the overall number of cases remains low in the U.S., the WHO estimates that in 2018 there were 405,000 deaths worldwide from malaria with children making up two-thirds of those cases. Malaria remains a major public health threat across the globe.

Clinical Features

There are no symptoms specific to malaria. Uncomplicated malaria most commonly presents with fevers in addition to generalized malaise, myalgias, arthralgias, and mild respiratory and gastrointestinal symptoms. Temporal patterns to the fevers associated with malaria have been classically taught as indicative of the specific *Plasmodium* species, however, this has been largely disproven. Indeed the fever pattern can be variable in all cases of malaria regardless of species. Symptoms in returned travelers typically develop within a month of returning from an endemic area. However, symptoms can be delayed for up to 6 months in patients infected with *P. vivax*. The physical exam may show hepatosplenomegaly, jaundice, icterus, or even petechiae. However, there are no specific exam findings to suggest malaria.

A subset of patients will develop severe malaria, encompassing hemodynamic changes and multisystem organ failure. This is a true medical emergency and a presentation emergency physicians should be familiar with. Severe malaria is more

common in *P. falciparum* infections and in patients from non-endemic countries. Severe malaria requires prompt diagnosis and empiric treatment to stave off significant morbidity or mortality. A particularly worrisome variant of severe malaria is cerebral malaria. The pathophysiology is a complex interaction between the infected erythrocytes, cerebral inflammation, and a breakdown of the blood-brain-barrier. The hallmark of cerebral malaria is altered mental status and can progress to seizures. Behavioral changes, neurologic deficits, and epilepsy are potential long-term sequelae of the disease. Other possible presentations of severe malaria include ARDS, renal failure, severe anemia, coagulopathies, and shock (often termed algid malaria). Hypoglycemia has been noted as a potential complication, particularly in pediatric patients.

Diagnosis

There are multiple ways to diagnose malaria. Rapid Diagnostic Tests (RDTs) are antigen-based assays commonly found across the globe. They are particularly sensitive for *P. falciparum* but may miss other species. Furthermore, they cannot differentiate most *Plasmodium* species other than *P. falciparum* & *P. vivax*. RDTs are a qualitative test and do not reflect the level of parasitemia which may be prognostic in some patients.

The gold standard for diagnosis remains direct visualization via thick and thin blood smears. In the hands of an experienced microscopist, smears may be more sensitive than RDTs. Direct visualization is also needed for specific species identification outside of *P. falciparum* and *P. vivax*, as well as determining parasite burden. Malaria can be definitively ruled out with three negative thick and thin smears obtained over 24-72 hours. Of course, malaria is just one of several infectious diseases that cause fever in the returning traveler. Providers should consider other causative etiologies (Table 1) pending on clinical presentation and travel history.

Treatment & Disposition

Once the diagnosis is made, either through RDT or smear, treatment should be started in the emergency department in conjunction with an infectious disease specialist. If one is not available the CDC's Operation Center and local public health departments may be able to provide guidance. The choice of treatment is largely based on the causative species, where the infection was obtained, and whether or not the patient was on prophylaxis. If the patient was on prophylaxis an alternative agent should be chosen.

For all but *P. vivax*, artemether-lumefantrine or atovaquone-proguanil should be sufficient. If unavailable, quinine with doxycycline or clindamycin can be used. Chloroquine is an antiquated treatment given widespread resistance. If *P. vivax* or *P. ovale* are suspected based on geographical risk factors or confirmed with testing then primaquine must be added to treat hepatic hypnozoites (a latent form of the parasite). Primaquine should be avoided in patients with G6PD deficiency, which has been found to be protective against certain forms of malaria. In patients with severe malaria, parenteral artesunate is preferred but must be obtained from the CDC given its status as an orphan drug. Generally, in the US it is common that malaria patients are admitted for 24 hours observation even if only mild symptoms are present on the initial presentation. This facilitates speciation, parasite burden determination, and adequate treatment plans. Those with severe malaria should be considered for admission to the ICU.

Prophylaxis guidelines, should you need to prescribe it, can be found through the CDC's Yellowbook (link in the references). The most common prophylactic medications include atovaquone/proguanil, doxycycline, mefloquine, primaquine, and tafenoquine. Key considerations in choosing a chemoprophylactic agent include the country being visited, length of stay, and side effects of the chosen medication. Atovaquone/proguanil and doxycycline tend to be the most well-tolerated, with the exception of the increased sun sensitivity from doxycycline. Mefloquine, while also effective, is known to have potentially severe neuropsychiatric side effects however has better compliance as dosing is weekly rather than daily. Primaquine and tafenoquine are very effective against *P. vivax* (the species with most resistance) but require prior G6PD testing. Like most insect-transmitted diseases, prevention is key. Beyond prophylactic medications, travelers in high-prevalence areas should consider using insect repellent, treating clothing with permethrin, and particularly with the night-biting *Anopheles* mosquito, sleeping under a bed net.

Case Conclusion

While in the ED the patient underwent IV fluid resuscitation and showed interval improvement in hemodynamics and mental status. An RDT came back positive for P. falciparum. With the improvement of his mental status, the patient was able to provide further details including that he had skipped several days of his malaria chemoprophylaxis. He was started on artemether-lumefantrine after consultation with the infectious disease service and admitted to the ICU. He had a short, uncomplicated ICU course followed by a brief ward stay prior to being discharged home. ✶

TAKE-HOME POINTS

- Malaria is a potentially life-threatening disease to consider in the febrile returning traveler.
- Signs and symptoms can present up to a month after returning from an endemic country.
- Thorough travel, exposure, and prior chemoprophylaxis history are key to diagnosis and treatment.
- Prompt diagnosis and treatment are potentially lifesaving and should be done in consultation with an Infectious Disease expert or CDC.

Disclaimer

The views expressed in this case report are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the United States Government. I am a military service member. This work was prepared as part of my official duties. Title 17 U.S.C. 105 provides that "Copyright protection under this title is not available for any work of the United States Government." Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person's official duties.

Framework for New Cancer Diagnoses in the ED

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Since the coronavirus pandemic, emergency rooms across the country have been experiencing lower volumes and higher acuity.[1] In my hospital, emergency physicians are now seeing more mental health crises, acute on chronic disease, and late stage presentations of new diagnoses. As the first New York coronavirus surge came to a lull in the late spring, recently, my C-word has not been "COVID," but "cancer." For the past few weeks, I have been diagnosing metastatic disease on nearly every shift — from pancreatic adenocarcinoma with hepatic invasion, to ovarian cancer with severe ascites, esophageal cancer with dysphagia, and thyroid cancer causing subglottic obstruction and stridor.

At the same time, cancer recently barged through my family's front door. Within minutes, our lives were changed. Priorities shifted. Expectations of the future paused. My family member's story is similar to so many of my patients' experiences. *"I haven't been feeling well, but I've been too scared to see the doctor. I thought I wasn't supposed to come in…"*

During the peak of the pandemic, many patients attributed their symptoms to coronavirus. Fevers — it must be COVID; back pain — probably viral myalgias; weight loss — perhaps deconditioning from quarantine. My relative did this too. As a result, his diagnosis was delayed. Now, I find my personal life paralleled in my professional life, causing me to reflect — what kind of doctor do I want to be in these moments?

Approximately 11% of new cancer diagnoses are ED-mediated.[2] Historically, this disproportionately affects medically underserved patients with more advanced disease. As

emergency physicians, we have unparalleled access to lab tests, EKGs, point-of-care ultrasounds, imaging, and consultants. Tests result in minutes to hours. Given our diagnostic power and breadth of knowledge, emergency physicians can diagnose diseases faster than most other fields of medicine. We can give patients answers the same day. But diagnoses carry weight. Due to the fast-paced work up, many patients are never warned of the possibility of cancer, which can make the news even more jarring.

Due to widespread clinic closures and patients' fear of exposure, COVID is possibly pushing even more of these new cancer diagnoses to the ED. Given the gravity of this diagnosis, it is important for all practitioners to develop a compassionate and deliberate approach when informing patients in the ED. The SPIKES[3] approach (setting, perception, invitation, knowledge, empathy, and summary) lays the foundation for breaking bad news in medicine. Supplementing the SPIKES method, I have developed a framework for new ED cancer diagnoses. The purpose of the following section is to encourage all physicians to develop their own method for discussing new cancer diagnoses in the ED.

The radiology read.

After reviewing the radiology images and impression, I strongly recommend discussing the case with the primary radiologist. Ask them what is the pre-test probability for cancer and what other diagnoses are on the differential. Print out a copy of the final radiology impression for the patient in case they are planning to follow up in a different hospital system. Give instructions on how to access medical records in case they would like the images as well. Most cancer patients are encouraged to seek second opinions during the treatment process so having a copy of these records will help streamline this process.

Scrub in.

Treat breaking the news like a procedure and give it the respect that it deserves. Scrub in for it. The patient will always remember this moment, and their life is likely going to change after this conversation. Try to create a sterile field by minimizing distractions. Familiarize yourself with the basics and introduce yourself to family members. Try to assess: what are the patient's values and level of health literacy. Make sure to communicate the radiology results. Before leaving a shift, you must ask yourself: does the patient know the suspected diagnosis? If not, who will tell them? What is the plan for when and how will this information be shared?

Open with a question.

Elicit the patient's understanding of their health, and how much they would like to know. This will give them an opportunity to share some of their fears. Simply asking, "What is your understanding of what's going on today?" can be a powerful question to gain insight into their health literacy.

Say "cancer."[4]

When explaining the radiographic findings, remember that there is no substitute for the word "cancer." Even the words "malignant," "metastatic," or "tumor" will not suffice. If cancer is high on your differential, you should communicate this possibility clearly while still leaving room for alternate diagnoses. It is important to emphasize that nothing is proven until the biopsy. Most patients will inevitably pepper you with questions about the staging, treatment plan, and prognosis, but try to remember your own limitations. Importantly, you can encourage patients to write down their questions for the specialist.

Read the room.

Explore their emotions after receiving this news. Many patients will "black out" in the moment and forget most of the details. Convey empathy and mirror their moods. If your patient expresses interest in learning more, you can draw them pictures of the anatomy and use simple language to describe the disease. Consider sharing the radiology images with them and highlighting the concerning lesions. If your patient seems to be in shock, it is perfectly acceptable to remain silent. At times, I have walked away from the conversation to offer privacy for the family, given them a moment to process, and then returned with a glass of water to answer any further questions.

The follow-up.

Oncologic work-ups take time, especially for final pathology results. The lag between a definitive diagnosis and initiating treatment can be anxiety-inducing, so encourage your patients to be expeditious in scheduling both a biopsy and follow-up care in a timely manner. You must secure close follow-up. If a patient is being admitted to the hospital, the inpatient teams will coordinate the oncologic work-up. However, if a patient is being discharged, consider their resources. A patient who regularly sees their primary care physician and is adherent with medications is vastly different from someone who has low health-literacy and rarely sees a doctor. Familiarize yourself with your hospital's resources, such as a rapid oncology clinic or breast clinic. If you are concerned, you can also call your affiliated oncologist to alert them of the new diagnosis and help coordinate outpatient management.

Compassion and hope are key.

A cancer survivor advised me that just simply saying, *"I'm sorry, this isn't fair, and I wish I had different news to share with you today,"* is often more appropriate than offering platitudes. Through intentional verbal and nonverbal communication, try to convey empathy and set the tone that physicians genuinely care. It is our honor and privilege to guide these conversations. Lastly, even with the grimmest diagnoses, always leave room for hope.

Takeaways

Between the fast-paced nature of the ED and shift changes, providers often forget to inform patients of their diagnoses. Cancer is a life-altering diagnosis, so as emergency physicians we must develop a framework to convey this information clearly and compassionately with the goal of securing timely follow-up. ✶

Lung Ultrasound in COVID-19

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Introduction

As SARS-CoV-2 spreads globally, physicians are turning to different imaging modalities to assist in the diagnosis of COVID-19 and risk stratification of patients. Along with clinical suspicion, chest radiography (CXR), computed tomography (CT), and point-of-care ultrasound (POCUS) are being used in varying degrees to assist in diagnosis while awaiting confirmatory lab results. CXR is the predominant imaging modality being utilized, but has been found to exhibit a poor sensitivity of 59%, while CT has been shown to have a sensitivity of as high as 86%-97%.[1,2] However, CT in suspected COVID patients has disadvantages such as increased cost, risk of iatrogenic transmission, and in the case of severely ill patients, the risks associated with transporting these patients. In Italy and China, ultrasound has been used as an effective tool in the triage, diagnosis, and the assessment of lung improvement in affected patients. The attendant advantages of bedside US in COVID-19 are multiple; a timely diagnostic modality providing immediate information, real-time capability to monitor improvements and guide treatment, low relative cost, and the absence of radiation.[3] In this brief review, we go over some basics of lung ultrasound and the current literature on the ultrasound findings associated with COVID-19.

Basics of Lung Ultrasound

Before covering the sonographic findings of COVID-19, let's review the basics of lung ultrasound. To start, curvilinear or linear probes are preferred options. The suggested best practice is to use a linear probe for superficial structures and curvilinear probe for deeper structures (diaphragm or pleural effusions) given the latter's improved depth of penetration.[1,2,3] Lung ultrasound has been described as an eight zone technique, but other variations occur (see Figure 1 below). Views in each quadrant may include both longitudinal and transverse views.[4]

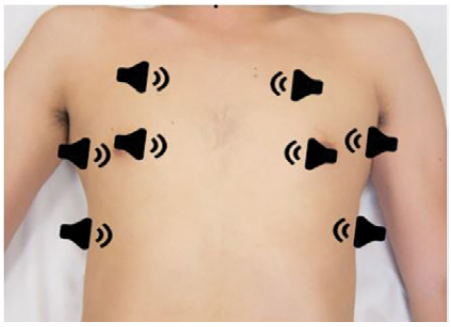

FIGURE 1. Transducer Positioning for the 8 Lung Zones
Aspler, A. Heslop, C., Stone, M. 2015. *PV Card: Focused Lung Ultrasound.* ALiEM.[5]

TIPS TO OPTIMIZE LUNG POCUS[6]

1. For general lung evaluation, use a low frequency curvilinear transducer with a "lung" preset. If a curvilinear transducer is not available, use a phased array low frequency transducer
2. To visualize the pleural line in detail, you may need to use a linear probe. Recommend depth settings of 7-10 cm with a lung preset
3. Scan with the transducer orientation marker in the cephalad direction. To view an area more in-depth, you can turn the probe transversely
4. Check all the chest zones and do not forget to scan the lower posterior lung fields bilaterally

Begin in the sagittal plane with the probe indicator oriented cephalad. An optimal view will show the hyperechoic pleural line between two ribs that display prominent shadowing.[3] Non-pathologic, aerated lung will demonstrate lung sliding, as parietal and visceral pleura glide past one another. Use of M-mode at this interface will demonstrate the 'seashore sign' in normal lung as compared to the 'barcode sign' in the setting of pneumothorax.[7]

Aerated lung will also reveal multiple hyperechoic lines at regular intervals deep to the pleural line, known as "A-lines" (see Figure 2 below). These are reverberation artifacts caused by acoustic reflections between the probe and the pleural line. They are a normal finding in healthy individuals.[3]

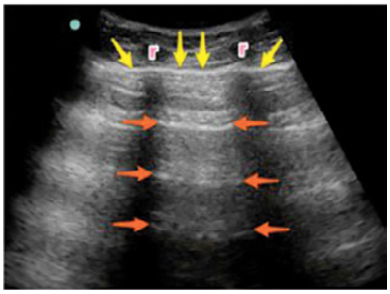

FIGURE 2.

The A-lines are demonstrated by the orange arrows that are visualized as hyperechoic, horizontal artifacts at the regular intervals deep to the pleural line (yellow arrows). There are two ribs (r) in the image.[5]

"B-lines" are another artifact that are described as long, well-defined, laser-like, hyperechoic lines that originate from the pleural line and move with lung sliding.[3] B-lines start at the pleural line and travel to a depth of at least 8 -10 cm. In addition, B-lines move back and forth with respiration as the pleural line moves. They will initially appear as thin single, vertical lines (see Figure 3), however, with more interstitial fluid, the lines can coalesce and become more wedge-shaped.[3] Greater than three B-lines in each lung field is pathologic and suggests Alveolar-Interstitial Syndrome (AIS) caused by various disease processes including pulmonary

edema, lung contusion, interstitial fibrosis, and acute respiratory distress syndrome (ARDS).[7,8]

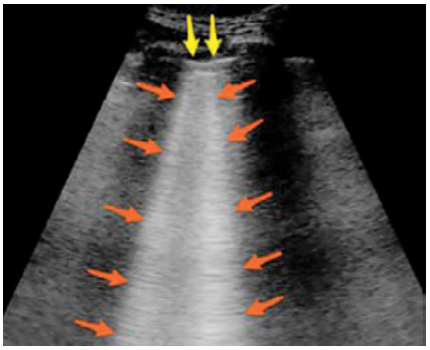

FIGURE 3. The B-lines (orange arrows) are visualized as hyperechoic vertical artifacts arising from the pleural line (yellow arrows) and extending off the screen without fading, erasing the A-line pattern.[5]

B-lines and pleural irregularities are often the first sonographic finding seen in COVID-19 pneumonia and can develop into outright consolidations. These findings are discussed in the following section.

Lung Ultrasound in COVID-19

Lung POCUS has been increasingly utilized for COVID-19 patients. The most common symptoms found with COVID-19 include fever, dry cough, and shortness of breath. Most patients who present to the ED only have mild symptoms (80%), whereas 14% present with severe disease, and 5% become critically ill as per the latest WHO reports.[9] Of the hospitalized COVID-19 patients, almost all present with distinctive clinical characteristics that progress in a similar way on CT and ultrasound. During COVID-19 disease progression, changes to the lung parenchyma begin in the peripheral regions of the lung and progress centrally. Table 1 is adapted from Smith et. al, and differentiates typical sonographic characteristics and clinical characteristics based off the severity of COVID-19 related lung injury.[4]

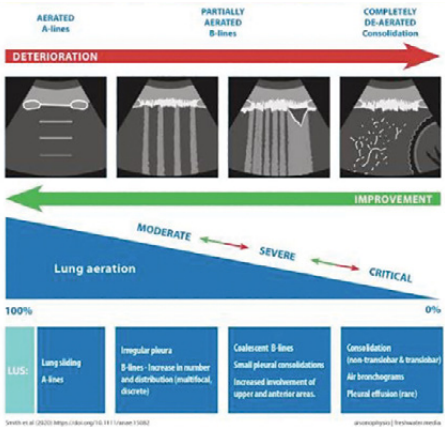

FIGURE 4. Sonographic characteristics of moderate, severe, and critical pleural and parenchymal changes in patients with COVID-19.[4]

Multiple studies out of China corroborate these common lung ultrasound characteristics seen in COVID-19. Peng et al compared CT and ultrasound features of patients with COVID-19 pneumonia and demonstrated CT findings corroborating the disease progression seen on ultrasound. The most common findings seen on CT include a thickened pleura, ground glass opacities, pulmonary infiltrating shadow, subpleural and translobar consolidations, and frequent bilateral involvement. A patient can have a negative or atypical lung CT scan in the early stages of the disease.[12]

Most Common Lung Findings in Covid-19[11,12]

1. Thickening of the pleural line with pleural line irregularity
2. Subpleural consolidations that can interrupt pleural line
3. B-lines in variety of patterns (focal, multifocal, and confluent)
4. Possible air bronchograms seen in the consolidation
5. Possible predominance in dependent locations (posteriorly and at bases)
6. Re-appearance of A lines during recovery phase
7. Pleural effusions are uncommon

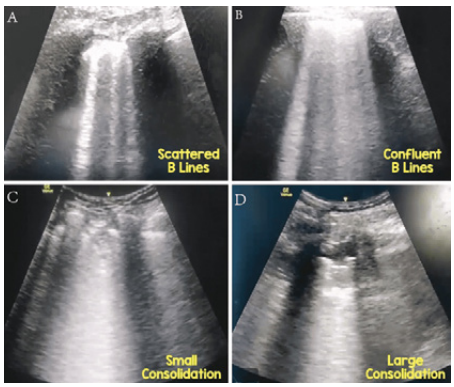

FIGURE 5. Multiple images from a patient who is COVID-19 positive.[12]

Limitations of Lung POCUS in COVID-19

There are some limitations of lung ultrasound that must be considered. Lung ultrasound is limited in its ability to detect lesions deep in the lung parenchyma, while abnormalities extending to the pleural surface are more readily visualized. Definitive detection of deeper lesions may require CT scan.[12] Infection control is another important consideration, as ultrasound machines, like any other surface, can theoretically

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TABLE 1. Typical Sonographic Characteristics and Clinical Characteristics Based off the Severity of COVID-19 Related Lung Injury

Disease Severity	Clinical Characteristics	Ultrasound Findings
Mild to Moderate	• Respiratory rate >30 • spO2 ≤ 93% on room air • Typically, will require supplemental O2 • Lung tissue begins to lose aeration	• Development of B-lines which begin to increase in number and distribution • Pleural line begins to become more irregular • Small <1 cm consolidation
Severe	• spO2 ≤ 93% on supplemental O2 • Start to show signs of respiratory distress • Increase need of supplemental O2 or respiratory support • Lung tissue is becoming progressively de-aerated	• B-lines that continue to increase in number and distributions as well as more coalescent and confluent • Begin to affect the upper and anterior areas of the lungs • Small consolidations increase in number and size
Critical	• Requiring invasive mechanical ventilation • Need high fraction of inspired O2 • Dependent areas of lung tissue have progressively de-aerated	• Extensive coalescent B-lines • Postero-basilar lungs develop. Significant bilateral alveolar interstitial syndrome progressing to consolidations with or without air bronchograms • Pleural effusions are small or rare unless the patient's fluid balance is high, they have concomitant CHF, or they have superimposed bacterial infections

References available online

Positivity Amidst Pandemic

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Strange. Unprecedented. Tumultuous. These words, among others, have become familiar descriptors of the times in which we are living. The COVID-19 pandemic has wrought havoc on life as we know it, and with that has come an overwhelming collective negativity. Although the damage that COVID-19 has done cannot be minimized, it makes it all the more important to find the positive stories amidst the uncertainty. Hopefully these stories of compassion, self-sacrifice, and humanity will be able to offer some encouragement in this strange, unprecedented, and tumultuous time.

Putting Compassion Before Personal Comfort

Part of being a great physician is putting compassion before personal comfort. Because the current pandemic impacted specific cities significantly more than others, providers from across the country offered their time and services where they were needed most. One emergency department physician, Brad Butler, MD, FACEP, saw a decrease in patients at his local hospital, which allowed him to travel to the city facing the harshest impact of COVID-19. When asked about his experience treating patients during the pandemic he replied,

> *I have been gone… for the past 3 weeks, deployed with the Navy to the Javits Center in NYC. It has been an honor and a privilege to serve with over 2,000 of my fellow service members (Navy, Army, Air Force, National Guard, and Public Health Service) here in NYC, taking some of the burden off the local EDs and hospitals. I have personally met over a hundred COVID patients, who were universally pleasant and thankful for our service and care of them.*

It is encouraging to see that so many physicians are willing to offer assistance during times of crisis, even if it means travelling over two thousand miles and treating a convention center full of COVID-19 patients. At the core of healthcare is compassion, and that quality is being highlighted now more than ever.

Setting a Good Example

Role models and mentors are an invaluable part of good health care. Every physician, resident, and student can name the individuals who contributed the most to their journey in medicine. Amidst the current pandemic, many providers have reached out to their mentors for inspiration, advice, and a sense of comradery. When asked about positivity among COVID-19, Katherine Dahl, MD, pointed toward her mentor as an example of resilience and forward-thinking:

The other day, a friend of mind said, "COVID really shows people's true colors." It's true. This crisis seems to reveal and augment deep personal qualities both negative and positive. I have a story of a man whose beautiful soul is revealed by this crisis. He is my mentor from training in New York City. His hospital was running out of CRRT machines and he was told that he would need to come up with a plan to decide which patients would be denied dialysis. He refused to deny dialysis to anyone, and insisted that he would find a way to dialyze everyone who needed it. He contacted a large dialysis company and got them to lend home dialysis machines that could be used for continuous dialysis in the ICU. The company also sent nurses who could run these dialysis machines, and could teach the ICU nurses how to run them. When they were running out of dialysate, he came up with a formula to make their own dialysis solution from scratch. He also came up with an idea to use a blood pump to make new dialysis machines in case the home dialysis machines were not enough. When everything seems impossible and dark, everyone feels some element of despair. Some people get overwhelmed and give up, while others stay creative and think outside the box. My mentor will never give up.

Having mentors who are resilient and innovative will continue to pave the way for new physicians, and this pandemic will allow those mentors to shine. If every student and resident can find inspiration during this time of adversity, we will surely be set up for success in our own medical practices.

Knowing When Kindness Supersedes Risk

Adversity has the incredible effect of revealing the enormous propensity that humans have for kindness. There seems to be no limit to the ways people will support each other. From home-made masks to video wellness chats, the COVID-19 pandemic has become the intersection of innovation and compassion. Sometimes the most meaningful impact can be made through the simple gesture of human contact. This deed means acknowledging the risk of contact during the pandemic but doing it anyway. Even in knowing the risks of COVID-19, one physician, Leslie Koenig, MD, was able to prioritize humanity and compassion.

"I gave a patient a hug last night. Two, actually. I had just told her she had a giant abdominal mass (looked like a solid tumor) and she started sobbing. Broke my heart so I held her hand at first. Came back later to update her and she broke down again. She had zero COVID symptoms and we were both wearing masks. She was terrified. So I just hugged her. She needed it and maybe I needed it too. This sucks and I know it's only going to get worse. But, hugs are magical. Hug who you can."

There are a million reasons not to hug a patient given the current COVID precautions. To choose to abstain from touch is a reasonable choice, and should not be faulted. But physicians like Dr. Koenig will continue to take the calculated risk of offering physical consolation to a patient. This action provides a reminder that humanity must not be lost during this time of social distancing and utmost precaution.

COVID-19 has caused adversity among health care providers, patients, and so many others. It is easy to focus on negativity when it seems that the world has been thrown into chaos. But even amidst that chaos, stories of compassion, resilience, and selflessness have been brought to the forefront of healthcare. We are seeing inspiration in the ways that healthcare providers are engaging with their patients, their students, and their peers. Physicians are finding new ways to heal, even when it seems impossible, and theirs are the stories that will endure, long after COVID-19 has become a thing of the past. ✶

Lung Ultrasound in COVID-19 *continued from page 35*

become fomites. Institutions should implement best practices to clean the machine to be able to use it between multiple patients. These measures should include limiting the number of probes in the room, using probe covers during aerosolizing procedures, and paying particular attention to both cleaning and disinfection. Some hospitals are designating ultrasound machines for COVID-19 patients only. For more details on mitigating nosocomial spread and proper cleaning with regards to ultrasound in COVID-19, see the ACEP Guideline on COVID-19: Ultrasound Machine and Transducer Cleaning.

Conclusion

Lung POCUS is becoming more popular in COVID-19 patients to aid in diagnosis and characterization of severity of disease. As the incidence and prevalence of COVID-19 pneumonia fluctuates within the community, there is potential for ultrasound to play a role in prognosticating and risk-stratifying patients in the ED, especially those who toe the divide between requiring inpatient monitoring and outpatient follow-up. Further prospective studies are required to appraise this application. ✶

Calling 911 on Climate Change

A Matter of Public Health

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The oft-quoted mantra in emergency medicine is "anyone, anytime, anywhere." We are the front line and safety net of our health care system. We are trained to respond in any emergency, whether big or small. There is increasing recognition in the house of medicine that climate change is not just an issue for scientists and politicians, but for our patients.

A Public Health Emergency

According to a recent *New England Journal of Medicine* article,[1] climate change is a health emergency with numerous effects on human wellbeing. There are direct health impacts such as traumatic injuries from increasingly severe natural disasters, and indirect impacts as well, including food insecurity from drought, increasing spread of insect-borne diseases, and exacerbations of chronic lung disease from air pollution.

It is largely the direct impacts of climate change that will be increasingly felt by the EM community, but indirect impacts are affecting our most vulnerable our patients as well: whether the elderly woman with no access to air conditioning who presents with heat stroke on an abnormally hot summer day, or homeless patients seeking shelter from a severe winter storm, or the chronic asthmatic who presents in extremis on a day when air quality levels are exceptionally low.

In the 2018 article "Climate Change and Health: An Urgent Call to Academic Emergency Medicine" published in the *Journal for Academic Emergency Medicine,*[2] Renee Salas, MD, argues that the public health harms of climate change:

"...disproportionately affect children and elders, the poor, and those with chronic diseases—the patients we see in our EDs. Globally, those most affected are the least responsible. Thus, there are practical and ethical imperatives for academic emergency physicians to become climate and health champions."

Systems Impacts

Climate change threatens our patients' health, but it also threatens our ability to provide care. For example, the neighborhood where Boston Medical Center is located is particularly at risk for one climate impact: storm water flooding. It is predicted[3] that by the 2030s, 11% of the neighborhood will be flooded during storms, and with just 40 additional years, the number goes up to 26%. Our emergency and radiology departments are located on the ground level of our hospital, so such flooding could devastate our ability to provide basic emergency care. The impact[4] of Superstorm Sandy on New York City hospitals also serves as a warning for vulnerable coastal hospitals. Power generators located in hospital basements failed, leaving elevators inoperable for evacuating patients. NYU Langone ended up spending $1.5 billion on repairs and fortification for future storms. Perhaps we should also consider the preemptive installation of flood barriers and other protections that would allow hospitals to remain functional in the event of severe storm water flooding. Flooding, wildfires, and power blackouts from severe storms are just some examples of the potential impact of climate change on health care delivery.

A Call to Action

It's time to embrace the power physicians have to make a difference — if not in mitigating climate change, then in mitigating the impact on our patients, especially those with the fewest resources to protect them.

There is plenty of room for action. First, medical schools should include climate and health in their curricula to educate future physicians on this important social determinant of health. In review of the AAMC's Curriculum Inventory there are no listed curricula explicitly addressing climate change and human health. The current presence or variety of climate and health, or "environmental health" related content in medical school curricula is unknown.

Similarly, there is a need for increased research on the topic, including ways that natural disasters will impact the delivery of care in our EDs and hospitals, specific climate-related health effects on our various patient populations and, for example, whether these effects impact the increasing numbers of ED visits around the country.

Finally, physicians are well-suited as advocates for action on climate change. We hold a unique and trusted position in the public sphere, and have an obligation to use our voices to amplify the discussion around this public health crisis. The Medical Society Consortium on Climate & Health is one great resource for physicians looking to get involved. Physicians for Social Responsibility (PSR) also work as advocates for environment and health issues.

Climate change is arguably the health care emergency of our time. Let's get to work. ✶

LANGUAGE JUSTICE

One Step Toward Health Equity

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Patient safety has been a prime issue in health care since the 1999 Institute of Medicine (IOM) report *To Err is Human*, which led to adverse event tracking and quality improvement measures in almost every facet of health care delivery. One facet that poses a challenge includes native and spoken language.

Patients for whom English is not their primary language and who have difficulty communicating in English present unique challenges in the provision of safe, high-quality care. The U.S. Department of Health and Human Services (HHS) refers to this barrier to care as Limited English Proficiency (LEP). Historically, the safety issues relating to LEP patients have not been adequately tracked or considered in quality improvement assessments.[1] Patient safety could be jeopardized because of missed portions of the history and physical examination, omitted details, and lack of clarity of discharge instructions, to name a few possible reasons. As a result, patient safety can be jeopardized due to language barriers, particularly in the noisy, chaotic environment of an emergency department where the need for timely and effective communication is paramount.

Imagine the following clinical scenario:

You are a patient with LEP; Spanish is your primary language, and you called 911 because you have had fever, a cough, and shortness of breath. You did not go to the doctor's office because you lack insurance, you have a busy work/family schedule, and you certainly wanted to avoid the expense of an ED visit. You are picked up by EMS who recognize your distress, put a non-rebreather on you, but you cannot communicate with one another due to the language barrier. Imagine how scared you must be.

When you arrive in the emergency department, health care workers bustle around you; they put in IVs, get a chest x-ray, EKG, draw blood cultures, and ask you about your health problems. Your physician attempts to use the interpreter phone, but the interpreter can't hear you over the non-rebreather, so they search for someone with Spanish-speaking ability in the department. One of the staff members in broken, high-school level Spanish is able to determine a very basic story, but misses vital components of your past medical history, current meds, and symptoms leading to your 911 call.

For many LEP patients, this is their emergency department experience. Even though language assistance is mandated under Title VI of the 1964 Civil Rights Act, inadequate interpretation is an unfortunate reality. Consequently, it should be no surprise that LEP patients have less understanding of their medical conditions, higher rates of ED recidivism, and worse outcomes than their English proficient counterparts.[2] Health equity for LEP patients is a complex, multifaceted problem, with quality interpretation being just one part of the puzzle. The purpose of this article is to give concrete suggestions for learning about language access in your department and becoming a local advocate for language justice.

First, when a patient comes through your hospital's doors, does a nurse or registration worker ask, "What's your preferred language?" If the response is anything other than English, do they follow up with, "Would you like an interpreter during your visit today?"[2]

Next, look at how physicians and nurses obtain the services of an interpreter, either through a phone/video service or an in-person interpreter. As providers, we know that LEP patients are safer with a Certified Healthcare Interpreter (CHI), but you may find that there is no consistent procedure for using their services. Instead, we often try to "get by" either with our own basic-intermediate language skills or those of other staff members.[1] Hospital staff may also use a family member or friend to act as an interpreter. However, this approach is problematic because many ad hoc interpreters have no training in interpretation, are not a neutral party, may have limited exposure in health care, and are likely to be emotionally distressed by the situation.

To better understand your institution's approach to LEP interpretation, review any relevant hospital policies and inquire whether there is a specific department dedicated to language services. Talk with colleagues both within your department and other

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RECOMMENDED READING

- Price-Wise, Gail. Intoxicating Error: Mistranslation, Medical Malpractice, and Prejudice. Bookbaby, 2015.
- Betancourt JR, Renfrew MR, Green AR, et al. Improving patient safety systems for patients with limited English proficiency: a guide for hospitals. (Prepared by the Disparities Solutions Center, Mongan Institute for Health Policy and Massachusetts General Hospital and Abt Associates, Cambridge, MA, under Contract No. HHSA290200600011I). Rockville, MD: Agency for Healthcare Research and Quality; AHRQ Publication No. 12-0041. September 2012. https://www.ahrq.gov/sites/default/files/publications/files/lepguide.pdf

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EM Virtual Interviewing
TIPS AND TRICKS

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COVID-19 has led to a change in the practice of medicine and medical education. To avoid spread of disease, there is a focus on minimizing in-person contact. Restrictions have been placed on the number of people in groups and in the same area. In the field of emergency medicine, applicants and interviewers are the frontlines of health care seeing the COVID patients.

Normal applications for fellowships or residency consist of meeting the department and participating in different interviews with various members of the team. The goal is to find out your best fit and the best fit for the different programs. Generally, applicants or candidates use the in-person interview to demonstrate their personality and their strengths. However, AAMC released a statement on May 7 recommending all interviews for fellowship and residency to be virtual interviews.

How can you put your best foot forward? Virtual interviews are a change from traditional interviews, but they have been used successfully in the past for residency and fellowship positions.[2,3,5] There are many ways to optimize your success; invest in the time to determine which work best for you.

Preparation

Before interview day, download the application used by that residency program and run through a mock interview to ensure the technology works with your computer. Focus on the functionality of your camera; if the camera included on your computer is low quality, consider using an external webcam. Evaluate the performance of your speakers and sound system and consider utilizing headphones for better sound quality and to prevent feedback or echoing. If it is an application you have used before, ensure that your display name is a professional version of your actual name.

Record the mock interview to try to observe your unconscious habits, as they could become distractions. Examples include adjusting your glasses, playing with your hair, stroking your beard/mustache, chewing on your nails etc. If you see yourself doing this in the recorded mock interview you will be able to make a conscious effort to avoid this in the future. Having a friend or mentor watch the interview will give you additional perspective on any areas that can be improved.

Spend some time before your first interview learning how to optimize your internet connection and quality of the picture- explore the options available on the application you will be using. Close other programs on your computer that might make it run slower. Turn off other devices using the internet, or at least turn off their Wi-Fi connection temporarily. Find a place with a strong Wi-Fi signal, close to the router, to maximize

connectivity, or consider utilizing a wired connection if that is a possibility. All of these steps should help to avoid freezing your video or audio signal.

Just as you would prepare for any other interview, develop answers to questions you think will be asked. Explore the program's website and watch their promotional videos to become familiar with the institution. Have a list of questions that you want answered.

One of the difficulties with adjusting to remote interviewing is to get a general "feel" for a place, so try to include questions that could assist in this. Some examples are to ask about mentoring, examples of activities residents do

TABLE 1. Example Questions

Questions	Sources
Who has ownership of patients?	Residents and Faculty
Who do you present to on shift? As an intern? As an upper level?	Residents and Faculty
Availability of fellowships?	Residents and Faculty
Do residents feel ready for independent practice at the time of graduation?	Faculty
What would you change about the program?	Residents and Faculty
What is the culture of mentorship? How do residents go about finding a mentor?	Residents and Faculty
What unites residents?	Residents
How do residents and faculty get along with ancillary staff? Consulting Services?	Faculty and Residents
How often do residents hang out with colleagues or coworkers outside of shift?	Faculty and Residents

together for fun, or asking residents how comfortable they are contacting their attendings while not at work. See Table 1 for other example questions. If the option is offered, strongly consider contacting residents after the interview to try to replace the social interactions missing from virtual interviews.

Environment

The following are some ways to enhance the quality of the interview during the interview itself.

- Make sure you have a neutral light-colored background without a direct light source behind you. The light source can cause unflattering shadowing or make it difficult for the interviewer to see your face. A warm light source positioned just off to the side but shining on your face is generally the most flattering.
- A neutral background will bring you to the foreground. Try to avoid images or artwork in the background. The images and artwork, although potentially a key to your personality, can detract from what you are saying.
- There are other distractions to try to avoid during your interviews. Pets are a great example; barking, walking across the screen, or walking across the background draws attention away from what you're saying. Some ideas are to have someone else keep an eye on pets, children, etc., in a different area, or investigate other methods of keeping the room where you're interviewing quiet and interruption-free. If allowed at your institution, finding an empty classroom or office on campus may provide the quiet environment you need.

Appearance

Just like an in-person interview, dress for success. If in person you would wear a suit and tie or formal dress, wear the same thing during the interview. Groom your hair, beard, etc., just as you would for an in-person interview. Although what you are wearing on the bottom may not be shown on video, dressing professionally may serve as an unconscious reminder that this is an interview and to take it seriously. There have been multiple examples of virtual meetings where participants did not realize how much of themselves was visible on screen.

Try to look directly at the camera when you are speaking instead of looking at the screen (watch your recorded practice interview to see how both options come across). Just as meeting someone's eyes during an in-person interview, looking at the camera exudes confidence. Looking at the screen may also distract you from what you are saying or make you self-conscious. It can be helpful to look at the interviewer when they are speaking to pick up on non-verbal clues during the interview.

It's harder to project your personality through a virtual interview, and easier to come across as low energy which can be interpreted as uninterested. If sitting, make sure you are sitting upright not lounging on a sofa or bed. Consider arranging your laptop on an elevated surface so that you are standing during the interview. Practice with either option before the actual interview, watching the recorded interview for which option shows off your personality the best without creating distractions.

Keep your phone away from the computer during the interview, in addition to removing anything, such as an apple watch, that lights up or makes noise that could possibly distract you from the conversation. Just before the interview starts, make sure you turn off all alerts or pop-up windows on your computer. In a one-on-one interview especially, it is obvious if you get distracted from the conversation.

Closing Remarks

Although interviewing virtually is a change from the usual, hopefully these tips will assist in preparation and success during interview day. If you're feeling stressed about the change, consider considerable time (>$3000 per applicant[4]) and money saved as you no longer have to travel across the country, balancing completing clinical requirements with time for interviews. ✶

Language Justice *continued from page 39*

specialties, including nursing and ancillary staff, about their experiences and concerns. Gather information from an interdisciplinary group is integral in advocating for improvements.

Because the care of LEP patients touches all parts of the health care system, it is important to develop a broad base of support for this important issue. If your institution has in-person CHIs, speak with them about their experience, how they view hospital interpreter use, and what improvements they would like to see. Often, they are the most knowledgeable about language barriers to care. Also, ask your ED Operations or Safety/Quality Improvement Department if there have been previous quality improvement projects to address the needs of LEP patients. Especially if you use your own non-English language skills in the clinical setting, be sure to review your health system's policy on bilingual clinicians. In many systems, a bilingual exam is available to become a certified bilingual provider. However, if you use your non-English language skills without certification, the health system may fault you if the case has a bad outcome.

When LEP patients visit the hospital, we know their outcomes and overall experience are not equal to that of their English-speaking peers. Regardless of where you are doing your emergency medicine residency, our country's demographics are changing and it is incumbent upon us to provide high quality care to every patient, regardless of language spoken.

As emergency physicians, we treat patients when they are most vulnerable. Put yourself in their shoes, exercise curiosity about your institution's policies and performance regarding LEP patient care, and you will likely find areas for improvement. With this information, you can become an advocate for meaningful change and propose solutions that are supported by an interdisciplinary team of fellow advocates dedicated to providing more equitable, compassionate care. ✶

References available online

HEART OF EM

Coping with the Loss of a Pediatric Patient in the ED

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I will never forget my first pediatric death as a resident. It was around 5:45 am, and our shift was beginning to wrap up. I had a disposition plan for most of my patients and could almost taste the fresh air when we got the call: "10-day-old, CPR in progress, 4 minutes out." We quickly prepped the Panda warmer, the pediatric code cart, and the team. Then we waited.

As emergency physicians, we are trained to carry out complex tasks. We mentally rehearse, read, practice, and teach so that when difficult cases arise, we think clearly and concisely. We thrive in hectic environments. We feed off of medical crises and interesting cases. We bury emotions in order to offer the best care possible. However, often we forget we are human too.

Our team coded the patient just long enough for the infant's parents to see our efforts. Just long enough for them to be part of the decision to stop. Their wails echoed in the halls of the 70-bed ED and resonated in our hearts. I still hear their cries to this day.

I went home that morning and broke down. I had never felt so alone. I did not want to share this story with anyone because I did not want to make my loved ones sad. I felt guilty for crying, because they were not my tears to shed. They were the family's tears, and the baby's tears; that beautiful baby. I felt weak. I felt like it was not very "EM" of me to cry. I should be stronger.

This case was a reminder that I am human and that it is OK to feel emotions. My attending, during our debrief a few days later, told me something that has resonated ever since: *"The moment you stop feeling like this, it is time to pick another career."*

Although rare, the specialty of EM is peppered with heartbreaking pediatric

cases. Coping with death in the ED is challenging – and pediatric losses are more powerful. It helps to know what to do when a child dies, as well as what resources are available to you.

Incidence and Management

Of the thousands of pediatric deaths that occur each year, approximately 20% happen in the ED.[1] These events are tragic, and an appropriately trained medical provider can make a significant difference to parents and staff.

The American Academy of Pediatrics (AAP) recommends that parents and guardians be offered the option to be present with their child during medical procedures.[2] Although they do not make recommendations on their presence during resuscitation efforts, the Emergency Nurses Association (ENA) and American Heart Association (AHA) both recommend that family members be offered the opportunity to be present during cardiopulmonary resuscitation.[3,4] Families tend to feel that being present is helpful in their grieving process.[5]

It is also essential to use a team-based approach. Examples of team members include social workers, child-life workers, chaplains, spiritual leaders, mental health professionals, emergency medical technicians, paramedics, nurses, and physicians. The team must have open communication, know their roles, and be sensitive to the desires of the family.

Effective counseling has a positive impact on the family's ability to cope.[6] One member of the team should be assigned to be with the family continuously during the resuscitation to answer questions, explains procedures, and if possible, let the family know the child did not suffer.[7]

The emergency physician ultimately has the responsibility of notifying the family of the child's death and the circumstances around it. When this falls to you, take these steps:

- Ensure the appropriate family members are gathered in a safe, quiet area with enough space.
- Sit at eye level with the family and introduce yourself as the physician who cared for their loved one.
- Determine what the family members know before explaining what happened.
- Inform the family of the child's death in a direct statement, such as "we did everything but [child's name] died." It is important to know and use the child's name in the conversation.
- Answer any questions, and (when possible) reassure the family that their child did not suffer. If possible, they may reassure the family that they did nothing that contributed to the event.[8]

It is important to offer family members time to be with their child after death, as this is a critical part of the bereavement process.[9] Care should be taken to clean the resuscitation area and make the child presentable. Cover any disfiguring wounds as much as possible with clean towels or sheets. Parents also find that collecting small mementos from their child helps with bereavement. Kits can be kept in the ED to make imprints of the child's hands or feet, and bags can be stored for taking their belongings.

The ED team must also notify the patient's pediatrician, as they will be a vital source of support for the bereaved family. Offer support and know what resources your ED has for bereaving families. Most important, the emergency physician and every other member of the care team must remember that compassion in communicating bad news is a crucial therapeutic tool. Surveys show that parents value health care providers who are honest, caring, and approachable and who speak in lay terms that match the pace of the parents' processing and understanding.[8]

Finally, it is important to provide emotional support to the health care team involved in the event. This is often done via a debriefing; however, mental health services should be available for staff members as well. A debriefing is any meeting held following a critical event in order to review and discuss event outcomes, team performance, medical management, errors, and emotional response. The attending physician often initiates it, but any member of the team should feel comfortable doing so. Although it may seem difficult to carve out time during a busy shift, it is crucial to the healing process.[10] Staff should be encouraged to share their worries, feelings, and successes. Just as the family needs a safe space to mourn the loss of their child, the health care team needs space to grieve.

As difficult as it may be to cope with death, research shows that providers who care for dying patients find more satisfaction in their work. When given the opportunity to incorporate their experiences caring for the dying into their personal and professional lives, emergency doctors find their work more meaningful.[11] As such, it is important to share your stories with colleagues, family, and friends. Higher levels of grief are associated with coping strategies that involve emotional distancing as opposed to actively dealing with stressors.[12] Take the time to share. Our EM community is vast in size and in support. Remember you are never alone and it is OK to feel emotions.

Lastly, be mindful in practicing self-care. Often in medicine we focus so much on our patients that we forget to care for ourselves. Make sure to get adequate sleep. Exercise and eat a well-balanced diet. Take time to do the things you love, and remember it is important to experience joy again. Finally, remember you are your own person, and there is no one-size-fits all for coping strategies. ✶

TAKE-HOME POINTS

Although the first pediatric death I experienced was heartbreaking, it was essential to shaping my practice today.

- It reminded me to learn and remember the steps to take both inside and outside the ED when dealing with a pediatric death.
- It inspired me to practice and perfect my communication with family members and the entire care team, and to create mental and physical space for the family and health care team to grieve.
- It reminded me that we as physicians are allowed to feel emotion and practice self-care.

That death will stay with me forever. The child's memory encourages me to learn, grow, and succeed as an emergency physician, and I hope that it will do the same for you.

Is the Grass Always Greener?

Perspectives from EM Residents Who Switched from Other Specialties

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Emergency medicine as a specialty has become more competitive over the past several application cycles.[1] Applicants cite a variety of factors for selecting EM, with the most frequently listed reasons being a variety in clinical encounters, work/life balance, and perceived job satisfaction.[2] Early exposure to EM, presence of an EM residency program associated with the applicant's medical school, prior employment in the ED or as a prehospital provider, and completion of a 3rd year clerkship are associated with earlier interest EM by applicants, while interest in an another specialty and delayed initial exposure to EM were associated with later selection of EM.[2]

A small, but often overlooked group of EM applicants are trainees transitioning from other residency programs. The number of residents who have transferred in to EM from other specialties is also on the rise, with 27 in 2013, 31 in 2014, 35 in 2015, 48 in 2016, and 53 in 2017.[1] These non-traditional residents come to the specialty with unique experiences that inform their practice and contributions to their programs.

Get a unique insight into your chosen path from these 5 EM residents who came to emergency medicine with prior post-graduate training in another specialty.

What was your PGY year when you started EM, and what was your prior training?

Marc Cassone, DO: After PGY-1 from Internal Medicine, Geisinger Medical Center

Pierson Ebrom, DO: After PGY-3 from General Surgery, New York-Presbyterian/Queens

Matthew Fisher, DO: After PGY-3 from General Surgery, Geisinger Medical Center

Michael Howard, MD: After PGY-2 from General Surgery, Ohio State Medical Center

Hersh Mathur, MD: After completion of IM/Peds residency, Geisinger Medical Center

What attracted you to EM from your initial training program? Had you considered EM prior to your initial match?

Dr. Ebrom: EM doctors always seemed to be pretty happy. I think the lifestyle attracted me the most because they all said they enjoyed doing shift work. They all felt they had an excellent work-life balance which is something that is sorely absent from most fields of medicine, especially surgery.

Dr. Mathur: The most appealing part of EM, and the part that I still enjoy the most, has been taking care of the sub-population that I can treat and discharge from the ER. To see patients improve and return home over the course of just a few hours is not something that can be done in many other specialties.

Dr. Fisher: Looking at my surgery attendings, I saw that they seemed to be working similar, if not longer, hours. I missed quite a lot of "life events" such as weddings, funerals, and family time during my training and had little control over my schedule. I finally realized I did not want that for the rest of my career. I have always preferred the diagnosis and management of acute disease in a fast-paced setting, and EM provided me with that.

Dr. Cassone: I did my off-service EM month during July of that year and loved it. One of my EM mentors during that month told me, "You're an ED doc, you just don't realize it." I think most of my friends and co-residents knew that already as well, and I guess I was just the last one to realize it.

Dr. Howard: Initially, I was attracted to the undifferentiated acuity of emergency medicine. During my clinical rotations in third and fourth year, I became attracted to general surgery because of my personal involvement in the hands-on delivery

of definitive care as well as the mindset and discipline of the field. Although I was performing well in my surgical training, I found that my clinical interests are broader than the focused scope of practice found within the surgical specialties.

What has been the biggest surprise in EM training that you did not expect before starting?

Dr. Ebrom: The sheer breadth and range of diagnoses that you encounter on a daily basis. It was also interesting to learn how challenging it can sometimes be to manage the undifferentiated patient. When a crashing patient arrives, knowing how to efficiently and accurately discover the underlying problem is almost an art form.

Dr. Fisher: It was startling the amount of push-back and animosity that emergency physicians sometimes face from other providers and specialists. I was probably guilty of this during my surgery training as well… (EM has given me) thicker skin overall.

Dr. Mathur: On the surface, the EM schedule seems easy, but the mental and physical exhaustion after the completion of each shift was definitely unexpected.

Dr. Cassone: Shifts can seem like both a marathon and a sprint at the same time. Emergency physicians have an unique perspective on social determinants of health, risk-stratification, and community outreach that other specialties sometimes underestimate. I also didn't realize how many different career avenues there are in EM.

Dr. Howard: The pressure of managing a department with a full waiting room on a busy shift was hard to appreciate as a medical student and might be somewhat lost to residents in other specialties. The constant rotation of night/day shifts is also chronically challenging in its own way.

How do you use/apply what you've learned in your prior training?

Dr. Fisher: The hands-on procedural experience from nearly 4 years of surgery training is irreplaceable.

Dr. Howard: I also appreciate some of the communication styles used by other specialties during acute/time limited situations.

Dr. Mathur: Spending the last several years in the children's hospital, medical wards, and outpatient clinic settings has allowed me to have a good grasp on the patients who benefit most from coming in to the hospital and what conditions can reasonably be managed by a primary provider.

Any regrets about EM training after other training? What would you have done differently?

Dr. Ebrom: It was the best decision I ever made. I only wish I had gone straight into EM from the first place!

Dr. Mathur: I always make it a point to let others know that I didn't switch into EM but added it to my previous training. I find the skill set gained in EM training is very different from other specialties and can be complementary.

Dr. Fisher: I am much happier where I am at right now and definitely made the right decision for me. It was hard to leave the residents in surgery whom I had worked with for so long. We had become a little family. While dysfunctional at times, we looked out for each other. It was hard leaving the surgery attendings who had invested so much time into my training. I did not want them to feel as if they wasted their time on me. Hopefully that is not the case.

How has your training in EM been different? Are there aspects of your training that EM does well? Could do better?

Dr. Ebrom: On your days off you don't feel completely exhausted, and you actually have the energy to not only take care of yourself but to also study.

Dr. Fisher: While I no longer work the long 24-28 hour shifts anymore, I feel that I work much harder during my shifts. I don't think you can understand how hard seeing 20 or so patients in 9 hours, along with managing their care and documentation, is until you actually do it. In the long run though, those days make you a more efficient and effective doctor.

Dr. Howard: I love how much direct attending interaction I receive as opposed to the resident team general surgery model, although there are trade-offs as well.

Dr. Cassone: The academic EM model provides a great way for residents to have increasing levels of responsibility through their training while always have an attending present for feedback. I think EM in general is ahead of the curve in terms of medical education with all the podcasts, simulation opportunities, blogs, FOAMed, etc. Excited to see how other specialties are catching on.

What plans for the future do you have (ie, fellowship, observational medicine, urgent care, academic, etc)?

Dr. Mathur: I hope to split my practice between hospitalist and emergency medicine work and eventually create a niche in observation medicine.

Dr. Ebrom: I'm going to start working as an attending in a community hospital this summer.

Dr. Cassone: Working in the community and considering academic emergency medicine down the road.

Dr. Fisher: I would eventually like to work in some aspect of medical education.

Advice/tips for residents wanting to switch into EM?

Dr. Mathur: A big part of any residency training is learning the intricacies of the hospital system you function in. If I were to do it again, I would have given more consideration to training in a different system for the primary purpose of seeing how things are done differently in various systems.

Dr. Ebrom: EM is getting more and more competitive each year, so it's important to build a strong resume…the process can be intimidating, but don't be afraid to get the ball rolling and it's a good idea to start by asking your program director for help.

Dr. Fisher: Do and be what makes you happy. Reach out to people in your program that you trust for advice. Your education and training are a large part of your life that should be putting you in a position to have a successful future so use that time wisely. It is never too late to reset or change course.

Dr. Cassone: Find an EM mentor. Join EMRA. For better or worse, you only go through residency once!

Dr. Howard: Use every last shred of every network and contact you have. ✶

"Brews and News"

An Innovative, Resident-Driven Model for Wellness and Topical Discussions in an Emergency Medicine Residency

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Resident-driven, extracurricular topical discussions can improve and support resident wellness in an emergency medicine (EM) residency. Geisinger Medical Center has developed an innovative, collaborative model that serves as a means of social bonding and a venue for discussing various topics that may not fit into traditional EM curricula. The name "Brews and News" sets the stage for social interaction and fellowship, to discuss topics affecting emergency medicine residents and physicians — it is not a suggestion or sponsorship of alcohol consumption.

Background

Wellness has emerged as a crucial part of emergency medicine training and practice. The definition of wellness varies from individual to individual, but includes sleep hygiene, nutrition and fitness, access to mental health resources, and the enigmatic "work-life balance." Given the association between burnout and medical errors,[1] and increased risk of mental health disorders and suicide in physicians,[2] the benefits of wellness cannot be understated.

Many residency programs have developed wellness curricula[3,4] that provide a multi-faceted approach to improving resident wellbeing, both professionally and personally. A potentially high yield strategy for fostering wellness is strengthening residents' social connections, which has been shown to have a positive effect on their wellbeing.[5,6] There are factors unique to emergency medicine that likely contribute to the specialty's higher burnout rate compared to physician peers in other specialties.[7,8] These factors are often concentrated while in residency, which intensify both the challenge and opportunity to address these factors, which include shift work and social support.[9]

We describe a model educational innovation for wellness and topical discussion that has been developed by residents at the Geisinger Medical Center Emergency Medicine residency program. This innovation has created a unique, resident-driven wellness activity to provide for socialization and camaraderie and to promote bonding and important discussions outside of the hospital. Dubbed "Brews and News", this monthly, evening, off-campus gathering of residents, medical students, and faculty has shown benefits to all those who participate.

Innovation

"Brews and News" is held monthly for several hours in the evening at an off-campus venue such as a restaurant or faculty home. The event is sponsored usually by an employer, or other organization with a relationship to the specialty of emergency medicine. The sponsor is approached by residents and approved by program leadership. The sponsor has the opportunity to discuss their organization briefly during the event. "Brews and News" was developed at the same time that our residency assimilated journal club into the on-campus, didactic curriculum schedule rather than an evening event. Resident champions for the program, with input from their fellow residents and faculty, plan an event and select topics to discuss (Figure 1).

While residents set the agenda and select the activities and discussion topics, faculty, medical students, and families also are invited. This creates an informal opportunity to relax and learn about each other outside of the structure of didactics, clinical responsibilities, and journal club. Further, this format encourages discussion of topics that impact residents, faculty, and families in emergency medicine (Table 1).

Implementation

Despite the name, "Brew and News" is not predicated on alcohol consumption or solely on current events. The title sets an informal tone for these monthly events. We stress that these events should be resident-driven in terms of location, time, and topics discussed. We chose one "Brews and News" champion from each resident class (can include the Wellness Chief/Resident) to help arrange sponsors, location, dates and time and encouraged input from residents and faculty on topics of interest. In our model, we found holding events once a month and at a variety of easily accessible and new locations (including restaurants, brewpubs, faculty/resident homes, outdoor parks with barbeque facilities) allowed us to keep the events both consistent and helped to maximize attendance. The majority of events had meals sponsored by a variety of groups such as staffing companies, financial advisors, fellowship directors, and local hospitals. In addition to sponsors, our program encouraged attendance and input from medical students and resident's significant others (clinical and non-clinical) which helped not only with wellness and recruitment but also helped provide a variety of perspectives on topics.

Topics discussed during "Brews and News" varied widely, with most being

outside of the realm of peer-reviewed scientific literature, focusing instead on issues such as current events, challenges of residency, job market issues, or humanities in medicine. Depending on the topic, that event's moderator (either "Brews and News" resident champion or other resident who volunteered) would submit 1-3 articles (depending on length and topic) to help frame the discussion. We encouraged a variety of input materials including articles from newspapers, medical blogs, YouTube clips, or podcasts. Keeping the events optional, resident-led and in an informal, low-pressure environment encouraged open discussion and exchange of ideas. We found that inviting input first from medical students, followed by residents, and then lastly from attendings as a method of encouraging exchange from a variety of perspectives and experiences and allowed for conversations not typically encountered in a structured journal club.

Several "Brews and News" events each calendar year included physical wellness and team-building activities such as a short canoe trip, bowling, a "rage room", all followed by drinks, food, and conversation. During the COVID-19 pandemic a take-out meal with online video chat allowed for "Brews and News" to continue.

Outcomes

In the 2 years since its implementation, we have seen multiple intangible positive outcomes. In addition to providing a regular event for bonding and wellness, it has also become an informal, open environment for engaging discussions of various topics outside of the traditional EM didactic curriculum. A resident-driven event such as this also has given residents leadership opportunities in roles such as curriculum design and moderating discussions, important skills in both community and academic settings. Additionally, it has provided a key tool for recruitment of medical students by introducing them not only to the program, but also to the residents, and provided a venue for residents to interact with prospective employers, including fellowship opportunities.

Lessons Learned

Various challenges to implementation exist. Most important, attendance is key. A balance of keeping these events routine (monthly) yet flexible is critical to success. Our model worked well in the evenings, as our journal club has been moved from monthly evening meetings to our morning didactics. Selecting a variety of different venues with sponsored food and drinks encourage attendance. Finally, because residents select topics of interest, there is investment and engagement in robust discussions.

Participation in the discussion is important but can sometimes be difficult depending on the topic, reinforcing the need to keep topic selection up to residents. Sending articles ahead (we found 5-7 days the ideal lead time) is key to an informed discussion. Moderators should come prepared with important questions or summary statements to spur discussion. Programs may decide to discuss political or other polarizing topics related to medicine; while these can be engaging and eye-opening exchanges, resident-moderators must ensure an environment of open, civil discourse.

When choosing a venue, ensure your group will have a private or semi-private space with enough room for all participants, a layout that encourages open dialogue, and remains out of earshot of other groups, as sensitive topics related to medicine might be discussed. Many venues will arrange a separate side room or rent out the entire space. Sponsors help fund these events outside of department budgets and often provide insight on various topics and opportunities. Good attendance and open communication with sponsors (before and after the event) are key to maintaining good relationships for future events.

Transitioning leadership of "Brews and News" for continuity and consistency can also be challenging. Our model encourages a champion from each post-graduate year residency class to help organize the events, as a way to share the responsibilities of event planning, establish continuity, increase resident buy-in, and help ensure diversity of venues and discussion topics.

Conclusion

We present "Brews and News" as a model for integrating wellness and resident-driven extra-curricular topical discussions that supplements as a format to run separate but in complement to the traditional journal club format. While challenges to implementation exist, including timing, attendance, and competing events, these can be overcome by keeping the schedule flexible and resident-driven to encourage participation and to maximize the many benefits including wellness, resident-leadership, and fruitful discussion on topics important to today's trainees. ✶

TABLE 1. Sample Brews and News Event Itinerary

Details	Thursday, March 20, Martin's Bistro and Brewpub, 6:30-8:30 pm
Sponsor	Dr. Ryan Fitzgerald from Calgary Community Hospital
Topic	Mentorship
Recommended Pre-Reading	• Long B, Koyfman A. Mentoring and Emergency Medicine – Part 1&2 http://www.emdocs.net/mentoring-emergency-medicine-part-1 • Yeung M, Nuth J, Stiell IG. Mentoring in emergency medicine: the art and the evidence. CJEM. 2010;12(2):143-149.
Introduction	
Meal	Participants arrive. B+N chair introduces sponsor, who then speaks about their mission and future opportunities for residents.
Group Discussion	Food is ordered and obtained
Potential Talking Points for Discussion	PGY-2 volunteer summarizes articles and hosts discussion for group. Medical Students/Interns are encouraged to speak first, followed up upper level residents, and finally attendings.
Conclusion/ Socialization	• How have mentors affected your education/career thus far? • What do you look for in a mentor? • How do you view mentorship in our program? Med School? Post-graduation? • Examples of mentoring students/peers? • Attributes you'd like to replicate when you mentor?
	Discussion is wrapped up. Participants are encouraged to socialize with peers, faculty, and sponsor.

ABEM News

ABEM Certification Moves to MyEMCert

Exam dates have been set for the 2020 online ConCert Exam administrations: July 27–Aug. 16 and **Nov. 2–22**

Beginning in spring 2021, ABEM-certified physicians will be able to meet continuing certification requirements by completing 4 MyEMCert modules (online and open book, approximately 50 questions each) instead of taking the ConCert Exam. The switch to MyEMCert will emphasize relevant content, save emergency physicians time and money, and better accommodate their busy schedule. **ABEM will no longer offer ConCert after 2022.** Starting in 2021, **ABEM will move to a 5-year certification period** for physicians when they next recertify. Specifically, any certificate awarded or renewed in 2021 and after will be for a 5-year duration. It's important to note the move from a 10-year to 5-year certification length will not increase total requirements or increase the cost to stay certified. This change is in response to physician requests to use MyEMCert to recertify sooner. **By moving to a 5-year certification period, physicians will now be able to use MyEMCert to recertify starting in 2021**.

As physicians move to a 5-year certification period, **ABEM will also move to an annual fee structure**. We recognize this change affects physicians differently based on where they are in their current continuing certification process. ABEM has set a cap on fees paid by physicians so no physician will pay more than $1,400 to renew their certification. This approach levels the costs associated with certification. ABEM has identified physicians who have exceeded this fee cap and will issue a refund.

Visit the ABEM Reqs section of the website at www.abem.org or email staycertified@abem.org with questions. ✶

ABEM Announces New Officers

Mary Nan S. Mallory, MD, MBA, is the newly elected ABEM president. Dr. Mallory has been a member of the Board of Directors since July 2012 and was elected to the Executive Committee in 2019. She has served ABEM in a number of capacities, including as Chief Examiner and Editor for the Oral Certification Examination and Co-editor of the In-training Examination. Dr. Mallory received a medical degree from the Joan C. Edwards School of Medicine at Marshall University and completed an EM residency at the University of Louisville School of Medicine.

Others elected to the Executive Committee are:

- **Jill M. Baren, MD, MS, MBA, Immediate-Past-President.** Dr. Baren is provost and vice president of academic affairs at University of the Sciences in Philadelphia. She is Emeritus Professor of Emergency Medicine, Pediatrics, and Medical Ethics at the Perelman School of Medicine, University of Pennsylvania. Dr. Baren practices clinically at Penn Medicine and The Children's Hospital of Philadelphia.
- **Marianne Gausche-Hill, MD, President-Elect.** Dr. Gausche-Hill is Medical Director of the Los Angeles County Emergency Medical Services Agency, Professor of Emergency Medicine and Pediatrics at the David Geffen School of Medicine at UCLA, and clinical faculty member at Harbor-UCLA Medical Center Departments of Emergency Medicine and Pediatrics.
- **Samuel M. Keim, MD, MS, Secretary-Treasurer.** Dr. Keim is Professor and Chair of the Department of Emergency Medicine at the University of Arizona College of Medicine, and a professor in the Division of Epidemiology and Biostatistics at the Mel and Enid Zuckerman College of Public Health. He practices clinically at Banner University Medical Center in Tucson.
- **Ramon W. Johnson, MD, MBA, Member-at-Large.** Dr. Johnson is a full-time partner in Mission Viejo Emergency Medicine Associates at Mission Hospital Regional Medical Center in Mission Viejo, California, and Medical Director of the Doctor's Ambulance Company, Laguna Hills, California.
- **Lewis S. Nelson, MD, Senior-Member-at-Large.** Dr. Nelson is Chair of the Department of Emergency Medicine, and Chief of the Division of Medical Toxicology at Rutgers New Jersey Medical School; and Chief of Service at the University Hospital of Newark.

All ABEM Executive Committee members are clinically active emergency physicians. ✶

ABEM to Pilot Virtual Oral Exam in 2021

The COVID-19 pandemic has resulted in ABEM adapting to the ever-changing environment. The most recent development is the aggressive exploration of transitioning the current Oral Exam format to a virtual Oral Exam. **The virtual Oral Exam will be piloted and then fully implemented in 2021**; information from the pilot experience will inform further design, development, and administration of a virtual Oral Exam, post-COVID. ✶

Annals Names New Resident Fellow

Each year, *Annals of Emergency Medicine* selects a Resident Fellow (formerly the Resident Editor) to serve on the Editorial Board. Laura A. Dean, MD, of Harvard-Affiliated Emergency Medicine Residency, has been selected to serve as the Editorial Board Resident Fellow for the coming year.

Christopher S. Evans, MD, MPH, from Vanderbilt University Medical Center, is the immediate past Resident Fellow for the journal. Dr. Evans began his term in October 2019. His service concluded in October 2020.

The resident fellow works with submissions to the "Residents' Perspective" section of Annals. Abstracts can be submitted at www.editorialmanager.com/annemergmed (use the "Residents' Perspective" article type). If your abstract is approved, you will be asked to write the full-length article for the "Residents' Perspective" section. If you have any other questions for Dr. Dean, contact her at annalsfellow@acep.org.✶

ECG Challenge

Matthew Rizzotti, DO
ChristianaCare
Emily Luvison, MD
ChristianaCare

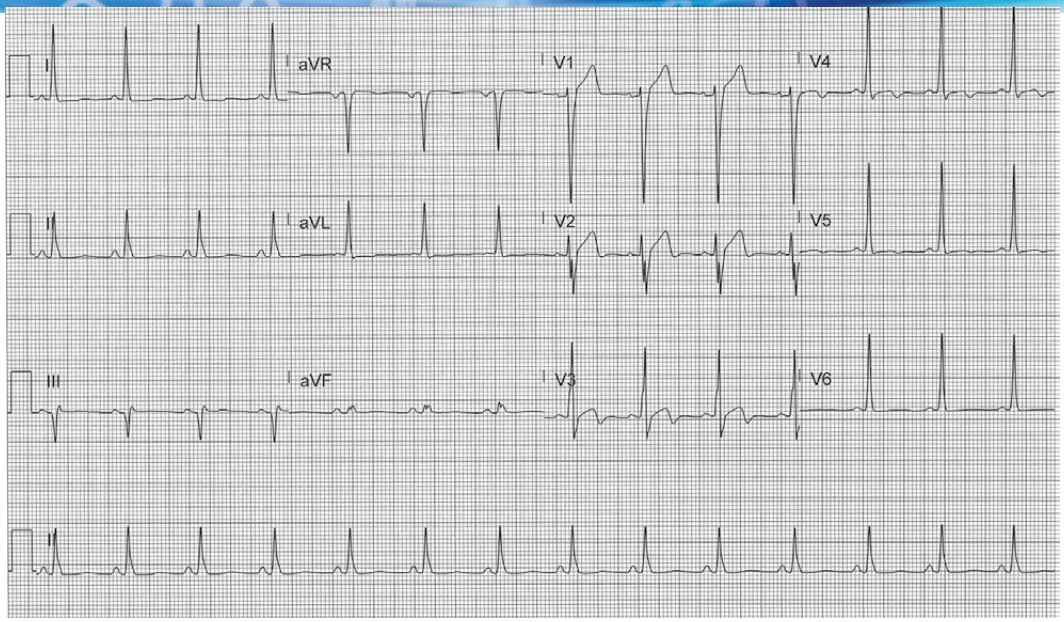
Jeremy Berberian, MD
Associate Director of Resident Education
Dept. of Emergency Medicine,
ChristianaCare
@jgberberian

CASE.

A 72-year-old male with a history of hyperlipidemia presents to the ED after an episode of exertional chest pain which has since resolved. What is your interpretation of his EKG?

What is your interpretation of his ECG?

See the ANSWER on page 50



ECG Challenge

This EKG shows a normal sinus rhythm with a ventricular rate of 82 bpm, normal axis, normal QRS duration, normal intervals, and biphasic T-waves in leads V2-V3. These findings, in the context of the patient's history, are concerning for Wellens' syndrome.

Wellens' syndrome, also called "LAD coronary T-wave syndrome," describes an abnormal T-wave pattern seen in a pain-free state with recent history of anginal symptoms and is suggestive of a critical proximal LAD stenosis. It was first described in 1982 by Dutch cardiologist Dr. Hein J.J. Wellens, who found that 75% of patients with this pattern developed an extensive anterior STEMI if they did not receive coronary intervention.[1]

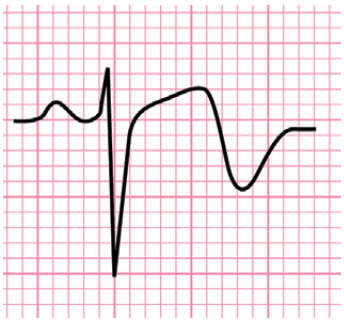
The pathophysiology of Wellens' syndrome is thought to involve a transient LAD occlusion which spontaneously resolves. Patients typically describe anginal pain which has resolved, and the characteristic EKG findings are seen in a pain-free state. These EKG findings represent coronary reperfusion, similar to what is seen after successful PCI.

Wellens described 2 T-wave patterns: biphasic T-waves (type A), which are an early finding, and deeply inverted T-waves (type B), which are a later finding and more common (up to 75% of cases). The full diagnostic criteria include:

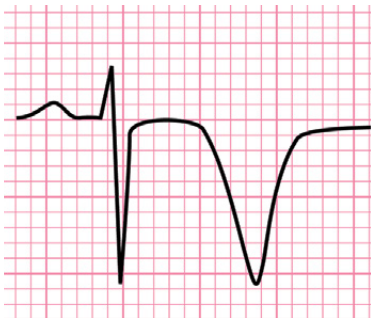
- Biphasic (type A) or deeply inverted (type B) T-waves in precordial leads, typically V2-V3
- Isoelectric or minimally elevated ST-segment (< 1 mm)
- No precordial Q-waves
- Preserved precordial R-wave progression
- Normal or minimally elevated troponins
- Onset of action is hours to days, so not indicated for acute hyperkalemia treatment

Of note, though bicarbonate was traditionally considered an element of the hyperkalemia treatment regimen, there is no literature to suggest a benefit when used in patients with hyperkalemia with normal pH. Bicarbonate infusions may have a role in the treatment of academia in patients who are concurrently hyperkalemic.

Wellens' Type A



Wellens' Type B



Note that there is no universal definition for a preserved precordial R-wave progression, but common criteria include:

- R-wave > 2–4 mm in V3 or V4
- R-wave in V4 > V3 or V3 > V2
- R-wave in V3 ≥ 3 mm

The AHA addresses the type B pattern thus:

- "The specific pattern of deeply inverted T waves with QT prolongation in leads V2 through V4 should be interpreted as consistent with severe stenosis of the proximal left anterior descending coronary artery or with a recent intracranial hemorrhage."[2]

Patients with these EKG findings in the appropriate clinical context have a high likelihood of developing an anterior MI and should be admitted for an urgent, but not necessarily emergent, cardiac catheterization. Provocative testing (eg, stress testing) should be avoided as it could precipitate an MI.

WELLENS' SYNDROME LEARNING POINTS

- Wellens' syndrome describes an abnormal T-wave pattern seen in a pain-free state with recent history of anginal symptoms
  - Type A: biphasic T-waves seen immediately upon reperfusion
  - Type B: deeply inverted T-waves, later finding
- These findings represent critical stenosis of the proximal LAD and warrant admission for cardiac catheterization
  - Provocative testing should be avoided as it could precipitate an MI

Case Conclusion

This patient was admitted to the cardiology service and a cardiac catheterization showed a 95% occlusion of the proximal LAD. ✶

References available online

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1. An ill-appearing 6-year-old boy presents with a high fever, inspiratory stridor, accessory muscle use, and a barky cough that has worsened over the past hour. His mother says he had a positive flu test 10 days ago and that he can breathe better when he is flat on his back. Nebulized racemic epinephrine is administered, after which the stridor is unchanged. His SpO_2 is 90% on room air. What is the best next step in management?
   A. Administer dexamethasone and repeat nebulized racemic epinephrine
   B. Prepare for intubation and administer intravenous antibiotics
   C. Provide suctioning and supplemental oxygen only
   D. Start intravenous antibiotics and order a chest x-ray

2. A 58-year-old woman presents with sharp chest pain. Her medical history includes chronic uncontrolled hypertension, and her blood pressure is 190/100. Which diagnostic test is most likely to help rule out aortic dissection?
   A. ABG
   B. Chest x-ray
   C. D-dimer
   D. ECG

3. A mother brings in her 2-year-old son after he choked on a peanut. Which symptom would indicate that the foreign body is in his bronchus?
   A. Drooling
   B. Hoarseness
   C. Stridor
   D. Wheezing

4. In the setting of a benzodiazepine overdose, flumazenil administration is contraindicated with which coingestant?
   A. Bupropion
   B. Carisoprodol
   C. Gabapentin
   D. Phenobarbital

5. Which facial bone fracture is associated with the lowest rate of infection?
   A. Frontal
   B. Mandibular
   C. Orbital
   D. Zygomatic ✶

ANSWERS
1. B; 2. C; 3. D; 4. A; 5. D

Reference available online

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