

# EM Resident

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## Managing the COVID Airway



**The Pediatric Elbow  
Near-Death by Nasal Packing  
Developing a Diversity Pipeline**

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# Post-Match

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

**HAPPY post #matchday!!**

**If there's one anxiety-provoking day in a young physician's life,  
it's Match day.**

I still remember the EXACT time, place, and overwhelming emotions I experienced when I found out I matched into my No. 1 choice of EM residency. The nights leading up to the match were filled with apprehension, racing thoughts, loss of sleep, and pendulation between overwhelming excitement and crushing anxiety. It's the most career-defining (and life-defining, to a certain degree) moment of your life: four years of college, a year of research, four years of med school, all leading up to this very moment.

Some of you have gone through match day with a significant other matching with you (couple's match) or with an ideal location in mind — only adding to the anxiety and fear.

Although it is an exciting and celebratory time for many, it can also be a devastating season for those who didn't match — or who matched in locations or programs they don't feel are the best option. Just remember, it DOESN'T take away your worth. Read that again. The outcome of the match does not take away your worth!

## **Unmatched? Remain Unfazed**

If you didn't match into your choice of residency, try and try again. Our program recently matched a surgical resident and a family medicine resident; medicine can offer more flexibility than the match implies.

EM is a competitive residency, and I want to see all of you succeed. EMRA is also here to help. Reach out to us on ways to succeed in the next cycle, get involved in research, and how to make the best use of the interim year as you prepare to enter the match again.

## **Prep and Celebrate**

And for those who matched, cherish every second. Let this achievement soak in, and realize YOU did this! All too often in life and in medical school, we don't celebrate our successes enough. So, celebrate this moment with family (zoom or in-person, if vaccinated). Enjoy a nice meal and your favorite activities with loved ones. We will see you on-shift soon, doctor! ★

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Emergency Medicine Residents' Association

A healthcare worker is shown from the chest up, wearing full personal protective equipment (PPE). They are wearing a white gown, blue nitrile gloves, a teal surgical mask, and clear safety goggles. Their dark hair is pulled back into a ponytail. One hand is visible adjusting the ponytail. The background is a plain, light color.

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# Class of 2022, We're Here for You

**RJ Sontag, MD**  
EMRA President  
Mid Ohio Emergency Services  
@RJSontagMD



## What made you choose emergency medicine for your career?

I knew this was the specialty for me on my first EM rotation. After spending my third year of medical school convinced I was going to be a pediatrician, then a surgeon, then an obstetrician, then a family physician, I realized I needed a specialty that would allow me to do everything. EM gave me the chance to treat every patient, day or night, regardless of their ability to pay, all while providing a mix of acuities, procedures, and intellectual challenges. Exploring this field during away rotations reinforced my choice, and I made friends in those rotations that I remain close to.

**COVID-19 upended this process.** Last year, national EM organizations came together to provide clarity with a consensus statement outlining our approach. As the pandemic



evolves in 2021, major EM groups have once again stepped up to provide a unified roadmap to the away rotation and eSLOE process. This is so important, since **so many questions require answers this year**, such as:

- What is the earliest I can start an away rotation?
- How many EM rotations should I do this year?
- What do I do if I don't have an EM residency associated with my medical school?
- What is an eSLOE, and how many should I have this year?
- How can programs support students without a "home" EM rotation?
- How should programs address issues like COVID-19 vaccine status?

EMRA is proud to be a leader in advocating for physicians-in-training, and we were excited to help lead the development of the 2021-2022 recommendations below. Use this QR code to find this year's full recommendations with answers to those questions and more.

EMRA will also host our popular EMRA Hangouts on the 2021-2022 application season. Mark your calendar for these engaging sessions, as we will be breaking down the entire landscape piece by piece there, with updates as the situation evolves.

### We're Here for You

Have a question about this process? **Let me know.** I want to help you thrive this year, despite the uncertainty. Send me an email at [president@emra.org](mailto:president@emra.org) or reach out to us on social [@emresidents](https://twitter.com/emresidents). ★



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# CONGRATULATIONS!

EMRA is pleased to recognize the following individuals  
as recipients of EMRA's Winter 2021 Awards.

Join us for a Virtual Awards Ceremony on Sunday, April 11 at 7 pm Central.

**Bo Burns, DO, FACEP**

University of Oklahoma School  
of Community Medicine

*EMRA Chair of the Year*

**Jason Seamon, DO, MHS, FACEP**

Spectrum Health/  
Michigan State University

*Residency Director of the Year*

**David Peak, MD**

Massachusetts General Hospital

*Associate Residency Director  
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**Robert Dixon, DO**

Stanford University

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**Jeffrey Tadashi Sakamoto, MD**

Stanford University

*Chief Residents of the Year*

**Kelli Jarrell, MD**

University of Cincinnati

*Fellow of the Year*

**Cindy Chang, MD**

Harbor-UCLA Medical Center

*EMRA Resident of the Year*

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Harbor-UCLA Medical Center

*Jean Hollister Contribution  
to Prehospital Care Award*

**Thomas Ems, MD**

Prisma Health

*Rosh Review  
One Step Further Award*

**Chelsea Harrison**

Northwestern University

*Residency Coordinator  
of the Year*

**Samita Heslin, MD**

Stony Brook University

*Academic Excellence Award*

**Fiona Chen**

Brown University

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**Ashley Penington**

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*Dr. Alexandra Greene  
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*Critical Care Medicine  
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Boston Medical Center

*FeminEM FIX 2021*

**Uche Nkemdilim Erica**

Medical Student

*SAEM Annual  
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EMRA  
AWARDS



# Management of the COVID-19 Airway

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**T**here are many perspectives available and early data to guide our management of COVID-19 patients that present with respiratory failure. This article will review practice-altering data and the approach used by the authors at their institution with success. These

hypoxic and crashing patients are difficult to manage, with the added challenge of provider safety being ever-present. The decision of oxygen delivery method, escalation of care, physiologic goals, and intubation procedure will be discussed below.

## Background

COVID-19 is a viral respiratory infection caused by a positive sense RNA coronavirus that binds type 2 alveolar cells, intestinal epithelial cells, and vascular endothelial cells via the ACE2 receptor. This viral syndrome is marked by hypoxemic respiratory

failure with decreased surfactant levels, direct cytopathic effect on pneumocytes, lymphocytic pneumonitis, and acute fibrinous organizing pneumonia leading to diffuse alveolar damage. Other aspects of this illness include a cytokine storm as well as disseminated intravascular coagulation with marked systemic inflammation and direct endothelial injury.<sup>8,11</sup> The most likely and significant modes of transmission are droplet and contact transmission, with aerosol/airborne transmission being possible but less likely to contribute to severe disease burden.<sup>4</sup> Infection prevention and control measures must include a variety

of personal protective equipment, viral filters for respiratory support machines, consideration for aerosol-generating procedures (AGPs), and the possible role of drying agents or antimuscarinics. Goals in immediate care and resuscitation of the person-under-investigation (PUI) for COVID-19 in respiratory failure include decreased work of breathing, oxygen saturation greater than 90%,<sup>2</sup> and improvement in mental status and other markers of end-organ perfusion.

### Initial Evaluation and Measures

Patients should be transferred into a negative pressure room as soon as possible, receiving oxygen via a face-mask device if necessary (related to “dispersal distance” of potentially infectious droplets/aerosols specific to oxygen delivery methods reviewed below). Minimal personnel should be exposed to the patient at this point in care, including physician, nurse, and respiratory therapist, with other personnel donned with PPE available to help outside the room. The minimum PPE to be worn by health care workers in contact with the patient includes an inner and outer pair of gloves, gown, n95 or PAPR, and sealed goggles.

### Choosing Oxygen Delivery Method

The key considerations in choosing an oxygen delivery method are the patient’s physiologic requirements and the risk of exposing providers to potentially infectious particles. The amount of oxygen deliverable (FiO<sub>2</sub>) and the dispersal distance of aerosols/respiratory droplets vary with each device and choices may also be institution-dependent. Based on high-fidelity mannequin studies, the following oxygen delivery methods are listed in order of increasing dispersal distance of aerosol; Non-rebreather mask (NRM), HFNC, nasal cannula, venturi mask, simple mask, nebulizer, NIPPV.<sup>3</sup> The traditional nasal cannula can provide approximately 45% FiO<sub>2</sub> with a dispersal distance of 40 cm. Venturi masks and simple masks provide approximately 50% FiO<sub>2</sub> with dispersal distances of approximately 40 cm as well. NRMs provide FiO<sub>2</sub> of approximately 90% and have a dispersal distance of only

10 cm, making this the ideal method of oxygen supplementation with regard to both amount of oxygen delivered and safety profile for healthcare workers. Many of these COVID-19 respiratory failure patients will require more than just additional oxygen, however. When supplemental O<sub>2</sub> alone cannot improve the patient’s condition, one must consider high-flow oxygen systems (like the high flow nasal cannula [HFNC]) and non-invasive positive pressure ventilation (NIPPV) such as BiPAP or CPAP. HFNC can provide high FiO<sub>2</sub> while boasting a dispersal distance of only 5-17 cm. This method decreases work of breathing and dead space while providing a small amount of positive end-expiratory pressure (PEEP). It involves oxygen-rich humidified gas with precisely set flow levels and oxygen concentrations.<sup>5</sup> Importantly, the use of HFNC during the SARS-CoV outbreak in 2003 in Toronto did not contribute to the risk of HCW transmission.<sup>6</sup> Even though HFNC seems to be the clear winner when choosing how to give extra oxygen, it must also be stressed that this device may still not be enough. Failure of HFNC may be indicated by requirement of vasopressors, worsening RR and asynchrony, and possibly the ROX index greater than 4.88. The ROX index is a score created by Roca, et al. that combines respiratory rate, oxygenation status, and HFNC settings to generate an objective measure to predict failure of this form of non-invasive ventilation and indicate the need for endotracheal intubation.<sup>7,10,9</sup> NIPPV is not an ideal choice for the safety profile of HCWs. Dispersal distances up to 95cm or greater with BiPAP are intimidating, and if patients are requiring high levels of oxygen as well as positive pressure ventilation with clinical worsening, the patient may require endotracheal intubation to precisely control respiratory mechanics and reduce staff exposures. One way to minimize the viral dispersal is to use a BiPAP mask on a ventilator with viral filter in place on the expiratory limb to create a closed circuit, something that is not possible with BiPAP machines. Similarly, nebulized breathing treatments are also risky, and should be replaced with MDI treatments whenever possible.

### Intubation

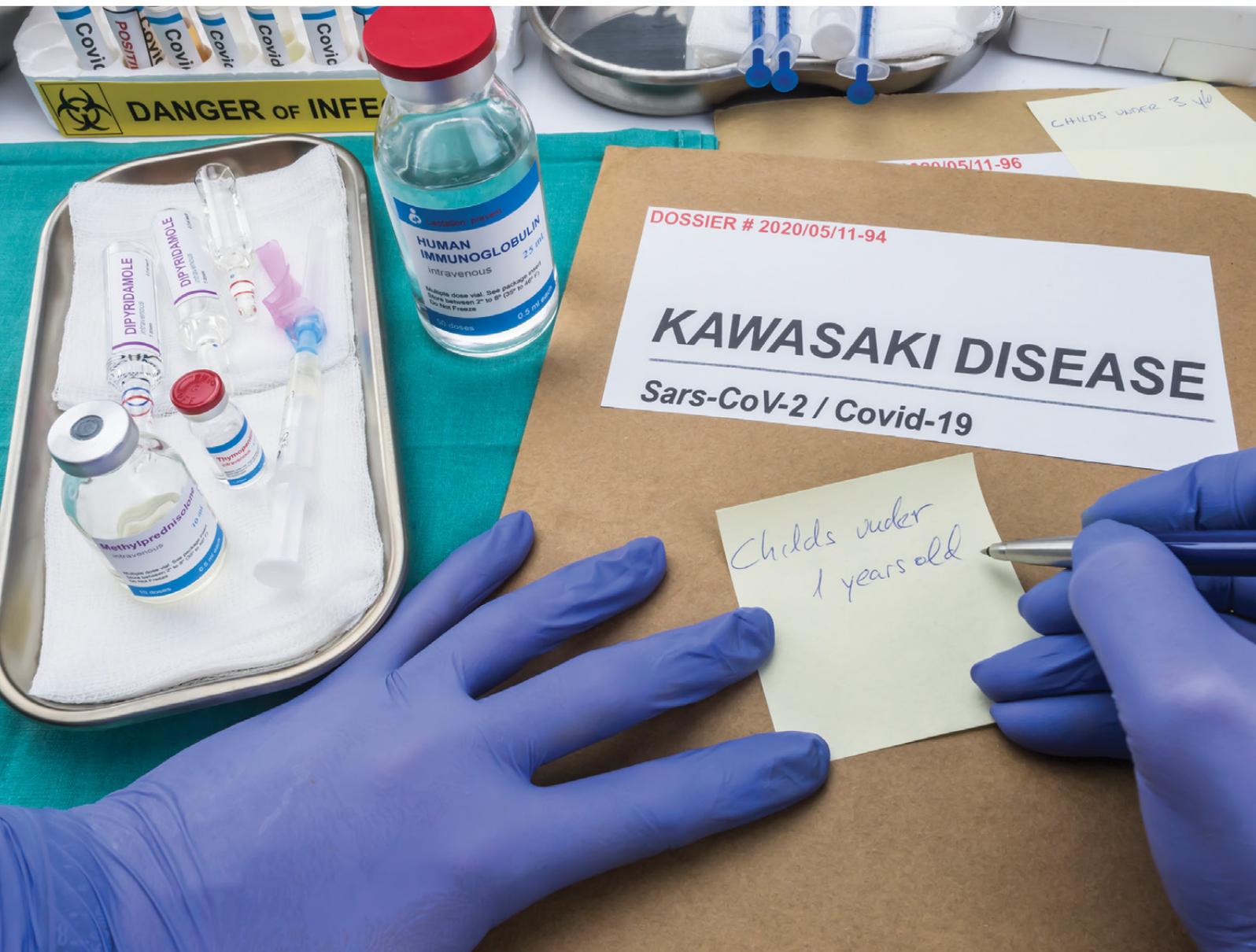
The use of a checklist method may be helpful in preparing for intubating patients, to minimize the opening of doors in negative pressure rooms as well as staff exposures.

- Preoxygenate: use a combination of HFNC with maximal settings with a NRB mask placed over the patient’s nose and mouth.
- Delayed sequence intubation vs Rapid sequence intubation: consider DSI if there is a concern for the ability to ventilate the patient once sedated and paralyzed. Ketamine should be the induction agent of choice for DSI and is a reasonable choice for RSI as well. Alternatively, etomidate can be used. Use rocuronium for paralysis for prolonged effect unless otherwise contraindicated.
- Fiberoptic intubation: avoid direct laryngoscopy when possible to reduce exposure during this AGP. An intubation box may be used over the patient as a physical barrier to respiratory droplets and aerosols. Consider leading with a bougie in anticipation of a difficult airway to increase the chance of first-pass success.
- Initial ventilator settings: LPV and APRV should be used to manage the significant atelectasis associated with COVID-19 respiratory failure and ARDS. ★

### TAKE-HOME POINTS

- The COVID-19 respiratory failure patient poses many challenging aspects of care. Healthcare workers are at risk of becoming infected when working in close proximity with patients, especially during AGPs. Liberal use of PPE and judicious use of personnel are key to reducing HCW exposures. The safest and most effective ways to provide respiratory support before endotracheal intubation are HFNC and NRB, which may be used in combination as well. Intubate with extreme caution using fiberoptic technology and consider DSI when appropriate.

# Kawasaki Disease or MIS-C?



**Blair Gaines, MD**  
University of Miami  
Jackson Health System

While emergency physicians have become more accustomed to managing COVID-19 in adults, the knowledge regarding how the virus affects children still lags behind. A major concern for the physician is discharging a child who presents with mild upper respiratory or gastrointestinal symptoms only to have the patient return to the ED several days to weeks later, presenting with Multisystem

Inflammatory Syndrome in Children (MIS-C). Fortunately, approaching this rapidly progressive and potentially fatal disease process under the larger umbrella of a Kawasaki-Like Hyperinflammatory Syndrome<sup>1</sup> can help guide management in a condition where early diagnosis and intervention are crucial to survival.

## Case

A 4-year-old previously healthy Hispanic female presented to the ED with a diffuse rash and facial swelling, concerning for an apparent allergic

reaction. She was rushed into the treatment area for evaluation of possible anaphylaxis and respiratory assessment. She was tachycardic with a heart rate of 130, tachypneic, and borderline hypotensive for her age. Initial exam was negative for wheezing or stridor, but she had edema of the face and neck with a red maculopapular rash covering her face. Epinephrine IM, diphenhydramine PO, and methylprednisolone IV were given to treat anaphylaxis.

Additional information from the mother revealed no prior history of

anaphylaxis, no new food/medication ingestions or topical exposures, no known allergies, and no significant past medical history. Of note, she had been seen in the ED 3 days earlier, diagnosed with strep pharyngitis, and discharged after treatment with IM penicillin G. The patient was tearful, ill-appearing, and withdrawn. On a quick review of systems, mom reports that over the past 5 days her daughter initially had a high fever (102° F) and sore throat, followed by anterior neck swelling on day 2, with vomiting, diarrhea, and the rash presenting on day 4. On secondary examination, the patient was noted to be febrile in the ED, and physical exam was significant for diffuse blanching maculopapular rash, tender cervical lymphadenopathy, dry lips, conjunctivitis, and bilateral hand and foot edema and erythema. While her presentation was most consistent with Kawasaki disease, given the current pandemic, MIS-C was also high on the list of differential diagnoses. Other diagnoses considered included other viral exanthems (EBV, CMV, measles, adenovirus), scarlet fever, toxic shock syndrome, staphylococcal scalded skin syndrome, Stevens-Johnson syndrome, allergic reaction, and sepsis.

### ED Course

Considering MIS-C as a likely alternative diagnosis, a slower approach to fluid resuscitation was utilized instead of the traditional 20 cc/kg bolus used in sepsis/septic shock, due to risk of development of acute heart failure. Vital signs and repeat physical exam were essentially unchanged following the first 10 cc/kg NS bolus, so an additional

10 cc/kg bolus was administered. Ceftriaxone and vancomycin were also initiated in the ED, with blood and urine cultures pending at the time of admission. EKG showed sinus tachycardia. Chest X-ray was negative for pneumonia or any other acute cardiopulmonary findings. Additional laboratory workup is seen below. She was admitted to the Pediatric ICU for further management of Kawasaki disease vs. MIS-C (see figure).

### Discussion

**Kawasaki Disease (KD)** is the second most common vasculitis in children after Henoch-Schönlein Purpura affecting small-to-medium size arteries. It has replaced rheumatic heart disease as the most common cause of acquired heart disease in children in developed countries. The disease was identified by Dr. Tomisaku Kawasaki in the 1960s, who described it as acute febrile mucocutaneous lymph node syndrome. It usually affects children < 5 years old and appears to peak in the months of January and June/July.<sup>2</sup> Development of the disease also appears to be influenced by regional and genetic factors, notably in individuals of Asian descent. KD is generally self-limiting and rarely fatal, with an in-hospital mortality rate of only 0.17% in the U.S. Almost all deaths attributed to the disease result from cardiac complications. A significant factor in overall prognosis is the time to diagnosis and initiation of appropriate treatment. Coronary artery aneurysms occur in up to 25% of untreated children and peak mortality is seen in days 15-45 following the onset of fever.<sup>3</sup>

Despite more than 50 years of

studying KD and linking it to a post-infectious process, no definitive cause has been determined.<sup>4</sup> Attempts at identifying a viral cause appeared promising when Dr. Kawasaki observed a relative spike in children presenting with symptoms consistent with this syndrome following a coronavirus rhinitis outbreak in Japan. However, later studies provided inconsistent results and failed to establish a link between acutely infected coronavirus patients and KD.<sup>5</sup>

### MIS-C is defined by the CDC as:

- Patients aged <21 years presenting with fever, and laboratory evidence of inflammation, and evidence of clinically severe illness requiring hospitalization with >2 organ system involvement
- No alternative plausible diagnosis
- Positive for current or recent COVID-19 infection by PCR, serology or antigen testing, OR exposure to a suspected or confirmed COVID-19 case within the past 4 weeks<sup>6</sup>

Although our patient was negative for COVID antigens and antibodies, it is possible that she may have cleared the infection by the time she developed KD symptoms. Furthermore, it is important to note that the novelty of the virus leads to uncertainties regarding the sensitivity and specificity of COVID-19 RT-PCR testing as well as antibody detection and interpretation. Recent studies, although limited by size and duration, have shown that these Kawasaki-like symptoms can develop weeks after exposure to COVID-19, and the majority of patients are not acutely infected with the virus at the time of presentation.<sup>7</sup> Generally, antibodies are fairly reliable 4 weeks

138	102	21 (H)	86	9.7	11.9	230	35.5	<b>Ca++: 9.1</b>	<b>T.Bili: 3.8 (H)</b>
4.4	12 (!)	0.51						<b>Lactate: 1.6</b>	<b>Alb: 3.8 (L)</b>
								<b>Trop: &lt; 0.012</b>	<b>NT-proB NP: 771 (H)</b>
								<b>AST: 60(H)</b>	<b>D-Dimer: 1.67 (H)</b>
								<b>ALT: 93 (H)</b>	<b>Ferritin: 259 (H)</b>
								<b>Alk Phos: 388 (H)</b>	<b>LDH: 813 (H)</b>
<b>VBG: 7.31/31/87/15</b>			<b>ESR: 70 (H)</b>	<b>EBV Ig: Negative</b>					
<b>Lymphocyte %: 13.2 (L)</b>			<b>CRP: 32.5 (H)</b>	<b>COVID PCR: Negative</b>					
<b>Absolute Lymph: 1.3 (L)</b>			<b>Procalcitonin: 3.74 (H)</b>	<b>COVID Ig: Negative</b>					

post-infection; however, some studies have shown that even in patients with positive RT-PCR results, 19% may be IgG seronegative at 4 weeks following exposure and up to 40% at 8 weeks.<sup>8</sup>

There is also significant overlap in symptomatology and pathophysiology of the two disease processes. Initial studies have provided strong evidence showing that COVID preferentially targets the protein angiotensin-converting-enzyme 2 (ACE2) on endothelial cells resulting in a systemic vasculitis similar to that seen in KD.<sup>9</sup> This evidence is further supported by the fact that MIS-C generally presents with physical exam findings consistent with a diagnosis of atypical KD. Additionally, in both severe MIS-C and KD Shock Syndrome, there may be associated left heart systolic dysfunction and significant hypotension requiring vasoactive medications for hemodynamic support.<sup>10</sup> KD has also been associated with multiple viruses, including the seasonal coronavirus strain linked to the common cold. With this knowledge and understanding, it may be more appropriate to describe this disease process as COVID-19 associated KD instead of trying to differentiate between MIS-C and KD.<sup>5</sup> It is possible that MIS-C has been improperly classified as a separate entity from KD, when perhaps it is the same post-viral process we have been studying for years with Kawasaki Disease. The major difference in this case is that SARS-Cov-2 would be the first virus simultaneously linked to Kawasaki Disease and a global pandemic.

Considering these factors, in combination with the high prevalence of asymptomatic COVID carriers within the population, the presence of GI symptoms, and lab results that were consistent with an acute inflammatory syndrome, MIS-C remained high in the list of differential diagnoses.

## Diagnosis

No single test provides a definitive diagnosis of KD. The diagnosis is based on clinical presentation and supported by characteristic laboratory abnormalities. According to the AHA, in order to make a diagnosis of Typical KD, a child must have a fever for at least 5 days AND have 4 of the 5 additional

physical exam findings:

- Conjunctivitis (bilateral, painless, non-purulent)
- Mucocutaneous changes (cracked lips, strawberry tongue, erythema, pharyngitis)
- Polymorphous rash (diffuse, macular, may be scarlatiniform)
- Extremity changes (erythema, edema, desquamation)
- Lymphadenopathy (generally cervical and unilateral)

Patients with 5 or more days of fever and < 4 of the above findings should be considered for atypical KD with additional laboratory testing.<sup>11</sup> If CRP >30 mg/L and or ESR >40 mm/hour; and if positive echocardiogram OR 3 or more of the below criteria are positive, patients should be treated as atypical Kawasaki.

- Anemia for age
- Platelets >450 x 10<sup>6</sup>/microliter after the 7th day of fever
- Albumin level <30 g/L
- WBC count of >15 /microliter
- Urine >10 WBC /HPF

More severe disease, termed Kawasaki Shock Syndrome, often requires the use of vasopressors for hemodynamic support and is associated with increasingly high levels of CRP, procalcitonin, d-dimer, and IL-6.<sup>12</sup> Elevations in NT-proBNP and troponin reflect cardiac inflammation and edema as opposed to myocardial ischemia.<sup>10</sup>

## Management

Urgent echocardiogram is recommended for all cases of confirmed or suspected KD due to coronary artery manifestations. Although early treatment within 10 days of fever onset may prevent coronary artery pathology, recent studies have shown that up to 44% of patients will have coronary artery ectasia or aneurysms at the time of hospital presentation.<sup>3</sup> Myocarditis and acute heart failure may also be seen.

Standard therapy for patients with KD involves IVIG (2 g/kg over 10-12 hours) and high dose aspirin (80-100 mg/kg/d divided into four separate doses). After fever resolution, the dose of aspirin is decreased to 3-5 mg/kg/d. IVIG can result in elevated ESR, thus changes in ESR should not be used as a gauge for disease progression or resolution.

Steroids are indicated for IVIG resistant patients. Other agents have been seen in smaller trials to improve outcomes, notably Infliximab and Abciximab, however, more prospective studies are needed before they can be widely recommended.<sup>3</sup>

The clinician must be aware of the risk of recurrence, especially in children < 3 years old at the time of diagnosis. Repeat echocardiograms are indicated at 2 weeks and 6-8 weeks following hospital discharge. Patients should continue taking aspirin daily and may stop once the echocardiogram at the 6-8 week follow-up visit is negative for coronary artery abnormalities.

## Case Conclusion

*The patient received treatment with IVIG upon admission and had an uncomplicated inpatient course. Transthoracic echocardiogram showed normal cardiac structure and function with no evidence of proximal coronary artery aneurysm or ectasia. Initial urinalysis was consistent with UTI but repeat urinalysis the day following admission was negative. Stool PCR studies were positive for Enteropathogenic E. coli (EPEC). She continued to improve and was transferred to the floor after 2 days in the Pediatric ICU. Blood and urine cultures were also negative after 48 hours and antibiotics were discontinued. Parotid gland ultrasound showed cervical LAD. She was discharged on hospital day 4 with a diagnosis of Kawasaki Disease based on her negative COVID studies and relatively quick recovery. Her parents were instructed to continue giving her aspirin daily for continued prevention of complications related to coronary artery aneurysm.*

*She was seen in the pediatric cardiology clinic 2 weeks and 6 weeks following discharge from the hospital. Her mother noted persistent bilateral hand and foot swelling at the 2-week visit, but by 6 weeks, all symptoms had resolved. Repeat electrocardiograms and echocardiograms at those visits were reassuring with normal cardiac structure and function. Daily aspirin was discontinued, and she was scheduled to follow up in the clinic again in 6 months. \**

# TEE in the ED

## Role of Transesophageal Echocardiography in Cardiac Arrest

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Cardiac arrest is one of the most demanding presentations for emergency physicians to manage, due to its diagnostic uncertainty and time-sensitive complications. High-quality chest compressions have been shown to increase survival and improve neurological outcomes.<sup>1</sup> Focused transthoracic echocardiography (TTE) can identify critical, potentially reversible, pathology during cardiac arrest: tension pneumothorax, cardiac tamponade and hypovolemia.<sup>2,3</sup> However, TTE results in prolonged chest compression pauses<sup>5</sup> and may compromise high-quality CPR. TTE is limited by impediments to images generated through the skin surface, such as defibrillation pads, body habitus, and gastric air. Focused transesophageal echocardiography (TEE) has emerged as an alternative to TTE that overcomes these limitations and has the added benefit of improving, rather than hindering, the delivery of chest compressions.<sup>5</sup>

### Advantages

The transducer used in TEE is inserted into the esophagus and allows for visualization of clots in transit, clots in the pulmonary arteries, aortic dissections and cardiac tamponade. TEE permits the optimization of real-time chest compressions relative to cardiac anatomy, which is particularly useful for people whose left ventricle, the target of chest compressions, is not located beneath the sternum. For example, radiologic studies

have found that the left ventricular outflow tract, aortic root or aortic valve are located beneath the center of the sternum in 50% to 80% of patients. Therefore, TEE-directed modifications could be used to optimize cerebral perfusion.<sup>5,6</sup> TEE can also be used during post-arrest care for procedural guidance, including extracorporeal life support and placement of a temporary pacemaker.<sup>5</sup>

### Risks

The safety of TEE in cardiac arrest has not been studied directly, so the complications can only be deduced from ambulatory TEE examinations. Major complications such as oropharyngeal trauma, esophageal perforation and major bleeding events are rare with incidences reported as less than 1%. Additionally, since TEE can obtain life-saving information without compromising high-quality CPR, the risk-benefit ratio for TEE in cardiac arrest is extremely favorable.<sup>5</sup>

### Practicality and Value

In a resuscitative setting, TEE occurs after endotracheal intubation.<sup>5</sup> TEE transducers require specific storage and cannot stay with the machine, so it is recommended to designate an easily-accessible storage location.<sup>5</sup> A recent study focused on TEE in ED cardiac arrest found that it was achievable to perform a focused TEE exam early in resuscitation and that TEE had a therapeutic or prognostic impact in 97% of the cases.<sup>8-11</sup>

### Imaging Protocol

The American College of Emergency Physicians (ACEP) published a three-view (mid-esophageal 4-chamber, mid-esophageal long-axis, and transgastric

short-axis views), goal-directed protocol for TEE in cardiac arrest, which represents the minimum standard-of-care.<sup>9</sup> The protocol was designed with an appreciation for the scope of ED echocardiography and emphasizes efficiency, redundancy and views that are anatomically like familiar TTE views.<sup>9</sup>

A recent prospective observational study consisting of thirty-three patients presenting to the ED with out-of-hospital cardiac arrest used a four-view protocol for post-intubation TEE during cardiac arrest.<sup>11</sup> TEE was used to assist with diagnostic uncertainty, evaluate cardiac activity and determine CPR quality through AMC assessment. All participating physicians completed standardized training consisting of at least eight hours of didactics, high-fidelity simulation and a minimum of ten proctored examinations.<sup>11</sup>

The four-view protocol was obtained in 100% of cases, with an average ED door to TEE time of 12 minutes, which supports the feasibility of TEE in the setting of cardiac arrest.<sup>11</sup> TEE was found to have a diagnostic, therapeutic or prognostic impact in 97% of cases. Per this protocol, a mid-esophageal bicaval view was obtained in addition to the three-views suggested by ACEP. The authors report that this view aided with the initiation of extracorporeal life support in 21% of cases, which suggest that best practices for TEE during cardiac arrest may consist of a four-view protocol, like the one provided in this study.<sup>11</sup>

### Future Work

For TEE to become a widespread practice throughout emergency departments in the United States, future work is needed to assess its impact on patient outcomes, cost effectiveness and to ensure resources are available for providers to meet training requirements. The main use of TEE in the ED has been cardiac arrest, but indications will likely expand to include intubated, septic patients and patients requiring hemodynamic monitoring. ★

	Mid-esophageal 4 Chamber	Mid-esophageal long-axis	Trans-gastric short-axis
<b>Structures</b>	4 chambers, mitral and tricuspid valves, pericardium	LA, LV, mitral valve, aortic valve, pericardium	Ventricles, pericardium
<b>Goal</b>	Assess cardiac activity, cardiac tamponade, intracardiac thrombus, L V and RV function/size, fine ventricular fibrillation	Left-sided function, aortic and mitral valve movement, pericardial effusion	Assess ventricular function, ventricular function/size
<b>TTE Counterpart</b>	Apical 4 chamber	Parasternal long	Parasternal short

# How to Approach the Pediatric Elbow

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**Here it is: the dreaded pediatric elbow. Is it a fracture?  
An ossification center? Shouldn't there be a bone there?  
No, it's Superman.**

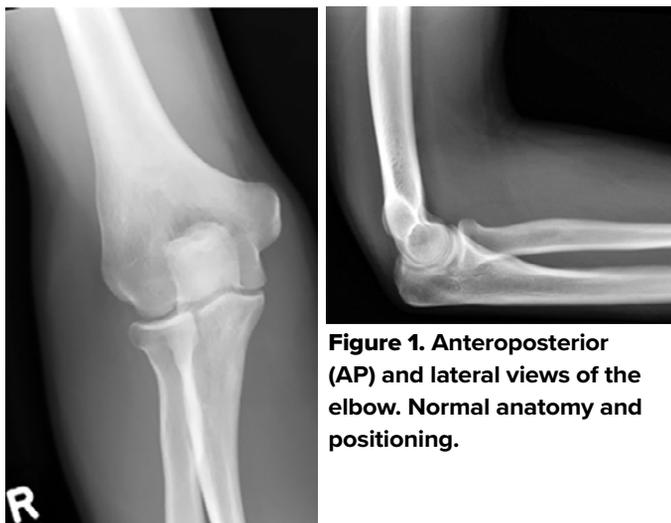
Radiographic assessment of acute pediatric elbow trauma requires a firm grasp of developmental anatomy, radiographic landmarks, and common injury patterns. By using a systematic approach to reading elbow x-rays delineated below, you can begin to feel more confident and adept at evaluating the subtle signs of pediatric fractures.

## Why is the pediatric elbow difficult?

The challenge comes from the complex developmental anatomy with multiple ossification centers that mature at different ages. The multiple ossification centers may be difficult to differentiate from fractures in the acute traumatic setting. Familiarity with age-variable anatomy is crucial for an accurate diagnosis.

### 1. Ensure adequate films

An AP film should be obtained with the elbow in full extension and the forearm supinated (*Figure 1*). For the true lateral projection, the elbow should be flexed 90 degrees with the forearm supinated. The routine use of comparative views is not recommended, as it comes at a considerable cost of radiation exposure to the child;<sup>1</sup> several studies have shown that the routine use of comparative views does not alter patient management.<sup>2,3</sup>



**Figure 1. Anteroposterior (AP) and lateral views of the elbow. Normal anatomy and positioning.**

### 2. Look for joint effusion and soft tissue swelling

The elbow fat pads are situated external to the joint capsule. On a true lateral radiograph, the normal anterior fat pad is seen as a radiolucent line parallel to the anterior humeral cortex; and the posterior fat pad is invisible.

Distention of a structurally intact joint causes displacement of the fat pads — the posterior fat pad moves posteriorly and superiorly and becomes visible; the anterior fat pad becomes more sail-like.<sup>4</sup> (*Figure 2*)

On the lateral x-ray of the elbow, a joint effusion can be inferred when there is displacement of the anterior fat-pad or presence of the posterior fat pad. An elbow joint effusion without a visible fracture seen on radiographs can suggest an occult fracture and should prompt further evaluation.



**Figure 2. a. Normal appearance of the anterior fat pad. b. Effacement with a sail-like appearance of the anterior fat pad (arrow). There is visualization with superior displacement of the posterior fat pad, related to joint effusion (arrowhead).**

A study by Major et al.<sup>5</sup> showed that a joint effusion without visible fracture seen on conventional radiographs is often associated with an occult fracture and bone marrow edema on MRI. The study found that 57% of imaging where the only finding was joint effusion had a fracture and 100% had bone

marrow edema on MRI. In cases where an occult fracture is suspected, follow-up radiographs in 7-10 days can be obtained to evaluate for the presence or absence of sclerosis or periosteal new bone formation as indicators of healing. For suspected occult fractures, standard of care remains posterior elbow splinting with follow-up radiographs at 7-10 days.

### 3. Check bone alignment

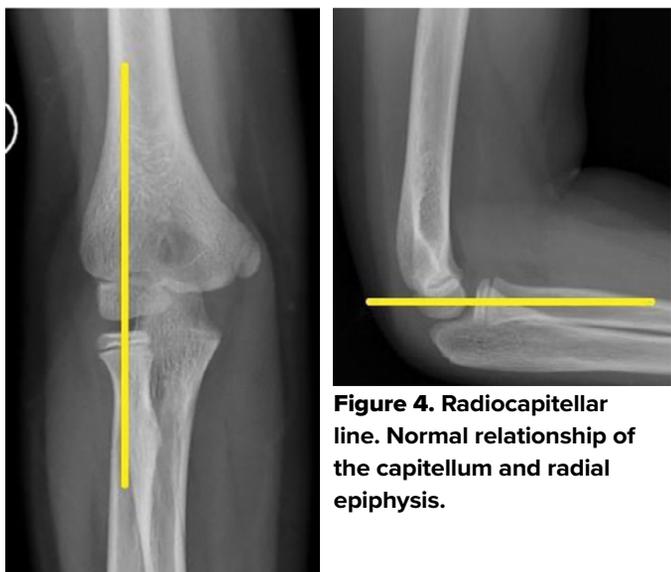
The anterior humeral and radiocapitellar lines are used to assess elbow alignment. The lines assess the geometric relationship of one bone to the other. Malalignment usually indicates fractures.

The *anterior humeral line* is drawn along the anterior cortex of the humerus and should bisect the middle third of the capitellum. Malalignment indicates a fracture – in most cases, posterior displacement of the capitellum in a supracondylar fracture. This sign relies on adequate ossification of the capitellum and therefore is reliable in children over the age of 4 years only.<sup>6</sup> *Figure 3*

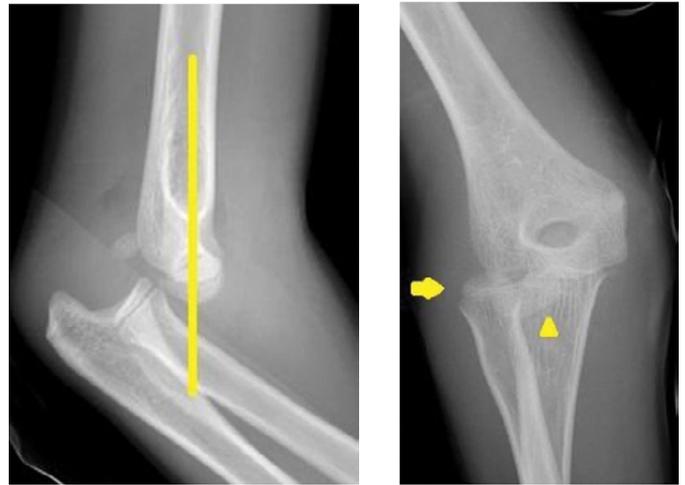


**Figure 3. a. Normal anterior humeral line, dissecting the middle third capitellum. b. Anterior displacement of the anterior humeral line, with posterior position of the capitellum.**

The *radiocapitellar line* evaluates the relationship of the proximal radius to the capitellum on all views (*Figure 4*). If the integrity of this line is compromised, then dislocation should be suspected (*Figure 5*)



**Figure 4. Radiocapitellar line. Normal relationship of the capitellum and radial epiphysis.**

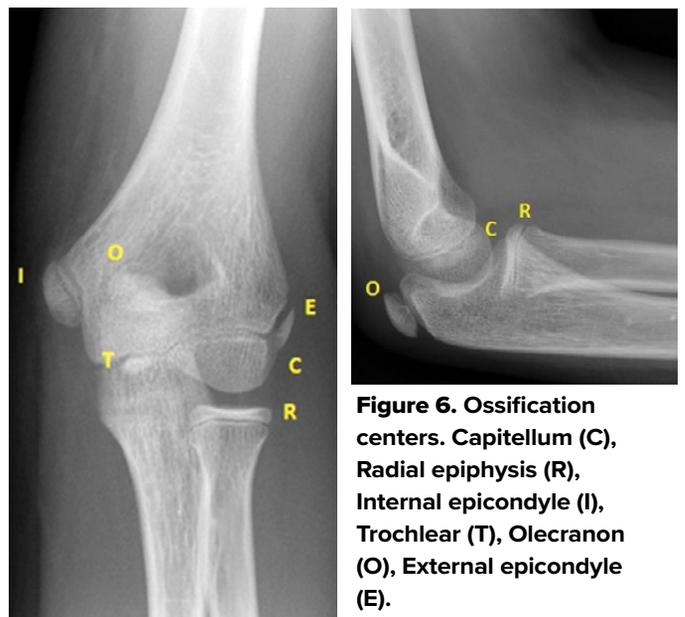


**Figure 5. Alteration of the radiocapitellar line, with posterior dislocation of the radius and ulna with respect to the humerus.**

### 4. Identify ossification centers

There are 6 secondary ossification centers in the elbow. They ossify in a sex- and age-dependent predictable order. CRITOE is a mnemonic for the sequence of ossification center appearance. (Table 1 and Figure 6)

Ossification Center	Females	Males
<b>C</b> Capitellum	1-2	1-2
<b>R</b> Radial Head	3	5
<b>I</b> Internal (Medial) Epicondyle	5	7
<b>T</b> Trochlea	7	9
<b>O</b> Olecranon	9	10
<b>E</b> External (Lateral) Epicondyle	11	12



**Figure 6. Ossification centers. Capitellum (C), Radial epiphysis (R), Internal epicondyle (I), Trochlear (T), Olecranon (O), External epicondyle (E).**

The medial epicondyle fuses to the shaft of the humerus at 13 years for females and 15 years for males. The growth plates are vulnerable to traction or shearing forces which result in fracture and/or apophyseal injuries. Displaced epicondyle fractures can be missed if the normal pattern of ossification development is not recognized.<sup>7</sup>

## 5. Identify Distal Humeral Fractures

Distal humeral fractures in pediatric patients include supracondylar, lateral condylar, medial epicondylar, medial condylar, and lateral epicondylar fractures. It is vital to correctly identify the fracture, as management varies greatly depending on the fracture (and severity). Following is a review of these fractures.

### A. Supracondylar fractures

- a. The most common pediatric elbow fracture is the supracondylar fracture, accounting for 50%-70% of cases, with a peak age of 6-7 years old.<sup>8</sup> At this age, significant bony remodeling of the supracondylar process occurs, causing cortical thinning and predisposing to fracture. Falls onto an outstretched hand account for 95% of supracondylar fractures, causing hyperextension stress on the elbow.<sup>8</sup> The severity of a supracondylar fracture is identified using the Gartland classification, which is helpful in delineating management. Important complications of supracondylar fractures include neuropraxia (including anterior interosseous nerve, radial nerve, and ulnar nerve palsies) and vascular compromise. (Figure 7)



**Figure 7. Supracondylar fracture. Non-displaced supracondylar fracture (arrow) associated with joint effusion (b).**

### B. Lateral condylar fractures

- a. Lateral condylar fractures are the second most common pediatric elbow fracture, accounting for 10%-15% of elbow fracture, with a peak age of 6-10 years old.<sup>9</sup> Patients usually present with lateral elbow pain after a FOOSH with the forearm in supination, creating a varus force on the elbow. A nondisplaced lateral condylar fracture is often very subtle and challenging to detect on conventional radiographs.

Joint effusion and soft tissue swelling may provide secondary signs as to the presence of the lateral condylar fracture. (Figure 8 a,b)



**Figure 8. Lateral condylar fractures. a. Mildly avulsed lateral condylar fracture. b. Complex comminuted lateral condylar fracture.**

### C. Medial epicondylar fractures

- a. Fractures of the medial epicondyle make up approximately 12% of all pediatric elbow fractures.<sup>10</sup> These fractures are typically due to valgus stress at the elbow joint such as from a posterior dislocation, a fall, or throwing, and usually occurs as an avulsion fracture.<sup>10</sup> Peak injury is between 7-15 years old. Usually, patients will present with their elbow in flexion with associated pain at the medial aspect of the joint. Throwing mechanisms of injury may be described by patients as a “popping” sensation just prior to onset of pain. (Figure 9 a,b)



**Figure 9. Medial epicondyle fractures. a. Avulsed medial epicondyle fracture. b. Avulsed medial epicondyle with an intra-articular position (arrow).**

#### D. Medial condylar fractures

- a. Medial condylar fractures are uncommon, accounting for less than 1% of all distal humeral fractures in children. These fractures usually occur in children 8-14 years of age after a fall onto an outstretched hand. Typically these fractures present with medial soft tissue swelling with pain in the condylar region. It is difficult to distinguish between these and medial epicondylar fractures, however, these usually are NOT related to dislocation.<sup>10</sup> (Figure 10 a, b)



**Figure 10. Medial and lateral condylar fractures. a. Non-displaced medial (yellow arrow) and lateral condylar fractures (blue arrow). b. Moderate joint effusion with effacement of the anterior fat pad.**

#### E. Lateral epicondylar fracture

- a. Lateral epicondylar fractures are extremely rare and usually occur between ages 9-15 years. In the older child, these fractures are due to a direct blow to the lateral epicondylar region and are usually associated with other injuries of the elbow.<sup>11</sup> In younger children, avulsion forces from the forearm extensor muscles are responsible, likely due to a reaction mechanism.<sup>7</sup> Pain and soft tissue swelling of the lateral epicondylar region are common complaints from patients with this fracture (Figure 11).



**Figure 11. Lateral epicondyle avulsion fracture. Mild separation of the lateral epicondyle concerning for an avulsion fracture.**

#### F. Distal Humeral Epiphyseal Separation

- a. This fracture is rare and has been described in children less than 2 years of age. Common mechanisms include FOOSH, traction, and rotary forces. A considerable force is required to cause this fracture, and since young infants are not mobile enough to produce this force, non-accidental trauma must be suspected in these cases. That being said, it can also occur due to birth trauma- both vaginal delivery and cesarean section. The diagnosis can be challenging since the distal humeral epiphysis is cartilaginous and not visualized on x-rays. The most important finding is the posteromedial displacement of the radius and ulna in relation to the distal humerus.<sup>12</sup> (Figure. 12)



**Figure 12. Distal humeral epiphyseal separation. a. The capitulum, proximal radius, and proximal ulna are displaced medially. b. There is a small displaced bony fragment, just inferior to the distal humeral metaphysis (arrow), compatible with fracture through the distal humeral physis with epiphyseal separation.**

### 6. Identify Radial and Ulnar Fractures

#### A. Olecranon Fracture

1. Olecranon fractures occur in children from a direct blow to the elbow or from a FOOSH. Clinical presentation includes pain and swelling with point tenderness over the olecranon. Most fractures are greenstick fractures, however, special attention should be made in regards to whether the fracture is extra-articular vs intra-articular. Always look for an associated injury, especially dislocation/fracture of the radial head.<sup>14</sup> (Figure 13)



**Figure 13. Olecranon fracture. Non-displaced transverse olecranon fracture (yellow arrow). Associated with anterior joint effusion (blue arrow).**

### B. Proximal Radial Fracture

1. Proximal radial fractures can occur in the radial head or the radial neck. Most common mechanisms of injury include FOOSH with the elbow extended or posterior dislocation of the elbow. Patients present with tenderness over the radial head with pain localized to the lateral aspect of the elbow with pronation and supination. Radial neck fractures typically are classified as Salter Harris II fractures through the physis, and radial head fractures are intra-articular and typically occur in older children or adolescents.<sup>13</sup> (Figure 14)

### 7. Management

If a fracture is suspected, immediate orthopedic consultation is recommended. In cases of closed displaced fractures, a prompt reduction may be necessary. A fracture should be splinted in a position of function until outpatient orthopedic follow-up is available. After placement of the splint, check that the extremity is neurovascularly intact.

Upon discharge, include ED return precautions, information on splint care, and provide a sling. Cases that require immediate attention in an operating room include open reductions, inability to reduce with procedural sedation, and any contraindications to procedural sedation. \*



**Figure 14. Radial neck fracture.**  
a. Lateral cortical radial neck contour abnormality, concerning for a buckle fracture, seen also on the lateral view (b)

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# Hemoperitoneum in a Reproductive-Age Woman

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**H**emoperitoneum during pregnancy is an emergent condition that places the mother and fetus at risk. In a woman of childbearing age, the most common sources of hemoperitoneum are ectopic pregnancy and ruptured ovarian cysts.<sup>1</sup> The corpus luteum is a functional cyst that develops from an ovarian follicle during the luteal phase of each menstrual cycle. If a vessel supplying the corpus luteum ruptures, the patient may hemorrhage with blood spilling into the peritoneal cavity resulting in hemoperitoneum. We present the case of hemoperitoneum in a pregnant woman resulting from a hemorrhagic corpus luteum during her first trimester of pregnancy.

## Case

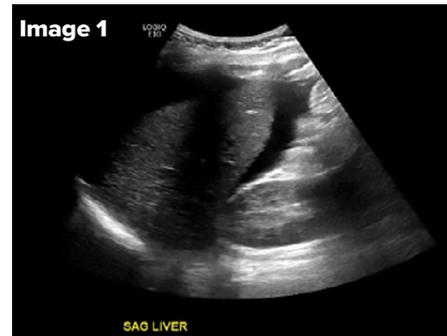
A 25-year-old G4P3003 female presented to the emergency department (ED) with a chief concern of abdominal pain and emesis since the prior evening. The patient was brought immediately to the ED resuscitation room upon arrival due to the severity of her abdominal pain as well as her vital signs. Her vitals were: BP 87/64 mmHg; HR 118; Resp 20, SpO<sub>2</sub> 100%, Temp measured 96.8 °F, BMI 23.7 kg/m<sup>2</sup>. The patient's pain had started the night before while she was laying down. She described it as severe (10/10), localized to the right upper quadrant, and with radiation to her shoulder. She had unrelenting nausea and vomited multiple times. She also had multiple episodes of non-bloody diarrhea. Her last menstrual period was 27 days prior to presentation, and she did not think she was pregnant. ROS was unremarkable. Of note, the patient's past surgical history included the removal of an intrauterine device due to displacement a couple of months ago.

In the trauma room, large bore intravenous access was obtained and resuscitation was started with one liter normal saline. A bedside RUSH exam was performed, noting free fluid in Morrison's pouch and in the splenorenal space. Laboratory findings were significant for: leukocytes  $20.9 \times 10^3$  /mL, hemoglobin 10.4 gm/dL, lactic acid 4.3 mmol/L, and a beta hCG quant 18 mIU/mL (which corresponded to an indeterminate result per the lab's reference range). The formal abdominal ultrasound showed complex free fluid suspicious for hemoperitoneum and was otherwise unremarkable (Image 1), and transvaginal ultrasound showed a structure of complex echogenicity in the right adnexa, which included a small cystic region with a surrounding thick rim, of approximately 5.9 x 7.9 x 7.7 cm. These findings were suspicions for right-sided ectopic pregnancy without an intrauterine gestation. (Image 2)

The patient was taken emergently to the operating room for diagnostic laparoscopic surgery with OB where 1500 mL of blood was evacuated and a ruptured hemorrhagic cyst ligated. The patient was discharged on post-operative day 2 after receiving one unit of RBCs and having a doubling of her beta-hCG, which provided reassurance of possible fetal viability.

## Discussion

Hemoperitoneum due to a ruptured corpus luteum in early pregnancy is a rare occurrence.<sup>2</sup> The corpus luteum is a functional cyst that develops from an ovarian follicle during the luteal phase of each menstrual cycle. The area forms a dense network of capillary vessels that enable the production of progesterone needed to maintain early pregnancy until the placenta produces its own progesterone around week eight.<sup>2</sup> Normally, if conception does not occur, the corpus luteum goes through apoptosis around the time of menstruation. If the



corpus luteum remains, it can fill with fluid or blood thereby forming a cyst.

During early pregnancy there is a substantial increase in the stability of the vessels that supply blood to the corpus luteum.<sup>3</sup> When one of those vessels supplying the corpus luteum ruptures, the patient hemorrhages into the peritoneum. Spontaneous hemoperitoneum can be a gynecological emergency, thus it is important to diagnose early and consult the gynecology service.

In the presented case, performing a bedside FAST exam was very beneficial because it immediately showed the presence of fluid in the abdominal cavity.

## Conclusion

In summary, the corpus luteum is a functional cyst that produces progesterone during early pregnancy. In rare occasions, the corpus luteum can rupture and result in hemoperitoneum and hemodynamic instability. The use of bedside RUSH exam can be used to visualize peritoneal or pelvic fluid in an unstable patient and thereby reduce the time from arrival to treatment. ★

# CAUSTIC INGESTIONS

## Feel the Burn



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Caustic ingestions cause either coagulative (acidic substance) or liquefactive (alkaline substance) necrosis. Management and treatment include observation, labs, imaging, endoscopy, and may require more urgent interventions such as intubation and vasopressors. Consider consulting the local poison control center early and GI, ENT or surgery depending on severity and types of injuries. Endoscopy is useful for prognosis, but early CT imaging may also be useful and more readily available.

### Case

A 56-year-old male with a past medical history of alcohol abuse, post-traumatic stress disorder (PTSD), and depression presented via EMS to the emergency department for persistent abdominal pain. Per EMS, the patient drank approximately half a cup of battery acid 1 hour prior to arrival.

On initial evaluation, the patient was hemodynamically stable but was complaining of burning epigastric abdominal pain. Initial vitals were temperature 36°C, heart rate 72 beats per minute, respirations 18 breaths per minute, blood pressure 128/82 mmHg, and O<sub>2</sub> saturation 98% on room air. Physical exam was significant for mild tenderness in the epigastric region without rebound tenderness or guarding. Chart review indicated a previous history of depression and

PTSD, but no previous suicide attempts/ideation. A call was made to the Regional Poison Control Center while toxicology, GI, and medical ICU consultations were initiated.

Patient's labs were remarkable for metabolic acidosis with a CO<sub>2</sub> of 9 mmol/L, anion gap of 22 mmol/L; initial venous blood gas (VBG) with pH of 6.99, pCO<sub>2</sub> of 48.5, base excess (BE) of -21.6, and lactic acid of 4.7 mmol/L. The next VBG showed worsening pH of 6.9, pCO<sub>2</sub> of 54.1, BE of -24.8, and lactic acid of 5.1.

Patient was intubated as his airway began to display whitened ulcerations in combination with his impending inability to compensate for his metabolic acidosis. He was admitted to medical ICU. The patient suffered acute decompensation and was taken for emergent endoscopy by general surgery, which revealed grade 3 caustic esophagitis that mandated gastrectomy.

## Discussion

Caustic ingestions resulting in critical injury to the gastrointestinal tract are a common toxicological occurrence in both adults and children. According to the American Association of Poison Control Centers 230,517 cases of household cleaning substance ingestion were reported during 2018.<sup>1</sup> Hall, et al reported 10,860 hydrochloric acid ingestions over a 7-year time frame and another 20,983 alkali ingestions over a 6-year time frame, resulting in 13 and 5 deaths, respectively.<sup>2</sup> In general, the mortality rate for caustic ingestion ranges from 7 to 14%, with a small-volume accidental ingestion more common in pediatric cases while adult ingestions are usually intentional and involve larger volumes.<sup>3,2</sup>

A small set of caustic ingestions can result in severe morbidity and mortality including severe metabolic derangements, extreme pain, mucosal injury, perforation, chemical mediastinitis, and esophageal strictures, cancer, and death.<sup>3,4</sup>

## Mechanism of Action

Depending on the agent ingested, patients may experience either liquefactive necrosis (alkaline substances) or coagulative necrosis (acidic substances). Liquefactive necrosis causes extensive damage as saponification occurs, allowing further penetration of the caustic material deeper into the tissues while coagulative necrosis denatures tissue proteins that form a coagulum that walls off the acidic substance resulting in limited, but perhaps intense, damage. According to Hoffman et al., guidelines recommend treating all significant ingestions as severe. The quantity, composition, and concentration of the ingested substance directly affect how much damage may be inflicted.<sup>4,3</sup> For example, ingestion of more than 100 mL of a substance with a pH under 2 or over 12 causes severe permanent injury to the mucosal membrane.<sup>4,3,2</sup>

## Management

Patients present with signs and symptoms ranging from minor nausea/vomiting to concerning physical examination findings including stridor, dysphagia, drooling, oropharynx ulcerations, soft tissue edema, and refractory pain.<sup>4,2</sup> It is important to note that ingestion injuries continue

to evolve after initial presentation so frequent reexamination is warranted.<sup>4</sup> Initial evaluation depending on the suspected degree of severity may include x-rays (upright chest x-ray for free air), laboratory analysis (including a complete blood count, basic chemistry panel, plus lactic acid), ABG/VBG, and advanced imaging (endoscopy and/or CT of thorax and abdomen/pelvis).<sup>4</sup> If the history is concerning for self-harm, consider co-ingestions and their relevant toxicology screens. While most patients will have unremarkable labs, severe ingestions are marked by elevated lactic acid and metabolic acidosis, along with probable active tissue damage. More specifically, hydrochloric acid ingestions will be marked by a non-elevated anion gap acidosis, while other caustic ingestions will show an elevated anion gap.<sup>4,5</sup>

When caustic ingestion is suspected, the patient should be placed on continuous cardiac and pulse oximetry monitoring. Focused physical examinations should be repeated periodically based on clinical changes especially of the oropharynx and abdomen, as some sources have observed the initial symptoms may not correlate with the extent of damage.<sup>4,2</sup> Medical management in the emergency department includes pain management, vasopressor support, and buffering agents such as sodium bicarbonate to correct pH abnormalities. Most importantly, early intubation should be considered as extensive burns, edema or uncontrolled

secretions threaten airway patency.<sup>4</sup> Many sources suggest early initiation of intravenous proton pump inhibitors (PPI) and H2 blockers to protect the gastric mucosa, and antibiotics, however there is disagreement on the effectiveness of these therapies.<sup>2,4</sup> In a review of multiple sources by Hall et al., there appears to be no agreement on when to initiate antibiotics, with some advocating for immediate administration while others recommend administration only if the patient shows signs of perforation or goes to surgery.<sup>2</sup> Caustic ingestions cases benefit from early consultations with the Poison Control Center, Gastroenterology, and possibly General Surgery, particularly in cases of suspected perforation or extreme damage. Most patients warrant admission and diagnostic endoscopy.<sup>4,5,2</sup>

Placing a nasogastric tube or attempting neutralization should be avoided, as this increases the likelihood of iatrogenic perforation and exothermic thermal injuries, respectively.<sup>4,2</sup> Additionally, charcoal, emetics agents, and corticosteroids are no longer recommended as first-line treatments.<sup>4,2</sup>

## Endoscopy vs CT

Endoscopy is the primary method for assessing the extent of damage and therefore determining the prognosis of caustic ingestions.<sup>2</sup> Endoscopy should be performed within 6-24 hours post ingestion, as later endoscopy (48 hours to 2 weeks post ingestion) carries a greater risk of iatrogenic perforation due to decreased wound strength during that period. The concern for delayed endoscopy is the inherent increased risk of perforation secondary to tissue necrosis. The argument against early endoscopy is the likelihood of gross underestimation of the extent of tissue injury.<sup>4,6,2</sup> There is growing evidence that CT of the thorax and abdomen can be useful in the management of emergent and acute cases. While these studies still suggest endoscopy is still the better alternative, CTs are definitely safer especially in patient with suspected impending perforation or airway concerns.<sup>6,7</sup>

## Case Conclusion

Despite multiple surgeries over a month's time, the patient continued to decline and was ultimately discharged to hospice. ★

## TAKE-HOME POINTS

- Physical examination especially of airway and abdomen are crucial.
- Obtain basic labs and consider blood gases and lactic acids if severe ingestion is suspected.
- Consult other services early especially poison control/toxicology, GI or ENT, and surgery if patient may require emergent interventions.
- Endoscopy is important for evaluation, however CT of thorax and abdomen may be easier to obtain and useful for early evaluation.
- DO consider intubation for airway support, antibiotics, vasopressors and buffering solutions.
- DO NOT place gastric tubes, give steroids, or attempt to neutralize ingestants.



# The Pediatric Patient

## Autism Spectrum Disorder

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Children with Autism Spectrum Disorder (ASD) are a patient population that faces unique challenges in the emergency department (ED). ASD is characterized by deficits in sensory processing as well as impairments in communication and social interaction.<sup>1</sup> This combination, particularly in a fast-paced ED setting, creates difficulty, especially when considering these patients often have a preference for routine and predictability.<sup>2</sup> This is increasingly important for the ED provider to be aware of, as the number of children with ASD has risen in the last decade, with approximately 1 out of 54 children now carrying the diagnosis.<sup>3</sup> Additionally, youth with ASD are up to 30 times more likely to come to the ED than youth without ASD.<sup>4</sup> In addition, pediatric patients with ASD have an almost four-times higher odds of unmet healthcare needs than children without ASD.<sup>5</sup> Therefore, it is critically important for ED providers to be aware of best practices in caring for this population.

## Working with Family

It is important to note that no two children who carry a diagnosis of ASD are the same. This disorder is characterized by a wide degree of variability.<sup>1</sup> Many children do not require deviation in routine practice, as long as the provider is knowledgeable of why and how they communicate differently.<sup>4</sup> Other children may have very complex medical or social needs, requiring active measures to promote optimal care. Therefore, healthcare practitioners should rely on family guidance to find the best strategies for interacting with their child. In general, it is important to create as secluded of an environment as possible.<sup>6</sup> Use single rooms if they are available and attempt to limit excess noise. When possible, try to limit the number of individuals entering the room to the minimum required. Use appropriate signage on the door of the room to encourage all staff to check-in with the patient's primary nurse prior to entering. This ensures everyone is oriented regarding best practices for making the patient comfortable. It is important to consider that communication may be difficult. Whenever possible, set aside ample time to answer questions and attempt to spend uninterrupted time with your patient.<sup>4</sup>

## Mitigating Uncertainty

While it is always important to explain to children what you are doing, this is especially true when working with patients with ASD. Use concrete language wherever possible with discrete choices between two things, rather than open ended choices or commands. Always attempt to make a thorough plan in advance, breaking things into small steps.<sup>6</sup> Many children with ASD struggle with unpredictability and not knowing what is coming often builds anxiety and discomfort. Work with family members to make a plan for what to do during waiting intervals and be realistic about the time course of a visit whenever possible.

## Physical Exam

It has been shown that individuals with autism have similar thresholds for pain response as compared to the

general population.<sup>7</sup> However, patients with ASD have been shown to have difficulty describing and grading pain, so it is advised to assess pain as simply present or absent.<sup>6</sup> Parents may also be aware of behaviors that occur when the child experiences pain. As with any vulnerable population, it is also important to fully assess for the presence of abuse or trauma. When possible, validated screening questions should be used, and a thorough physical exam should be conducted as indicated.<sup>8</sup> Always express a high degree of empathy for behavioral challenges and work to employ creative solutions for individual needs. For example, if a patient becomes overwhelmed by stimuli, consider dimming the lights, allowing sunglasses or noise-cancelling headphones.<sup>6</sup> If a patient is being admitted, be mindful that patients may prefer to wear their own clothing or have strong food preferences. As above, continue to work with family and ancillary staff to be accommodating where possible.

## Comorbid Conditions

There are several conditions that are often comorbid with ASD. These include seizures, pica, gastrointestinal complaints, migraines, asthma, allergies, sleep disturbances and metabolic disorders.<sup>9</sup> As such, it is important for the clinician to have a high degree of suspicion for these conditions. The most common comorbidity seen in autism is attention-deficit/hyperactivity disorder (ADHD), which has been shown to co-occur in as many as 50% of patients with ASD.<sup>10</sup> Social anxiety, specific phobias, obsessive compulsive disorder (OCD), and oppositional defiant disorder (ODD) also occur at rates that are significantly higher than that of the general population.<sup>11</sup> The prevalence of epilepsy in all children is estimated to be about 2-3%, but approximately 14% of children with autism are reported to have a seizure disorder.<sup>10</sup> A high degree of suspicion should particularly be employed in individuals with concurrent intellectual disability (ID), as it has been shown that the prevalence of epilepsy is approximately

22% in this population, versus 8% in subjects with ASD without ID.<sup>12</sup> Sleep disturbances are also incredibly common, with some studies reporting up to 77% of children with ASD having trouble with sleep.<sup>11</sup>

## Medication Mindfulness

Children with ASD may be on a number of psychotropic medications.<sup>13,14</sup> Both risperidone and aripiprazole have been approved for the treatment of irritability in ASD by the US Food and Drug Administration. Methylphenidate and atomoxetine are also commonly used for comorbid ADHD. Always perform a thorough medication reconciliation and be mindful of possible interactions. There is also evidence that children with ASD can be particularly sensitive to medications and side effects.<sup>15</sup> It is important to carefully monitor for medication reactions, especially when using sedatives.

## Establishing a Diagnosis of ASD

Methods of receiving a formal diagnosis of autism spectrum disorder include neurodevelopmental testing through the school system as well as through outpatient neuropsychiatry, child psychiatry, or neurodevelopmental specialists. It is important to recognize that the healthcare system is often one of the first places where autistic traits are noticed.<sup>16</sup> Early signs can include impaired eye-contact, lack of imitation or pretend play, and slowed verbal and nonverbal communication development.<sup>2</sup> Emergency physicians should encourage expedited follow-up with primary care providers for assessments and further referrals. Make sure parents are aware of the need for referrals if applicable; possibly including neurodevelopmental specialists, hearing assessments and outpatient support programs. Early intervention and socialization programs have been shown to be effective in improving core autism symptoms long-term.<sup>17</sup> Unfortunately, these resources vary widely between locations of practice. As much as possible, please be aware of the landscape in your own community to provide your patients with the best available access to services. ★

# A Case of Subcutaneous Emphysema and Pneumoscrotum Disguised as Angioedema

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A 72-year-old male with past medical history of cirrhosis and emphysema presented to the ED for facial swelling. Two days prior, the patient had a witnessed mechanical fall from standing without loss of consciousness or head injury. Patient endorsed worsening right arm swelling, followed by facial swelling, left arm swelling, and finally scrotal swelling. At triage, the patient's chief complaint was listed as "angioedema." The patient's wife provided a photo of the patient from 1 week prior that showed a thin male without facial or periorbital edema (Figure 1).

On presentation, his vital signs were BP 142/88, HR 143, RR 20, SpO<sub>2</sub> 93% on room air and temperature 36.9C. On physical examination, the patient had a midline epiglottis with no intraoral swelling, decreased air movement bilaterally, distant cardiac sounds, and diffuse, soft, nontender edema of the eyelids, face, neck, chest wall, abdomen, and scrotum. Crepitus was palpated over his shoulders, hands, and thighs.

POCUS of the anterior chest wall was performed to evaluate for lung sliding. Normal chest wall landmarks were difficult to identify. Images were difficult to interpret due to the presence of multiple hyperechoic vertical lines with dirty shadowing reverberation artifact which obscured the anatomy (Figure 2). These findings were concerning for

subcutaneous emphysema (SE). Similar POCUS findings were seen throughout the chest wall, abdomen, proximal extremities, and scrotum (Figure 3).

The patient began gurgling with respirations, prompting concern for airway compromise. A bedside fiberoptic nasal laryngoscopy demonstrated normal vocal cords without laryngeal swelling, but narrowed due to external compression. The patient was intubated for airway protection and transported to CT.

CT scan demonstrated extensive SE tracking from the chest wall up to the deep spaces of the face, right sided pneumothorax with rib fractures, pneumomediastinum, pneumoperitoneum, and pneumoscrotum (Figure 4, 5).

## Discussion

Subcutaneous emphysema is the presence of air within the subcutaneous layers of the skin caused by gas formation secondary to infection, or more commonly, air escaping from pleura, mediastinum, peritoneum, or gastrointestinal tract. Common causes include trauma, spontaneous pneumothorax, iatrogenicity, and barotrauma.<sup>2,3</sup> In our case, the source was traumatic given the right sided rib fracture. In the most severe form of SE (Grade V), there is involvement of the face, neck, torso, abdomen, and scrotum. While palpating for crepitus can help with the clinical diagnosis of SE, it often presents as generalized distention or bloating. In our case, the triage team labeled his symptoms as angioedema, which is similar to a previously published case report.<sup>1</sup>

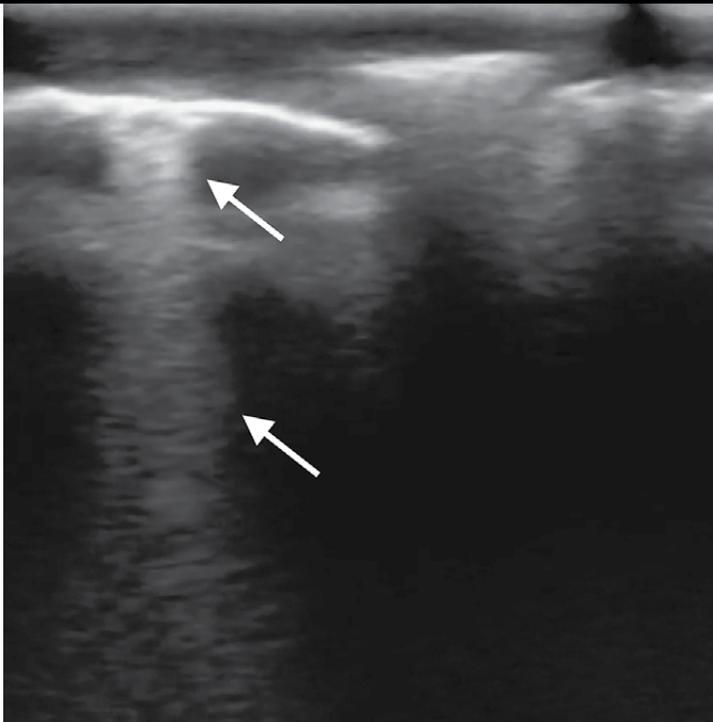
SE can be seen on ultrasound as focal punctate hyperechoic regions with "dirty" posterior acoustic shadows and



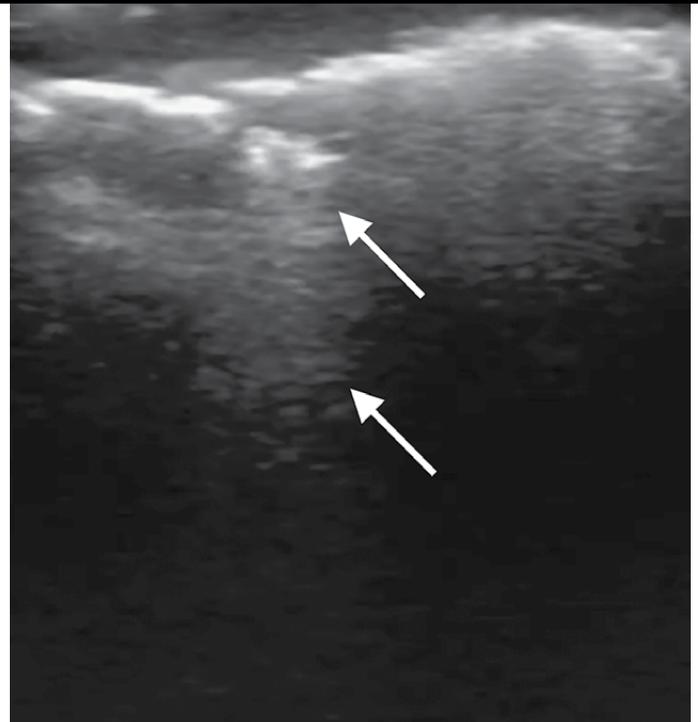
**Figure 1**

reverberation artifacts, called "E lines." In POCUS evaluation, the movement of "E Lines" in SE can be mistaken for vertical B lines seen in sliding lungs.<sup>4</sup> To avoid this mistake, it is critical to confirm that the vertical lines are originating from the pleural lines using rib shadows as reference, and to confirm the sliding motion correlates with breathing. In our case, there was no respiratory movement and no rib shadowing to indicate the level of the pleura.

SE itself is often benign, however, its discovery should be a red flag for significant injuries.<sup>3</sup> In a prospective observation of 405 blunt traumatic patients, SE was only seen in 6% of cases, however, every case with SE also had a pneumothorax.<sup>5</sup> SE can also cause severe airway compromise. A previous case report describes a case of a traumatic patient with SE and pneumothorax who



**Figure 2**



**Figure 3**

initially presented with an intact airway. His airway acutely decompensated 7 hours after presentation and he was unable to be intubated due to visualized airway edema, ultimately requiring a surgical tracheostomy.<sup>6</sup> Our prompt recognition of his SE and fiberoptic findings led to a change in management resulting in earlier intubation for airway protection.

The other unique POCUS finding in our patient was pneumoscrotum. Pneumoscrotum can be primarily caused by gas producing infections like Fournier's gangrene, or a secondary cause resulting in gas tracking from the mediastinum, peritoneum, retroperitoneum, or abdominal fascia. Pneumoscrotum is a very rare condition with only 59 cases in the literature since 2013. The majority were caused by abdominal endoscopy and laparotomic surgery, with only 5 cases of pneumoscrotum secondary to blunt chest trauma.<sup>7</sup>

Like SE, pneumoscrotum itself is often benign but associated with significant injuries. In the six reported cases of pneumoscrotum secondary to blunt trauma, every case was also found to have a pneumothorax and half of the cases had pneumomediastinum.<sup>8-13</sup> One case report describes a pneumothorax that was correctly identified and treated

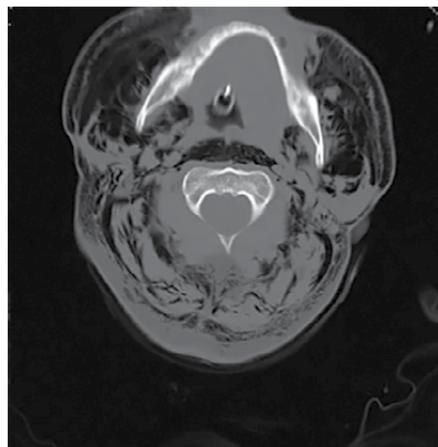
during a traumatic arrest based on the clinical presence of pneumoscrotum.<sup>8</sup> Pneumoscrotum can be difficult to diagnose clinically as it may present without crepitus and simply as scrotal edema, similar to our case. While most reports of pneumoscrotum were diagnosed by CT scan, evidence of pneumoscrotum can be seen on POCUS. Pneumoscrotum on POCUS is seen as linear hyperechoic reflections with significant retro-acoustic shadowing in the scrotal area.

SE can be a difficult and misleading clinical diagnosis, however, POCUS can rapidly confirm the presence of SE. While

SE may obscure POCUS evaluation of the thorax and abdomen, the presence of SE should alert the provider to significant traumatic injuries and possible airway compromise. In addition, POCUS can diagnose pneumoscrotum, another marker of significant trauma.

### Case Conclusion

The patient received a right sided thoracostomy tube with improvement of his vital signs. He was admitted to the medical ICU and received a blow-hole incision for significant SE. He was extubated on hospital day (HD) 3, had the thoracostomy tube removed on HD 5, and discharged on HD 7. ★



**Figure 4**



**Figure 5**



# Pediatric Gonococcal Hip Arthritis

## Diagnosed by Emergency Point-of-Care Ultrasound-Guided Arthrocentesis

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Point-of-care ultrasound (POCUS)-guided arthrocentesis performed in the emergency department (ED) can expedite the diagnosis and treatment of septic arthritis, potentially averting the need for surgery. Source control via aspiration of purulent synovial fluid, when accompanied by intravenous (IV) antibiotics, may provide definitive treatment and therefore reduce the need for surgery and therefore the overall morbidity of the disease. Performing hip arthrocentesis on pediatric patients, however, often requires assembling a multidisciplinary care team and thus may lead to delays in diagnosis and treatment. We report a case of pediatric gonococcal monoarthritis of the hip, for which initial diagnosis and treatment were directed by emergency medicine (EM)-performed POCUS-guided arthrocentesis.

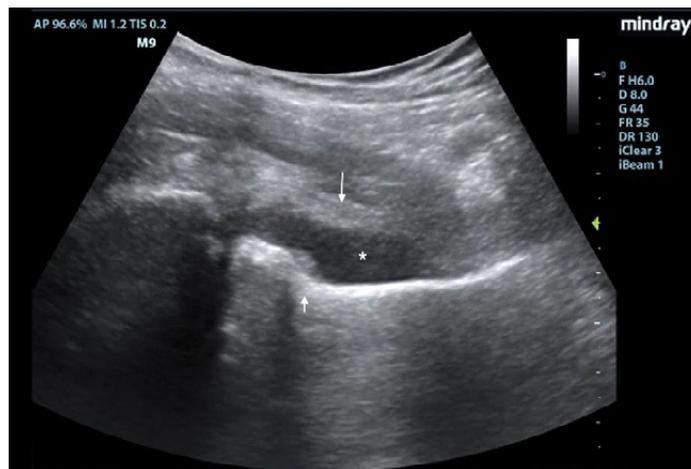
### Introduction

Acute septic hip arthritis is a pediatric emergency. Treatment delays may lead to complications including osteomyelitis, osteoarthritis, joint destruction, and systemic illness.<sup>1</sup>

Most arthrocenteses are performed by interventional radiologists (IR) or orthopedic surgeons.<sup>2,3</sup> Using a consult service, however, requires coordination among care teams, potentially delaying diagnosis and treatment. Use of POCUS-guided arthrocentesis in the ED supplants the need for a consulting service. Cases reported in the literature of emergency physician-performed POCUS-guided hip arthrocentesis demonstrate decreased time to diagnosis, initiation of antibiotics, and surgical intervention when necessary.<sup>4,5</sup>

### Case

A 16-year-old female with a history of coxa magna deformity of the femoral head and left congenital hip dysplasia was transferred from an outside hospital (OSH) to a pediatric tertiary care facility with fever and atraumatic left hip pain concerning for septic arthritis. The OSH reported fever of 38.5 C, elevated ESR and CRP, leukocytosis, and moderate left hip effusion on MRI. Upon presentation to the ED, the patient was afebrile



**Figure 1.** Oblique sagittal view of left hip using a curvilinear probe. Labeled structures: anterior joint capsule (big arrow), effusion (asterix), femoral neck (small arrow)

after being given ketorolac at the OSH but complained of persistent left hip pain. Initial vitals were: heart rate 85, respiratory rate 20, blood pressure 113/62, oxygen saturation 99% on room air. She endorsed three days of subjective fevers with no prior illness and one day of difficulty bearing weight on the affected leg. Her pain was dissimilar to that previously associated with her hip dysplasia. Additional history revealed high-risk sexual behavior with a prior diagnosis of chlamydia cervicitis. She had no history of tick bites, travel to Lyme-endemic areas, rash, or rheumatologic disease.

Physical exam revealed an anxious, nontoxic-appearing female with tenderness to palpation and decreased range of motion of the left hip with no swelling, crepitus, deformity, erythema, or skin breaks. Her preferred position was supine with left hip flexed and externally rotated. The remainder of the physical exam was unremarkable, including normal external genitalia.

Initial ED course involved IV hydration, analgesia, and labs demonstrating ongoing leukocytosis with left shift, normal coagulation studies, and normal liver and renal function. Urine was sent for *N. Gonorrhoeae* and *C. Trachomatis* nucleic acid amplification tests. POCUS examination of bilateral hips revealed a 10 mm fluid collection anterior to the left femoral neck consistent with a hip effusion. Orthopedic surgery was consulted and requested an arthrocentesis, a procedure typically performed by an IR team at this institution, requiring time for transport, team organization, and room set-up. The EM team therefore elected to perform a POCUS-guided arthrocentesis.

### Ultrasound Arthrocentesis Technique

With a linear array transducer positioned transversely over the inguinal region, the location of the femoral neurovascular bundle was marked using a surgical pen. The transducer was then rotated into a sagittal oblique position to visualize the hip effusion, and depth was measured to determine

appropriate needle length. A low-frequency curvilinear probe was also briefly used to optimize visualization and to compare bilateral hips (Figures 1 and 2). Under POCUS guidance, a 22-gauge 3.5-inch spinal needle was inserted distal to the long axis of the linear transducer and lateral to the femoral vessels. The needle was advanced in-plane to enter the anterior synovial recess and 10 ml of blood-tinged, purulent fluid was aspirated. There were no procedural complications and the patient had immediate resolution of pain with improved range of motion.

Synovial fluid was sent for cytology, gram stain, and culture, and was suggestive but not definitive for septic arthritis (WBC 29,000, no pathogens on gram stain). Urine *N. Gonorrhoeae* later resulted positive which, in combination with aspirate results, prompted initiation of IV ceftriaxone. After source control with successful aspiration, orthopedic surgery attempted conservative treatment for four days in lieu of incision and drainage. Ultimately, however, persistent hip pain and elevated CRP required operative management for definitive treatment.

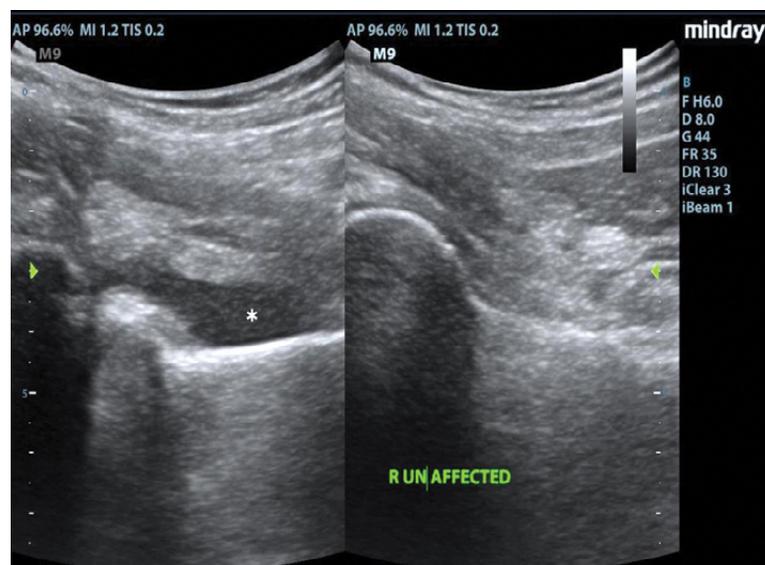
### Discussion

This case illustrates that POCUS-guided hip arthrocentesis by trained emergency physicians can be performed safely and rapidly in the ED, reducing time to diagnosis and treatment by eliminating the need for procedural consulting services. POCUS-guided arthrocentesis

directed medical management while culture results were pending and helped initially to avoid arthrotomy, although the patient ultimately required operative management after conservative treatment failed.

POCUS-guided arthrocentesis can be both diagnostic and therapeutic in stable patients with hip effusions, and a substitute for more invasive arthrotomy pending clinical improvement. This minimally invasive procedure is associated with less scarring, shorter hospital stays, and faster return to normal activity.<sup>6</sup> To date, no studies demonstrate a difference in clinical outcomes for pediatric patients with septic arthritis undergoing aspiration versus arthrotomy.<sup>7-10</sup> In a prospective multicenter treatment study of pediatric osteoarticular infections, however, 50 of 62 children with septic arthritis of the hip were treated successfully with aspiration and antibiotics alone.<sup>11</sup> There are also reported successes in treating pediatric septic arthritis of the hip with daily, repeated POCUS-guided aspiration and irrigation.<sup>6</sup> Of note, however, the literature cautions that this technique should only be used in previously healthy patients, and no more than five days from symptom onset.<sup>10</sup>

POCUS-guided arthrocentesis is an efficient and effective method for diagnosis of acute septic arthritis of the hip and, with adjunctive antibiotics, may be used as definitive conservative management. ★



**Figure 2.** Comparison of affected (L) and unaffected (R) hips using a curvilinear probe

# TORSION OF THE WHAT?

## Epiploic Appendagitis as a Rare Cause of Abdominal Pain

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The epiploic appendix is a small pouch of peritoneum that protrudes from the serosal surface of the colon and is filled with fat and small vessels. Acute epiploic appendagitis is an uncommon cause of abdominal pain and is due to torsion of the epiploic appendage or spontaneous venous thrombosis of a draining appendageal vein.<sup>1</sup> This diagnosis can be clinically similar to sigmoid diverticulitis, and the diagnosis is often discovered after imaging on cross-sectional computed tomography (CT). CT imaging will show peripheral hyperattenuation with an area of fat stranding.<sup>2</sup> Ultrasound findings demonstrate a fixed hyperechoic mass without Doppler color flow that is located adjacent to the anterior peritoneal wall and under the point of maximum pain.<sup>2</sup>

### Case

A 45-year-old male presented to the emergency department with a chief concern of abdominal pain. He reported having 2 days of abdominal pain that began shortly after finishing lunch. Over the night prior to presentation, he experienced acute worsening of the pain and was unable to tolerate much oral intake secondary to pain. The pain was concentrated over the right flank and right lower quadrant pain and did not radiate into the groin. He denied any fevers, urinary symptoms, or vomiting. He had a history of nonalcoholic fatty liver disease and no previous abdominal surgeries.

Physical exam revealed an anxious-appearing male with normal vital signs. There was mild tenderness to palpation in the right lower quadrant. There was

no rebound or guarding. He had normal male external genitalia with no overlying skin changes or tenderness to palpation of his scrotum. Cardiopulmonary examination was unremarkable.

Testing revealed a CBC and BMP within normal limits. AST and ALT were mildly elevated at 70 and 86, respectively. Lipase was within normal limits and a urinalysis was unremarkable. A CT with IV contrast of the abdomen and pelvis showed an ovoid area of mesenteric fat stranding and edema with central nodularity adjacent to the right hepatic flexure, most consistent with epiploic appendagitis. No focal fluid collection suggesting an abscess was visualized, though there were a few scattered colonic diverticula without evidence of acute diverticulitis. The patient was provided fluids, ketorolac, and ondansetron and was able to be discharged home with instructions for supportive care with pain management.

### Discussion

More than 7% of patients presenting to the ED with symptoms clinically consistent with sigmoid diverticulitis are found to have primary epiploic appendagitis.<sup>1</sup> Primary epiploic appendagitis is due to a torsion or venous thrombosis of the involved epiploic appendage.<sup>1</sup> “Secondary epiploic appendagitis is associated with inflammation of adjacent organs, such as in cases of diverticulitis, appendicitis, or cholecystitis.”<sup>3</sup> Often acute epiploic appendagitis is misdiagnosed as diverticulitis or appendicitis, which can lead to unneeded hospitalization and invasive procedures. Epiploic appendagitis is associated with obesity, history of hernias, and exercise injuries. It is most commonly seen in males in their 40’s.<sup>1,4</sup>

Clinical manifestations include acute abdominal pain, most commonly in the left lower quadrant. Patients are often afebrile and have unremarkable labs. CT



imaging is the test of choice for diagnosis and findings include a “fat density ovoid lesion (hyperattenuating ring sign), mild bowel wall thickening, and a central high attenuation focus within the fatty lesion (central dot sign)”.<sup>4</sup>

Management of acute epiploic appendagitis is conservative and symptoms often resolve in a few days.<sup>1,4</sup> In a retrospective study of 660 CT scans performed for suspected diverticulitis or appendicitis, it was found that 11 scans (2%) showed features consistent with epiploic appendagitis, of which only 4 were correctly identified and 6 were misdiagnosed as diverticulitis and 1 was misdiagnosed as appendicitis.<sup>1</sup> All of the misdiagnosed patients were hospitalized and 6 of the 7 received antibiotics.<sup>1</sup> Though ED physicians rely on radiologists to identify findings suggestive of appendagitis, it is important to include this on the differential as misdiagnosis can result in inappropriate financial burden, misuse of antibiotics, and the possibility of an unnecessary surgery.<sup>4</sup> Therefore, in cases where findings are indeterminate or questionably suggestive of an alternative diagnosis, it may be beneficial to discuss the possibility of appendagitis directly with the radiologist. ★



# A Case Report of **Septic Arthritis** of the **Shoulder** caused by ***P. aeruginosa***

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In 2012, there were more than 16,000 ED visits for septic arthritis in the United States; this accounted for approximately 0.01% of all ED visits.<sup>1</sup> Although septic arthritis is a relatively infrequent diagnosis made in the ED, a poor outcome is seen in almost half of patients depending on age and comorbidities.<sup>2</sup> While *Methicillin-resistant Staphylococcus aureus* (MRSA) is a well-known and feared cause of septic arthritis, *P. aeruginosa* needs to be considered by the emergency physician when caring for an IV drug user.<sup>3,4</sup> We present a case of septic arthritis in the shoulder caused by *P. aeruginosa*.

## Case

A 40-year-old female presented to the ED with a complaint of fevers and left shoulder pain. She had a past medical history of hypothyroidism and IV drug use. She reported that over the last three days she was having worsening shoulder pain with associated fever/chills. She denied any recent trauma. She stated the shoulder pain radiates to her left chest and into her back. Upon further questioning she did admit to using heroin daily. Interestingly, she stated several days prior to the pain starting she had attempted to inject heroin in her left forearm but reported the vein blew and therefore did not inject.

*She denied any pain like this in the past and denied ever injecting anything into her shoulder. She had no history of significant bacterial illness. She had no cardiac history (EKG and troponin were subsequently normal). Review of systems was negative for any neurologic, respiratory, or GI complaints.*

*On exam she was found to be febrile to 100.4 C, and her heart rate was 110 bpm. She had extensive pain with passive range of motion of the left shoulder, but the shoulder was without erythema, warmth, or joint swelling. X-ray was negative for any acute abnormality. However, there was still concern for septic arthritis given her history of IV drug use, so the patient was consented for arthrocentesis. Using a curved linear ultrasound probe, a posterior approach arthrocentesis was performed. A joint effusion was present between the glenoid fossa and humeral head.*

*The landmarks were marked and the patient was prepped and draped in usual sterile fashion. The needle was inserted just below the scapular spine. Five milliliters of cloudy fluid was obtained. Synovial fluid studies showed 67,740 cells/mm<sup>3</sup> with 95% neutrophils. Gram stain was negative. Other lab workup subsequently showed a CRP of 4.1, ESR of 54, and WBC count of 12.2.*

*Orthopedics was consulted, and the patient was admitted to the hospital. Based on established recommendations, Vancomycin and Ceftriaxone were given empirically.<sup>10,11</sup> Blood cultures were negative. The patient underwent washout the next morning. Less than 24 hours later the synovial fluid grew *P. aeruginosa* and ceftriaxone was then changed to cefepime.*

*The patient stayed an additional day,*

*but unfortunately left against medical advice with a prescription for 6 weeks of ciprofloxacin.*

## Discussion

Many patients present to the ED with musculoskeletal complaints; however, septic arthritis is a relatively uncommon diagnosis (7.8 cases per 100,000 person-years).<sup>5</sup> The shoulder only accounts for 5-12% of cases of septic arthritis.<sup>6</sup> The most frequent organism encountered in the general population as well as IV drug users is *Staphylococcus aureus*.<sup>7,9</sup> Septic arthritis in IV heroin users is frequently caused by MRSA and less commonly *P. aeruginosa*, with a recent large study showing it causes less than 2% of cases.<sup>8,9</sup> When *P. aeruginosa* septic arthritis is diagnosed, it is typically seen affecting the sternoclavicular, hip or sacroiliac joints, with one study not reporting any cases of *P. aeruginosa* in the shoulder.<sup>8</sup> Commonly, vancomycin and ceftriaxone are recommended for initial empiric treatment of presumed septic arthritis in the ED as they cover the vast majority of the pathogens.<sup>10,11</sup> Due to the significant morbidity associated with septic arthritis it is important for the emergency physician to consider *P. aeruginosa* as the cause of joint pain in the IV drug user.

## Conclusion

Although relatively uncommon, septic arthritis is a "can't-miss" diagnosis. Timely diagnosis and treatment is imperative due to the high morbidity associated with it. While *P. aeruginosa* does not frequently cause septic arthritis, a thorough history is paramount and physicians should consider antipseudomonal coverage with any history of IV drug use. ★

# Bleeding Risk after NSAID Use

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**A** 27-year-old male presents to the emergency department with abdominal pain and rib pain after colliding with a tree at the local ski resort. The patient is tachycardic at 115, his other vital signs are stable. The patient has no significant past medical history or allergies. Point-of-care ultrasound reveals an unremarkable E-FAST exam. He also endorses a headache and a minor laceration to the left arm. You want to address his pain and consider non-steroidal anti-inflammatory drugs (NSAIDs) as an option.

NSAIDs are the most commonly used class of drugs in the world. They possess analgesic, antipyretic and anti-inflammatory properties. Most NSAIDs inhibit COX-1 and COX-2 activity, although some are selective for COX-2. COX-1 and COX-2 regulate production of certain prostaglandins, COX-1 regulates prostaglandins that protect the gastrointestinal lining and activate platelets. COX-2 regulates prostaglandins geared more towards mediating the body's inflammatory response to injury and protecting against vascular ischemia.<sup>1</sup> It is estimated that between 5-7% of hospital admissions are related to medication side effects. Among those, 11-12% of admissions are from gastrointestinal, nervous system, renal, or allergic effects of non-aspirin NSAIDs.<sup>2</sup> The GI side effects are most apparent and well documented and can increase risk of bleeding.

## Anti-platelet Effect

Aspirin, one of the most widely used NSAIDs, is commonly prescribed by physicians for its anti-platelet activity through irreversible inhibition of COX-1. The COX-1 enzyme is found within platelets, it helps to produce prostaglandin H<sub>2</sub> which is then converted into thromboxane A<sub>2</sub>, a

necessary platelet adhesion factor. When COX-1 is inhibited, so is the creation of thromboxane A<sub>2</sub> and thus platelet aggregation.<sup>3</sup> Low dose aspirin *irreversibly* acetylates and inhibits COX-1 and only weakly inhibits COX-2. Since platelets cannot make new COX-1, the inhibition of TxA<sub>2</sub> is permanent for the life of the platelet.<sup>4</sup> Because of this phenomenon, aspirin is most commonly prescribed for vascular disease including coronary artery disease and cerebrovascular disease to prevent thrombosis. It has been shown to decrease risk of non-fatal MI by 21%, but on the other hand, has shown to increase the risk of bleeding by 48% due to its potent anti-platelet activity.<sup>5</sup> Aspirin reversal time is roughly 7 days due to average lifespan of platelets being between 7 and 10 days. When the patient stops taking aspirin, there will still be irreversibly inhibited platelets in the body until they have all been replaced 7-10 days after discontinuation. By 3-4 days after discontinuation of aspirin, there are enough functional platelets to guarantee suitable hemostasis.<sup>6</sup>

Among non-aspirin NSAIDs, the complete reversal time to get full platelet function back to normal varies. For example, ketorolac is 2 days and ibuprofen is 1 day for complete reversal; these are shorter intervals due to the reversibility of COX-1 inhibition. This allows the platelets to more quickly return to normal functionality, as they don't have to be completely recycled.<sup>6</sup> Note that paracetamol, also known as acetaminophen, is listed even though it is not an NSAID. It inactivates a site different than the aspirin-binding site on COX-1 and there is some controversy over whether this drug has an effect on platelets or not. Generally, it is accepted that its effect is not well established and if there is an effect, it is much less potent.<sup>7</sup>

## NSAID Bleeding Risk: Nonselective vs Selective NSAIDs Nonselective COX-1 and COX-2 Inhibitors

Aside from the anti-platelet effects previously discussed, NSAID

enteropathy can also increase bleeding risk. This side effect may not be recognized to its full extent, as some researchers claim that as much as 53-80% healthy short term NSAID users and a similar percentage in long term users for > 3 months<sup>8</sup> are affected. Anyone with gastrointestinal tissue damage from NSAID use is at a higher risk of bleeding. COX-1 and COX-2 enzymes reside in different areas of the body, and because of this, the prostanoids they each help to create exhibit different effects. COX-1 enzymes reside in the gastrointestinal epithelial cells, when inhibited, this blocks the production of prostaglandins in these epithelial cells that are shown to protect the mucosal lining of the GI tract, when their protective effects are diminished, this leaves the intestinal epithelium susceptible to damage. Ulcers and erosions can form and eventually damage small capillaries causing a slow but steady bleed that can continue for some time if not treated.<sup>1</sup>

In a study on GI bleeds, 3 groups of elderly participants received a 2-week NSAID regimen for arthritis. Each group received a different NSAID: diclofenac, naproxen, and piroxicam. Fecal blood loss was then measured.

"The mean 24-hour fecal blood loss with diclofenac (0.53 mL±0.21) was not significantly different from control (0.28 mL±0.06), whereas it was significantly increased with naproxen (2.76 mL±2.22) and piroxicam (1.16 mL±0.62),  $p=0.0013$ "<sup>9</sup>

Multiple hypothesis have been considered based on these data: COX-1 selective NSAIDs (naproxen, piroxicam) may pose a higher bleeding risk than the more COX-2 selective diclofenac, and longer reversal times is correlated with increased bleeding risk.

Diclofenac has been shown to have comparable COX-2 selectivity to celecoxib. However, multiple studies have shown that celecoxib and etoricoxib are associated with less GI toxicity than diclofenac and thus would be a much better comparison to the above

NSAIDs in the study to demonstrate the correlation between COX-2 selectivity and decreased bleeding risk.<sup>10</sup> Diclofenac, although selective, is associated with even more GI toxicity than some nonselective NSAIDs.<sup>11</sup>

There is a correlation between longer reversal time and increased bleeding risk. Both naproxen and piroxicam have longer reversal times than diclofenac and resulted in more fecal blood loss. Two of the patients from the above study that were on the piroxicam trial were withdrawn due to extensive GI bleeding.

### Selective COX-2 Inhibition

The high majority of COX-2 enzyme expression resides in the kidneys, brain, monocytes, and macrophages,<sup>12</sup> thus they pose a decreased risk of GI bleeding from mucosal injury and platelet malfunction.<sup>13</sup> Since the anti-platelet effect and enteropathy is only from the inhibition of COX-1 within the platelet and GI epithelial cells, the development of selective COX-2 inhibitors was meant to diminish these effects while still providing anti-pyretic and analgesic benefits.<sup>3</sup> One meta-analysis of 35 studies regarding the correlation between COX-2 inhibitors and risk of bleeding concluded that, “*Highly selective COX-2 inhibitors did not significantly increase the risk of intraoperative, postoperative bleeding, or blood loss. They also had no significant effect on platelet function. Therefore, perioperative, single dose, or short course of COX-2 inhibitors can be safely used in individuals who are undergoing surgery.*”<sup>14</sup> This meta-analysis included mostly studies on short term or single dose COX-2 inhibitors thus the evidence on bleeding risk and long-term COX-2 is not concrete. This analysis also reported that high dose COX-2 inhibitors administered with aspirin increase the risk of bleeding postoperatively and this combination is not recommended. The American College of Surgeons does not include selective COX-2 inhibitors in their guidelines on perioperative cessation of anti-platelet agents, the only NSAID with any preoperative guidelines is aspirin.<sup>15</sup> However, although COX-2 inhibitors have less anti-platelet effects, research has also shown that major coronary events are

increased by about one third when using coxib drugs or diclofenac.<sup>16</sup>

### Mitigating GI Bleeding Risk

All NSAIDs carry varying degrees of bleeding risk. The decision of what to use should be based on each unique patient. Increased bleeding risk is seen in patients with the following: age > 60, history of peptic ulcer disease or GI bleeds, diabetes, or hypercholesterolemia. Use of ASPIRING, clopidogrel, ticlopidine, alendronate, or corticoids have also shown to increase risk.<sup>17</sup> Interestingly, SSRIs have also shown to increase risk.<sup>18</sup> If a patient has any of these risk factors, consider co-administration of mitigating medications and/or use of non-NSAID analgesia.

One study done on mitigating NSAID related GI damage, studied the use of misoprostol and proton pump inhibitor (PPI) medications concurrently with NSAIDs to reduce risk. They found that 51% of patients who took a placebo with NSAID remained ulcer free after 12 weeks, 93% who took Misoprostol were ulcer free, and 80% who took lansoprazole were ulcer free. The side effects of Misoprostol, namely diarrhea, caused a significant number of participants to withdraw from the study and when this was taken into consideration, misoprostol and lansoprazole were comparable in their effectiveness at decreasing ulcer risk.<sup>19</sup> It is proposed that decreasing ulcer risk will decrease risk of bleeding.

### Can You Give NSAIDs to Preoperative Patients?

Research is conflicting, there are studies which show an increased bleeding risk, and others that show no significant correlation. One such study found that, “*perioperative ASPIRING use does not increase hemorrhagic complications in elective intracranial tumor surgery.*”<sup>20</sup> This study had 3 groups of patients, including those who were not taking aspirin, those who were taking 81 mg, and those who were taking 325 mg. Another study found that preoperative aspirin continuation reduced venous thromboembolism risk at the expense of increased preoperative major bleeding.<sup>21</sup> These, and many other studies emphasize the fact that the answer is unclear on whether or not to continue anti-

platelet agents such as aspirin, and that further research is needed. The general consensus is that these decisions should be made by the surgical team with careful consideration of each individual patient’s bleeding risks based on medical history, age, type of surgery, medications and more. Even with these conflicting studies, the American College of Surgeons still recommends discontinuing aspirin 7 days prior to surgery.<sup>15</sup>

### Case Conclusion

Generally speaking, the use of NSAIDs increase the risk of bleeding. Aspirin possesses the greatest platelet inhibition for the longest period of time (7 days) while ibuprofen and diclofenac (1 day) and celecoxib (0 days) have significantly less. In patients presenting to the ED with acute pain, NSAIDs are the most commonly used analgesic and often appropriate. In patients with active bleeding, NSAIDs should be avoided. In patients with gastrointestinal disease or risk factors, careful consideration should be made whether or not to use NSAIDs. If the physician elects to use NSAIDs, then they should consider co-administering a PPI, H2-blocker or misoprostol. Alternatively, selective COX-2 inhibitors should be considered. In patients presenting to the ED with an acute surgical emergency, the use of NSAIDs should be avoided unless risk-benefits are discussed with the surgical team. In all cases, when prescribing or using NSAIDs, physicians should use the “safest” NSAID, at the lowest dose, for the shortest period of time.

*The 27-year-old male was administered Ketorolac for pain relief and an appropriate improvement was noted. CT scan of the head revealed no acute findings and it was assumed that his acute symptoms were due to multiple contusions to the head and torso on initial impact. The small laceration was repaired. Upon questioning, it was noted that the patient had no additional risk factors or significant medical history. After several hours under hospital care, the patient was discharged. He was given ibuprofen 400 mg PRN for pain and told to follow up with his primary care physician if his symptoms did not continue to improve. ★*

# A Rare Complication Due to the Fatal Trigemino-cardiac Reflex



## Near Death by Nasal Packing

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**E**pistaxis is a complaint that is frequently seen in the emergency department. As a physician, we took an oath to do no harm, but what if we end up doing more harm than good when managing epistaxis?

A rarely seen reflex that humans possess is the Trigemino-cardiac Reflex (TCR). For the emergency physician, the reflex is likely encountered after nasal passage manipulation, such as insertion of a rhino rocket, nasal swabbing, and NG tube placement. If activated, the reflex can lead to rapid hemodynamic instability and death. We want to bring awareness to the reflex and expose the dangers that can come with it. Most clinicians will never come across it in their careers, and if they do, they may fail to even recognize it. In this case report we present a 91-year-old male who presented to our ED with epistaxis who quickly decompensated after rhino rocket insertion.

### Case

A 91-year-old gentleman with a history of CAD, hypertension, and NIDDM on aspirin and clopidogrel presented to the ED for a repeat visit with sudden onset of epistaxis from his left nostril that started 2 hours prior to arrival with no evidence of trauma or nasal manipulation. Patient had just arrived back home from a visit from the ENT office, where he had cauterization performed for a right nostril epistaxis with successful hemostasis. He then developed left nostril epistaxis, which led him back to the ED. Upon arrival, the patient had continuous bleeding from the left nostril with unsuccessful hemostasis using nasal clamping. His initial vital signs were stable and as follows: BP 152/66, Pulse of 89, Temp of 36.8 C, and SpO<sub>2</sub> of 95%.

The patient continued to have copious amounts of bleeding passing by the nasal clamp and had expectorated out several clots of blood from the oropharynx. The decision was made to apply a 7.5 cm Rhino rocket nasal pack in the left nostril, saturated with

tranexamic acid (TXA) followed by the administration of nebulized TXA in a 1:1 solution with normal saline. Approximately 35 minutes after administration of the nasal packing, the patient started to clinically deteriorate. He appeared to be in severe distress, with physical examination findings significant for diaphoresis, cool, and clammy skin. The patient was disoriented and minimally responsive to verbal stimuli. Vital signs revealed a blood pressure of 75/48 mmHg, sinus bradycardia at 55 bpm, and bradypnea. An instinctive response from the resident physician prompted him to immediately remove the nasal packing, and an IV was established for the patient with administration of 1 L Normal Saline and an H/H and type and screen were obtained. The patient was also placed on continuous cardiac monitoring.

Patient clinically improved within 5 minutes after the removal of the nasal packing. He was no longer disoriented, clammy, or diaphoretic. He had significant improvement of his blood pressure at 115/60 mmHg

and resolution of his bradycardia and bradypnea. He did not recall the events that had transpired. Patient's hemoglobin came back within normal limits and the patient was monitored for 3 more hours in the ED and remained asymptomatic during the rest of his stay and was subsequently discharged to follow up with ENT.

## Discussion

So, what happened to our patient? Activation of the trigeminocardiac reflex brings about an overstimulation of the parasympathetic nervous system leading to several potentially life-threatening hemodynamic changes such as bradycardia, hypotension, apnea, and even asystole.<sup>1</sup> Florian Kratschmer (1843-1922) was the first researcher to provide a comprehensive analysis of changes in breathing, blood pressure, and heart rate that can occur when mucosa of the nasal airways are stimulated mechanically or chemically. Based on the studies completed by Kratschmer, the reflex was ultimately named the Kratschmer reflex or trigeminocardiac reflex (TCR).<sup>3</sup> Figure 1 is a drawn-out sketch to represent the reflex.

You will notice that nasal packing can stimulate the maxillary branch of the Trigeminal Nerve (Labeled V2), and via CN 5 (blue arrow) results in activation of the main sensory nerve nucleus of Cranial Nerve 5 (Labeled 1). This ultimately sends signals down the internuncial fibers (red arrow) to the motor nucleus of Cranial Nerve 10 (Labeled 2) resulting in an activation of vagal myocardial depressor fibers via CN 10 (green arrow) which leads to an overwhelming hyper-parasympathetic response.<sup>4</sup> The reflex is usually witnessed during skull-base surgeries, facial, and dental surgeries, but in the emergency department this reflex can be elicited via utilization of nasal packing for epistaxis.

Literature documenting outcomes are limited at this time. However, there was a case that was noted. In a 2015 case report by Awasthi et. al, they discussed a patient who became agitated within 15-20 minutes after a posterior

nasal packing. The patient then developed hypotension, bradycardia, then subsequently apnea and asystole. Advanced cardiac life support was initiated but the patient failed to achieve return of spontaneous circulation and died. The nasal packing remained in place and was never removed during the cardiac arrest.<sup>4</sup>

A scarcity in current literature regarding this phenomenon is due to the inability to accurately document the neuroanatomy of this reflex coupled with the rare and variable expression of this in humans beyond the current anecdotal findings by craniofacial surgeries. Significant literature is also unavailable regarding the stimulation of the reflex after nasal packing, but it is a reflex we should know exists and know how to respond when it occurs.

## Conclusion

The quintessential significance about the TCR is that immediate removal of the nasal packing or other nasal foreign body will reverse the hemodynamic instability. Fluid boluses will help with hypotension but will not be effective without removing the offending agent. Other differentials for such a clinical presentation could be hemorrhagic shock from massive blood loss or septic shock from toxic shock syndrome. However, these changes would take time to progress and would not cause the immediate hemodynamic instability seen with the reflex. Our objective in presenting this case study is to spread awareness of the unlikely but deadly consequence that nasal packing can cause to your patients, and most importantly, knowing how to reverse it. ★

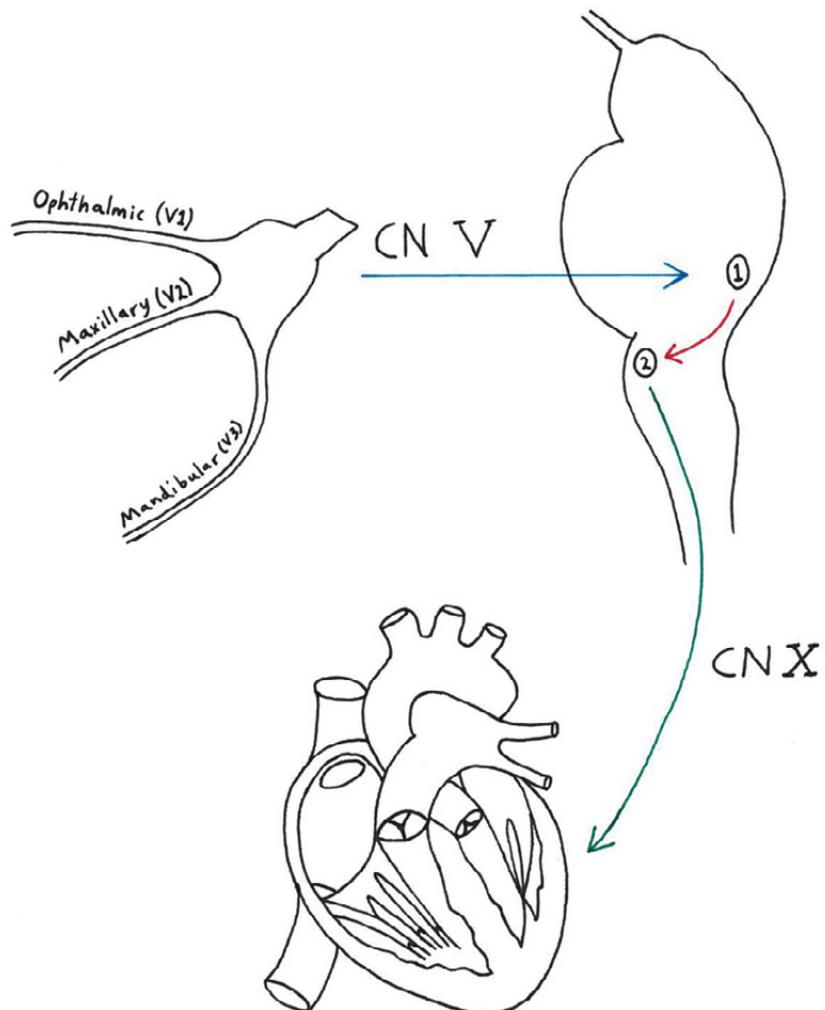


Figure 1. Trigemino-cardiac Reflex

# Blunt Cardiac Injury Manifesting as RBBB on Electrocardiogram

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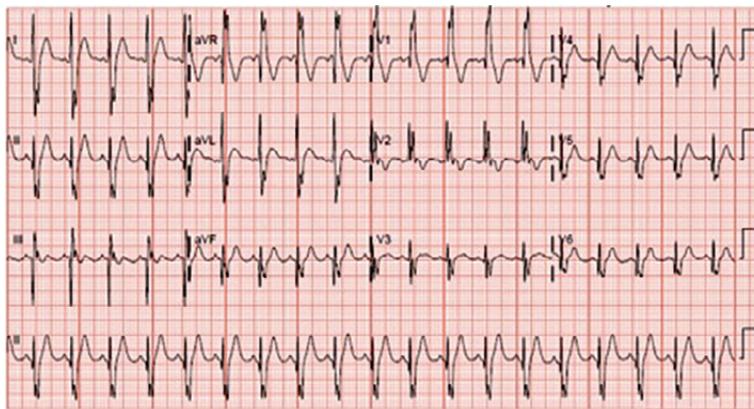
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## Case

A 25-year-old man with no past medical history presented to the ED after a motor vehicle collision, following a 10-minute extrication period. He had obvious injuries to the scalp, face, right hand, and right lower leg. Initial vitals were HR 68 bpm, BP 113/54 mmHg and RR 19 breaths/minute with 100% SpO<sub>2</sub>. The primary survey did not warrant emergent intervention and the patient's GCS was 15. FAST was normal, and the secondary survey demonstrated facial trauma, an obvious right lower leg deformity, chest wall tenderness, and multiple lacerations to the extremities.

## Diagnosis

His initial 12-lead ECG demonstrated sinus tachycardia with a right bundle branch block pattern, without historical comparison available (Figure 1). The ECG morphology raised concern for blunt cardiac injury (BCI) and cardiac enzymes were ordered. The initial troponin I and CKMB levels were 24.27 ng/mL (ref. <0.04 ng/mL) and 9.0 ng/mL (ref. </= 2.5 ng/mL), respectively.

An hour after presentation, the patient demonstrated tachycardia, and a repeat FAST demonstrated free fluid in the RUQ and LUQ. CT of the chest, abdomen and pelvis revealed liver and splenic lacerations and contusions. A plain radiograph revealed a comminuted right femoral shaft fracture.

The patient received emergent transfusion of packed red blood cells and was admitted to the trauma ICU for management and for monitoring of blunt cardiac injury with serial ECGs and cardiac enzymes given the high risk for cardiovascular complications.

## Discussion

Echocardiography performed on admission revealed normal systolic function without ventricular wall abnormalities. However, previous studies have shown troponin elevations to be associated with increased mortality in blunt cardiac injury, whereas echocardiography has been less consistently correlated with cardiac complications.<sup>1,2</sup> In this case, serial ECGs normalized over the course of admission, as the patient received blood transfusion and maintenance intravenous fluid in the ICU. The initial troponin I level was the peak value for admission and trended down with supportive care.

Blunt cardiac injury (BCI) is the result of a direct blow to the precordium or a sustained force to the chest wall causing compression of the heart between the spine and sternum, most commonly seen in the setting of motor vehicle collision or major thoracic injury.<sup>3,4</sup> The ED diagnosis

of BCI is difficult, as trauma patients often have various concomitant injuries that may serve as distractors. A lack of evident external thoracic injury or mild symptoms do not exclude the presence of BCI.<sup>3</sup> The presenting symptoms in patients with BCI fall across a spectrum ranging from mild symptoms such as precordial pain and palpitations to hemodynamic instability and heart failure (tachycardia, hypotension, hypoxia).<sup>3,4</sup>

An elevated troponin level is an important diagnostic and prognostic marker for BCI.<sup>1</sup> However, obtaining an ECG is important in the initial evaluation, with one series demonstrating that 88% of patients with BCI demonstrating abnormal ECG, defined as bundle branch block, T-wave changes or ST segment changes.<sup>1</sup> Cardiac injury to the left ventricle manifests as diffuse ST changes or pathological Q waves in contrast to the right ventricle which may manifest as right ventricular strain signs (such as right bundle branch block, as seen in this patient).<sup>3</sup> The right ventricle is more commonly injured due to its anterior position in the thorax; injury to its smaller mass may create subtle ECG abnormalities that are easily overlooked.<sup>3,4</sup> ★

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# Rare Presentation of Newly Diagnosed HOCM

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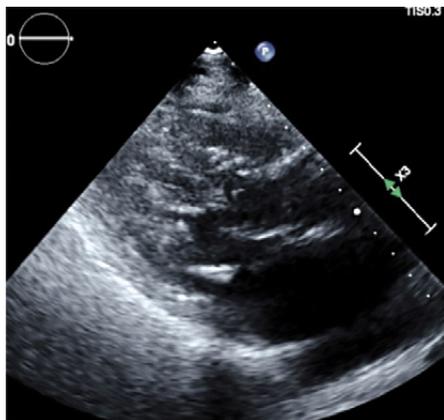
## The Case

A 94-year-old female was brought to the ED by EMS reporting syncope and dyspnea. EMS reported finding the patient to be hypoxic and hypotensive. They provided supplemental oxygen via nasal cannula, started a dopamine infusion, and transported her to the ED, where a non-rebreather mask was placed secondary to persistent hypoxia. She remained hypotensive and was subsequently started on vasopressor support with vasopressin and norepinephrine infusions.

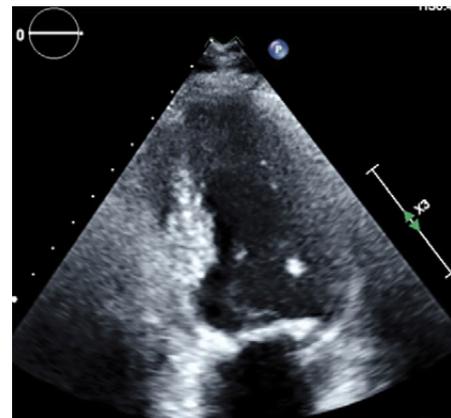
Initial EKG did not show any signs of arrhythmias. Initial diagnostic labs were concerning for mildly elevated creatinine compared to the patient's baseline and an elevated BNP. Chest X-ray revealed mild vascular congestion but no signs of acute cardiopulmonary abnormalities. Due to the concern for pulmonary embolism, a CT angiogram of the chest was obtained, which was unremarkable. She was then admitted to the critical care teaching service secondary to requiring vasopressors. An echocardiography performed during admission showed mild left ventricular outflow obstruction is present with findings consistent with hypertrophic obstructive cardiomyopathy. She also developed new onset atrial fibrillation during her hospital course.

## Discussion

Hypertrophic cardiomyopathy (HCM) is a well-known and researched genetic disease which leads to hypertrophy of the myocardium, generally most prevalent within the ventricular walls. The thickening of the heart muscle leads to left ventricular stiffness, mitral valve changes, and cellular changes to the myocardium. Hypertrophic obstructive cardiomyopathy (HOCM) is a subset of HCM, in which the hypertrophy of the ventricular walls results in obstruction of the ventricular outflow tract. It is the leading cause of non-traumatic sudden death in young individuals and most well-known for causing sudden cardiac death in athletes. While most known for being present in young individuals, it is diagnosed in patients of all ages. It has a prevalence of approximately 1:500.<sup>1</sup> HOCM is caused by mutations of dozens of genes encoding sarcomere-associated proteins. The genes most found to be mutated are MYH7 and MYBPC3, which encode beta-myosin heavy chain and myosin-binding protein C, respectively. They account for ~50% of HOCM families.<sup>2</sup> Inheritance is primarily autosomal dominant with variable penetrance. HCM is a relatively benign disease, with approximately two thirds of patients living a normal life span without significant morbidity. Those that



**Figure 1.** LVOT obstruction during systole

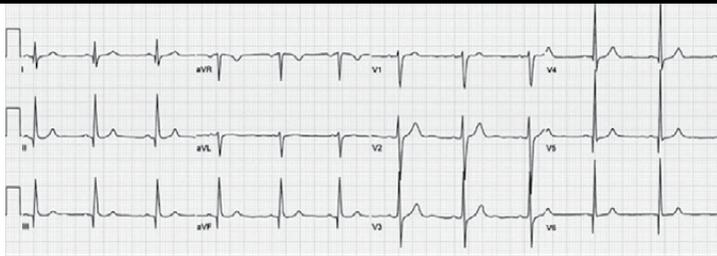


**Figure 2.** Hypertrophy of the interventricular septum with obstruction during systole

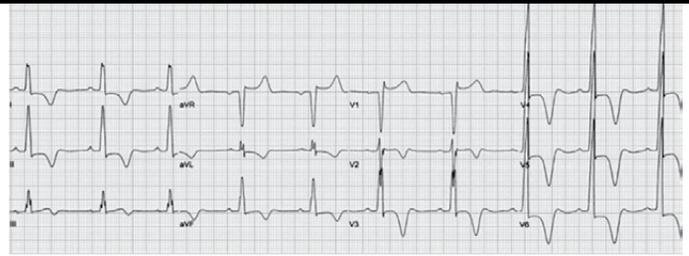
suffer adverse effects generally result due to severe left ventricular outflow tract obstruction leading to increased risk of sudden cardiac death (SCD) and heart failure. Major risk factors that increase the probability for SCD occurring includes family history of SCD, recurrent syncope caused by arrhythmias, sustained and repetitive non-sustained ventricular tachycardia, and a previous episode of cardiac arrest. Studies have found that individuals who are diagnosed at advanced age (>60 years) are generally at a decreased risk for SCD and consider it a negative risk marker. This is likely secondary to myocardial stabilization despite the genetic mutation, as well as the ability for the heart to tolerate chronic LV outflow obstruction appropriately.<sup>3</sup>

## Presentation

Patients with HOCM will generally present to the ED as a result of chest pain, presyncope, syncope, or palpitations. Chest pain results secondary to myocardial hypoperfusion due to the hypertrophic ventricular wall, which in turn leads to a myocardial oxygen supply and demand imbalance. This results in ischemic chest pain that may present similarly to anginal pain with crushing chest pain radiating to the left arm and



**Figure 3. EKG findings of HCM with dagger Q waves in the lateral and inferior leads<sup>5</sup>**



**Figure 4. EKG findings of apical HCM with giant T-wave inversions in the precordial leads<sup>5</sup>**

neck. Patients that develop arrhythmias secondary to HOCM will present with syncope, presyncope, or palpitations. The most common arrhythmia produced is recurrent non-sustained ventricular tachycardia. As with the patient presented in this case, atrial fibrillation occurs in approximately 25% of patients with HOCM and LVOT obstruction. It is unclear what the mechanism for development of atrial fibrillation is at this time.<sup>4</sup> Syncope can also result secondary to left ventricular outflow tract obstruction in the setting of preload reduction as well as a sudden increase in myocardial stress. Common causes of preload reduction include hypovolemia, hemorrhage, and medications effects. Myocardial stress can occur in the setting of exertion such as exercise or playing sports, as well as in the setting of emotional stress.

### Diagnosis

Initial evaluation in the Emergency department should begin with an EKG to evaluate for cardiac arrhythmias as well as for signs of left ventricular hypertrophy. EKG findings concerning for HOCM are variable in nature. One group of findings are increased precordial voltages with non-specific ST segment and T wave abnormalities with the voltages meeting voltage criteria for LVH. Asymmetrical septal hypertrophy results in deep, narrow (“dagger-like”) Q waves in the lateral (V5-6, aVL) and inferior (II, III, aVF) leads as seen in the EKG above.

A second and less prevalent form of HCM is apical HCM. This variant leads to localized hypertrophy to the left ventricular apex leading to a “spade-shaped” configuration of the LV on echocardiography. EKG findings of this include giant T-wave inversions in the precordial leads, as seen in the EKG above.

The diagnosis of HOCM is commonly confirmed with an echocardiogram and is generally not completed until a patient is admitted into the hospital. The presence of left ventricular end diastolic wall thickness >13mm is needed to make the diagnosis.

### Treatment/Disposition

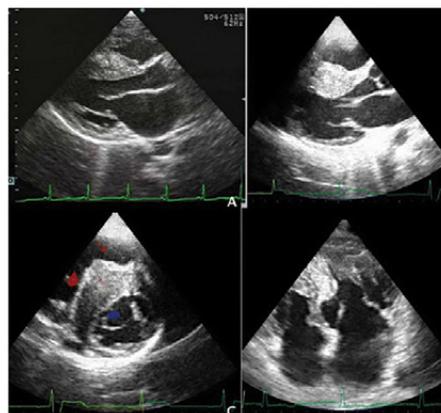
Many individuals that are diagnosed with HCM have a relatively benign course and do not require any significant interventions. Those who present to the ED should, however, pique a higher clinical suspicion for requiring interventions as they are symptomatic from the condition. For individuals presenting with anginal chest pain, beta-adrenergic receptor blockers have been found to relieve chest discomfort by decreasing myocardial oxygen demand. They have also been shown to attenuate exercise induced LVOT obstruction that results in dyspnea. Non-dihydropyridine calcium channel blockers such as verapamil or diltiazem have also been found to have benefit when patients do not tolerate or respond to beta-blockers. Individuals who present with new onset arrhythmias such as atrial fibrillation

are most responsive to cardioversion. If patients develop persistent or paroxysmal atrial fibrillation, they will require long-term anticoagulation to reduce the risk of thromboembolism. In individuals with increased risk factors for SCD, implantation of an implantable cardioverter defibrillator (ICD) is strongly advised. Major risk factors for SCD include SCD include family history of SCD, recurrent syncope caused by arrhythmias, sustained and repetitive non-sustained ventricular tachycardia, and previous episode of cardiac arrest. Individuals with any of these risk factors are likely to benefit the most from having an ICD implanted. For individuals who develop severe heart failure that is not improved with pharmacotherapy, they may eventually require implantation of a left ventricular assistance device (LVAD) or cardiac transplantation.

### Conclusion

This case presentation demonstrated a rare presentation of newly diagnosed HOCM in an elderly patient that presented secondary to syncope. She developed concern for cardiogenic vs. hypovolemic shock, requiring multiple vasopressors for cardiovascular support. She also developed new onset atrial fibrillation to further complicate the presentation and hospital course. Given the multiple possible causes for her syncope and persistent hypotension, the inciting event in this case remains unclear. The case teaches the importance of keeping a wide differential.

The patient was resuscitated in the ED, diagnosed on hospital day 1 (aiding in timely treatment) and was discharged home with a prescription for metoprolol after a brief hospital stay. ★



**Figure 5. Echocardiographic images of HOCM<sup>6</sup>**

# Sudden Post-Coital Hemopericardium with Cardiac Tamponade on Apixaban

Hardeep Hunjan, DO

St. Joseph Medical Center

Tiffany Anaebere, MD

Alameda Health – Highland Hospital

Direct oral anticoagulants (DOACs) have become the preferred anticoagulant medication for patients with nonvalvular atrial fibrillation, deep vein thrombosis, and pulmonary embolism. However, recent case reports show life threatening bleeding with DOAC use. Apixaban is a direct factor Xa inhibitor that is used commonly to prevent stroke in nonvalvular atrial fibrillation and in the prevention and treatment of blood clots in pulmonary embolism and deep vein thrombosis. Direct factor Xa inhibitors are alternatives to the well-known warfarin and for some patients are preferred given convenient dosing, no laboratory monitoring, less interactions with other medications and reported decreased bleeding risk.<sup>1</sup> Despite this reported decreased risk, bleeding remains a common adverse effect of apixaban with gastrointestinal and intracranial bleeding reported as most common.<sup>2-3</sup>

One rare bleeding complication is the development of spontaneous hemopericardium.<sup>4,7</sup> There are a few case reports that document the development of this condition in patients on apixaban, with the first case series of this in the United States reported in 2015.<sup>3</sup> We present a case of spontaneous hemopericardium in a patient on apixaban, specifically the development of spontaneous hemopericardium during sexual intercourse in an older gentleman in his seventies. There are no documented cases of the development of hemopericardium in association with exertional activity, in this case, sexual intercourse. We discuss sildenafil use as a potential serious drug-drug

interaction with apixaban. We also discuss reperfusion injury as a potential mechanism for bleeding after coitus. This case highlights the importance of reiterating bleeding risks to patients on anticoagulation, especially the possible development of spontaneous hemopericardium during sexual activity.

## Case Report

A 75-year-old Caucasian male presented to the ED with the chief complaint of severe shortness of breath, acute distress, and hypotension. He had a past medical history significant for hypertension, hyperlipidemia, benign prostatic hyperplasia, B12 deficiency, obstructive sleep apnea, erectile dysfunction, and atrial fibrillation on chronic anticoagulation with apixaban 5 mg BID. He had been on apixaban for 11 months. His other medications included losartan, extended release diltiazem, cyanocobalamin, furosemide, hydralazine, atorvastatin, finasteride, and sildenafil. He was not on any antiplatelet agents. The patient was having sexual intercourse with his wife when he developed sudden onset shortness of breath and suffered a near syncopal episode. The patient's blood pressure on arrival was 53 mmHg/palp, heart rate of 83 beats per minute and saturating 100% on 2 liters of oxygen by nasal cannula.

Shortly after arrival, a chest x-ray (Figure 1) and a bedside echocardiogram were performed to evaluate the patient's shortness of breath and hypotension. His chest x-ray revealed severe cardiomegaly and his echocardiogram demonstrated a large pericardial effusion with evidence of tamponade physiology. The patient was started on vasoactive medications with an initial increase in his blood pressure

to 90mmHg systolic. However, after escalating doses of vasopressors and volume resuscitation the patient's mentation worsened and he became more dyspneic and hypotensive. An attempt at bedside pericardiocentesis under ultrasound guidance was unsuccessful. The patient appeared to have developed a thrombus in the pericardial space, inhibiting successful drainage of the pericardial sac with a needle technique (figure 2).

Soon after the patient lost pulses. Cardiopulmonary resuscitation was started, the patient was intubated, and after verbal consent was obtained from the patient's wife an emergent subxiphoid pericardiotomy was performed in the ED by the on-call cardiothoracic surgeon. Eight hundred (800) ccs of blood and clot were evacuated from the pericardial space and the patient immediately regained pulses. He was taken directly to the operating room where a median sternotomy was performed given concern for persistently active bleeding. The pericardium was marsupialized and additional blood clot evaluated. Complete exploration of the heart revealed no evidence of aortic or coronary dissection, no cardiac chamber bleeding, no epicardial inflammation, and normal pericardial thickness. A surface of epicardium near the coronary sinus was found to have muscle and epicardial bleeding without an involved vessel. This was repaired with pledgeted sutures and biogluce. Labs at the time of ED arrival showed no evidence of thrombocytopenia, uremia, coagulopathy, or anemia.

After being transferred to the intensive care unit he required up to 4 vasoactive medications and was transfused with multiple units of blood products, cryoprecipitate, factor 7

and 9, and activated prothrombin complex concentrate. It was understood that these interventions would likely not reverse the effects of apixaban. Andexanet alfa was not available for administration. The patient developed cardiogenic and hypovolemic shock, upper gastrointestinal hemorrhage, oliguria, severe acidosis, and right sided hemiparesis. He ultimately died 24 hours after his initial presentation.

## Discussion

A multitude of research studies show DOACs are associated with lower risk of major bleeding when compared with warfarin. This has made DOACs a leading first line medication for nonvalvular atrial fibrillation patients. However, recently there have been several case reports of DOACs such as direct factor Xa inhibitors and direct thrombin inhibitors causing spontaneous bleeds, including in the pericardium.<sup>4-7</sup> Many of these case reports cite drug-interactions such as common CYP450 medication inhibitors,<sup>7</sup> herbal products,<sup>5</sup> and renal failure<sup>8</sup> as likely causes. A medication review of our case reveals our patient was on 180 mg of extended-release diltiazem and 20 mg sildenafil, both notable CYP450 inhibitors. Additionally, a recent in vitro study shows sildenafil may significantly block apixaban and rivaroxaban cell efflux via p-glycoprotein inhibition, thereby increasing DOAC intestinal absorption

and potentially increasing bioavailability and subsequent bleeding risk.<sup>8</sup> Given these research studies, we postulate regular sildenafil use prior to sexual intercourse in patients taking DOACs may be a risk factor for spontaneous serious post coital bleeding.

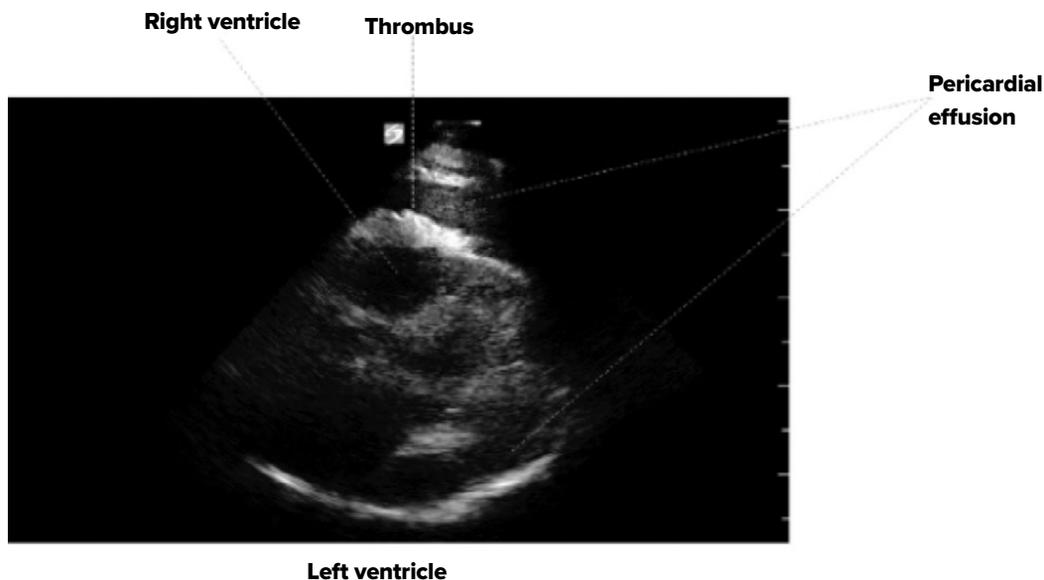
Currently it is unclear whether exertional activity such as sexual intercourse is a risk factor for cardiac bleeding in patients on DOACs. We propose a theory where exertional activity such as coitus may cause myocardial ischemia in older vasculopathic patients, leading to subsequent reperfusion injury. During reperfusion injury, increased intracellular calcium, increased supply of oxygen free radicals, and subsequent inflammatory response may trigger bleeding in patients taking DOACs. However, recent studies have shown exercise as a potential protective factor via heat shock proteins, extracellular vesicles containing antioxidants, and improved mitochondrial function.<sup>9-12</sup> In our patient it is unclear if the exertional activity itself played a role in his spontaneous muscle and epicardial bleeding. Our case could present a possible refutation of exercise as a potential protective factor in preventing reperfusion injury.

## Conclusion

This case highlights the importance of reiterating the bleeding risks to



all patients on anticoagulation. It is imperative to counsel patients, particularly older individuals, about the rare but possible development of spontaneous hemopericardium when engaging in sexual activity. Phosphodiesterase inhibitors such as sildenafil and other medications such as calcium channel blockers may decrease the metabolism of DOACs leading to increased bleeding risk. Exertional activity such as sexual intercourse, once thought to be protective against reperfusion injury, may lead to spontaneous bleeding. Although it is difficult to know to what extent these factors contributed to spontaneous hemopericardium, we highlight life threatening bleeding as a rare side effect in patients taking DOACs with sildenafil and diltiazem. ★



# Building Global EM and Its

**Ashley Pickering, MD, MPH**

Emergency Medicine Resident  
University of Maryland

**Jerry Z. Oommen, OMS-IV**

Michigan State University  
College of Osteopathic Medicine  
Class of 2021

**Dania Abu-Jubara, OMS-IV**

Arkansas College of Osteopathic Medicine  
Class of 2021

**Lorena Rodriguez Perez, OMS-IV**

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College of Osteopathic Medicine  
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**Alexandra Digenakis, DO**

University of North Carolina

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Department of Emergency Medicine  
University of Florida College of Medicine –  
Jacksonville

**Andrés Patiño, MD**

Assistant Professor,  
Department of Emergency Medicine  
Emory University School of Medicine

The Global Emergency Medicine Student Leadership Program (GEMS LP), formerly known as the International Ambassador Mentorship Program (AMP), was established in 2018 as a joint effort of EMRA and the ACEP International Ambassador Program to provide guidance to the growing number of EM-bound medical students seeking GEM mentorship. This program aims to expose medical students to the field of GEM through participation in global health projects, engagement in a thought-provoking journal club, mentorship from ACEP Ambassadors participating in EM programs worldwide, and networking with like-minded peers. In addition to fostering interest in GEM, the program seeks to expose students to some of the complex issues in global health and the importance of having an ethical, equitable, and sustainable approach to global health involvement.

**The Need**

Emergency medicine is unrecognized, or in its infancy, in the vast majority of the world. This is particularly true in low and middle income countries (LMIC) where it is estimated that 24 million lives are lost each year due to “conditions sensitive

to prehospital and emergency care” including: injuries, infections, perinatal complications, and acute exacerbations of noncommunicable diseases.<sup>1</sup> Recognizing this need, a recent World Health Assembly resolution emphasized the necessity of ensuring timely care for the acutely ill and injured.<sup>2</sup> To date, several studies in LMICs have shown that even small interventions in areas such as pre-hospital care and triage systems can have a significant impact on mortality.<sup>3,4</sup>

**Building a Workforce**

There is a growing interest in global health experiences among medical students and residents. Consequently, there remains an opportunity to institute programs that provide essential mentorship, education, and career guidance to the next generations of physicians in global EM, particularly early in training. A recent survey of EM residency programs revealed 75% of respondents offer short term experiences

## GEMS LP CLASS OF 2019-2020 COUNTRIES OF FOCUS & PROJECTS



**AMERICA**

ACEP International Section 

**GEMS LP Leadership Team**  
**Intl Section Chair:** Elizabeth Devos, MD, MPH  
**GEMS LP Chair:** Andres Patiño, MD  
**Resident Co-Chair:** Ashley Pickering, MD, MPH  
**Journal Club Director:** Alexandra Digenakis, DO



**MEXICO**

**Shelby Wood, MS-4**  
St. George's University SOM 

**Mentor:** Jessica Bravo, MD  
**Project:** "It involved a discussion of the historical roots of global health inequity. This led to an understanding the events that have shaped the state of modern global health by examining the history of classically impoverished countries and exploring solutions."



**BELIZE**

**Jerry Oommen, MS-3**  
Michigan State University COM 

**Mentor:** Mark Bruce, DO  
**Project:** "The aim of the project was to assess the state of Emergency Medical Services in Belize, collaborate with the Belize Emergency Response Team, and make a compelling argument to the national government on the need for a nationwide EMS system."



**ECUADOR**

**Michaela Banks, MS-4**  
University of Virginia SOM 

**Mentor:** Andrés Patiño, MD  
**Project:** "We were involved in a variety of projects throughout the year, including planning the ACEP Ambassador Conference. We worked on a manuscript describing the state of emergency departments in Quito, Ecuador which has been submitted to a journal."



**PARAGUAY**

**Kareem Eid, MS-3**  
University of Miami Miller SOM 

**Mentor:** Elizabeth DeVos MD, MPH, FACEP  
**Project:** "Our project involved helping establish and implement a pediatric emergency medicine ultrasound training module in Paraguay which included writing cases to be used during simulation training for the emergency medicine residents and attendings."

# Next Generation of Leaders

in global health, however only 39% offer longitudinal global health training in the form of tracks or concentrations.<sup>6</sup> Global health tracts have demonstrated a positive influence on knowledge, skills, and attitudes in working with underserved populations, and increase the likelihood that participants will choose to work abroad, as well as in high-need practice environments at home, following graduation.<sup>7</sup> However, one shortcoming of global health

experiences in residency tends to be inadequate pre-departure preparation to teach fundamental knowledge, skills, and attitudes needed for trainees to make a positive impact while working internationally.<sup>6</sup> At the medical school level, even fewer opportunities exist for GEM training at home and abroad.<sup>8</sup> Building competencies in domains such as: global burden of disease, social and environmental determinants of health, capacity strengthening, and program

management are essential for future careers in global health.<sup>9</sup>

Recognizing these needs, various resources have been created to aid in GEM career development. These include books such as “The Nuts and Bolts of Global Emergency Medicine” and SAEM’s Resident And Medical Student (RAMS) Roadmap for GEM, as well as educational and assessment tools such as AEM’s Global Health Milestones.<sup>5,9,10</sup> Though these resources are invaluable to understanding key concepts and the steps necessary to pursue a career in GEM, they fall short of providing aspiring GEM leaders with the personal relationships and hands-on opportunities necessary to kickstart their careers. GEMS LP is one such program that seeks to bridge this gap.

## Filling the Mentorship Gap

GEMS LP is a 1-year program, under the purview of the ACEP International Ambassador Program, that aims to expose medical students strongly interested in EM to the wide variety of opportunities in GEM through mentorship, journal club (JC), and a global health project. ACEP International Ambassadors, who represent ACEP and assist health care providers worldwide with sustainable development of emergency care, serve as mentors. Over the first two years of the program, mentorship followed the traditional dyad relationship where one medical student was paired with one Ambassador based on a shared country or region of interest. This year, the program has evolved to a multi-mentor format consisting of virtual mentorship meetings with multiple Ambassadors, along with longitudinal guidance and support from the GEMS LP leadership team. This change allowed access to a wider cohort of mentors with varied experience to fulfill students’ mentoring needs, including regional, academic, and GEM subspecialty interests.<sup>11</sup> The goal of these interactions is to enable mentees to form meaningful relationships with a network of mentors in the field of GEM and gain an understanding of the variety of career paths and subspecialties within GEM. Kaley Waring, MS4, affirmed that her primary mentor was “instrumental

**HAITI**  
**Kimberly Herard, MS-4**  
 Florida Atlantic University COM

**Mentor:** Nicole Piel, MD  
**Project:** "The project entailed discussion of some of the problems that could occur with Non-Governmental Organizations (NGO's) in Haiti and the issues that the country and patients may face with an NGO and the after-effects when the groups pull out of the country."

**NORWAY**  
**Karra Manier, MS-4**  
 Howard University COM

**Mentor:** Gayle Galetta, MD  
**Project:** "We developed a country report to highlight the current state of emergency infrastructure within Nigeria and to discuss the importance of advancing education and training experiences, as well as the emergency medical system in Nigeria."

**INDIA**  
**Sriram Venkatesan, MS**  
 Sri Ramachandra Medical College, India

**Mentor:** Arun Nandi, MD, FRCS, FACEP  
**Project:** "We established contact with one of the largest government-operated hospitals in South India and helped them work on a new triage protocol that will eventually be used in government-operated hospitals across the state."

**LAOS**  
**Kaley Waring, MS-3**  
 University of California San Diego SOM

**Mentor:** Kristiana Kaufmann, MD, MPH  
**Project:** "The project involved expanding the curriculum for the current Lao residency program including creating both a guide to utilizing FOAMed in their curriculum, as well as a train-the-trainer module in Problem-Based Learning (PBL) as a teaching modality."

**THAILAND**  
**Neha Sikka, MS-3**  
 Icahn SOM at Mount Sinai

**Mentor:** Wirachin Hoonpongsimanont, MD  
**Project:** "We sought to create a training program for laypeople from a rural hill tribe who live in the mountainous areas of northern Thailand by reviewing existing layperson trauma training in order to develop and implement a curriculum in the Thai Hill community."

**UGANDA**  
**Nivedita Poola, MS-4**  
 Boston University SOM

**Mentor:** Stacy Chamberlain, MD, MPH  
**Project:** "We contributed to curriculum development for an emergency care mid-level provider training program in Uganda. We created educational content on under-recognized noncommunicable diseases to improve care and reduce excess morbidity and mortality."

**CAMBODIA**  
**Dania Abu-Jubara, MS-3**  
 Arkansas COM

**Mentor:** Donna Venezia, MD  
**Project:** "We focused on exploring the benefits and barriers of point-of-care ultrasound training in resource-limited settings with a goal of creating an emergency ultrasound training curriculum that could be used in Cambodia and other low- or middle-income countries."

in helping me navigate a future in global EM. Through our discussions about partnership, I have a better appreciation for reciprocal learning opportunities and the importance of local project ownership.”

Monthly virtual JC meetings are another great opportunity for students and mentors to interact and continue to build dynamic relationships. Mentees present a book chapter, journal article, and a global health project proposal all pertaining to one central topic. Prior to the JC meeting, the students meet with mentors in preparation to guide a lively and insightful conversation. Discussion topics include global health inequity and the ethics of humanitarian work. Additionally, this year’s JC sessions are supplemented with two books, *An Introduction to Global Health Delivery* and *Reimagining Global Health: An Introduction*. Jerry Oommen, MS4, felt that “the reading topics covered essential global health concepts, but the most fruitful aspect was the conversations about real-world examples with GEM colleagues around the world.” These events are open to all members of the ACEP International Section, and participants do not need to be an Ambassador or to

be involved in the mentorship program. Diverse perspectives and insights are vital to the success of the discussion.

The final core component of the program is the global health project. The goal is to expose participants to real-world initiatives with mentor guidance and provide students with skills and experiences that can be applied to future work. Last year, projects sought to address needs in 11 different countries (as seen in the map) and ranged from assessing the unintended ramifications of non-governmental organizations to developing curriculum for EM training programs. Though one year is often insufficient to complete all the aims of a project or assess its impact, many students maintain a relationship with their mentors to continue their work. At the conclusion of the program, students feel inspired by their progress and are eager to continue forging their path in GEM. Dania Abu-Jubara, MS4, whose project centered on ultrasound training in low resource settings, noted that “[her] experience during this program reaffirmed [her] passion for global health and ignited a new passion — bedside

ultrasound.” She hopes to pursue a fellowship that combines these interests.

The world needs and deserves EM to help improve the quality of life and the state of healthcare globally. GEM strives to fulfill this need through better understanding of the current global health status and its limitations and the development of ethical and sustainable emergency care initiatives. Accomplishing such a feat is a tall task and begins with the development of robust educational and mentorship experiences at all stages of training. GEMS LP is one such opportunity on a mission to pave the way for the next cohort of outstanding GEM leaders!

### Get Involved

For more information on GEMS LP and how you can get involved as a mentor, mentee, or journal club participant please visit: <https://www.emra.org/be-involved/committees/international-committee/amp-program-info> or email the program leadership at [info.GEMSLP@gmail.com](mailto:info.GEMSLP@gmail.com). The 2021/22 GEMS LP application will open for students this spring with a deadline of June 30, 2021. We are always recruiting faculty mentors! ★



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# Part 1

**Lynea Bull, MD**

EM Resident  
Baylor College of Medicine

**Michelle Suh, MD**

EM Resident  
Baylor College of Medicine

**Anisha Turner, MD**

Fellow, Medical Education  
Assistant Professor, Emergency Medicine  
Baylor College of Medicine

**Sara Andrabhi, MD**

Assistant Residency Program Director  
Assistant Professor, Emergency Medicine  
Baylor College of Medicine

**E**mergency Medicine (EM) is a specialty that answers the call to serve, be on the frontlines, and step up to challenges. Due to deep inequities embedded within this country's history, we must address the deficiencies of diversity, equity and inclusion (DEI) within our field. Such a feat requires a multifaceted approach starting from eager medical students to attendings looking to push the envelope in DEI. In this three-part piece, we discuss how Baylor College of Medicine's (BCM) EM Program has targeted each stage of medical training to promote DEI within EM and beyond. On average, BCM EM is ~20% of the institution's African American composition and ~10% of the Latinx composition.

Residency and department DEI work are an important first step. Showcasing this effort to those that are unfamiliar with your program can be challenging. The most effective means of communicating DEI commitment is incorporating it before, during, and after the interview day.

## Before the Interview

Participating in conferences hosted by underrepresented in medicine (URiM) student organizations such as underrepresented minority (URM), LGBTQ, and women in medicine groups showcases the program's dedication to diversity early on. Programs can "show off" their diversity in person and "show up" by putting their time and money toward being accessible at events supporting URiM students. The candid conversations create memorable experiences for URiMs while allowing

# Developing a Diverse and Inclusive Pipeline in Emergency Medicine

programs to grasp the breadth of diversity in the applicant pool. Additionally, applicants can see that a program has the ability to support their residents' attendance at these conferences and give them the opportunity to network with other URiM residents/faculty.

Another impactful indicator is scholarship to support URiM students interested in an away rotation. A scholarship reduces the financial burden of away rotations to allow URiM students an immersive experience not overshadowed or precluded by financial stresses.

Programs should assess what information is available to prospective applicants online. Make a dedicated webpage stating a program's definition of and commitment to DEI work, with examples of projects and resident involvement. Consider the photos of the residents and faculty — are the visual representations proportionate to the makeup of the program and department? This is an opportunity for programs to be transparent about their current state of diversity, as well as describe goals for improvement. In the interview invitation, include a statement of the program's commitment to DEI and emails of DEI advocates. Resident DEI committees can reach out independently to share goals, current projects, and contact information.

## During the Interview

During the interview day, the introduction should include an overview of residency and department commitment to DEI. Standardized interview questions, such as one about implicit bias, allow programs to assess applicant commitment to DEI values and

minimize bias in their own interviewing. Consider choosing interviewers who can speak to the DEI work being done. The interview day is more intimate than the website or emails — if there is a need for difficult and honest conversations, such as where the program has gone wrong in the past and how it is rectifying it, this is the time.

For programs early in their endeavors for DEI, consider a dedicated dinner or interview day for URiM applicants. This is helpful for programs with a small number of URiM residents/faculty, so they are not unduly burdened with participating in interview days and mixers more than their counterparts. For all mixers, choose each location with an inclusive lens, assuring that all cultural orientations and genders will feel welcome and accepted.

Play to your strengths. BCM is located in the most diverse city in America, and we flaunt it. Our residents work at the county hospital known for taking care of marginalized patient populations, and we highlight it. We mention our community outreach to disadvantaged populations not only because we are proud, but also to recruit to our mission and vision.

## After the Interview

After the interview day, consider a weekend for URiM applicants to take a second look. Travel funds and/or hotel accommodations are a meaningful way to demonstrate the program's commitment. Send follow-up emails about more ways to learn about DEI work. Show these applicants that as they embark on residency, there will be a continued commitment to DEI efforts within the residency, department, and institution throughout the years to come. ★



# A Letter from a Paramedic to an EM Doc

**Rob Canning Jr., JD, MBA, NRP**

Loyola University

Chicago Stritch School of Medicine

Class of 2023

@Cannrg4

Whether it's holding up the wall while waiting to unload a patient at the hospital or sitting in the front of the truck twelve inches away from your partner after clearing a call, EMTs and paramedics (and increasingly social workers, nurses, nurse practitioners, and physician assistants) are regularly

thinking about ways they can improve.

*On that last call, could my handoff to the hospital have been more concise? Should I have gone further down the treatment algorithm and given that last medication instead of punting it to the ED staff? What other questions could I have asked in my history-taking to sharpen my differential diagnosis?*

Occasionally, these questions bubble to the surface and you turn to your partner to review cases, kick around ideas and offer tips for improvement. These

exchanges are emblematic of one of the greatest attributes of EMS professionals – the desire to support and help each other succeed.

As EMS services work to improve the care they provide to their constituencies, it sometimes becomes necessary to collaborate with their ED colleagues. However, there are often communication barriers between prehospital clinicians and the ED staff that make this difficult. Understandably, the logistics of different employers, workspaces and shifts add

structural obstacles. Additionally, differences in training and experience can lead to peculiarities in mindset, perspective, and approach.

With this letter, I hope to bridge some of these difficulties and convey the ten most important things that I wish I could share with my receiving ED team, particularly the new EM doc or resident, if given the opportunity.

- 1. Online Medical Control is of Critical Importance.** In most systems, when we call you on the radio for medical direction, it's a big deal and should be taken as seriously as any consultation with upstairs. Most often, we need one of two things: 1) permission to do a procedure that we already know we need to do, or 2) are genuinely seeking advice on a complicated situation and need a gut check on what we're proposing. Listen closely, help us from getting anchored or avoid premature closure, and support what is likely to be a high acuity, low occurrence intervention.
- 2. Listen to the Report from the Prehospital Crew.** Listening to the patient care report from the prehospital crew during the transfer of care can lead to a more efficient transfer of information and a better continuum of care. We worked hard to obtain that information and it may be the only chance to learn about the patient's home and on-scene tidbits. Additionally, it may not be possible to rely on information from the nursing staff if there is a shift change or that person is tied up with another patient.
- 3. Feedback, Feedback, Feedback.** When we show up later in the day, you cannot begin to understand how much we appreciate receiving feedback on the patients we brought in earlier. Any information on diagnosis and disposition can greatly aid in our professional development and understanding. Oftentimes, it's the only feedback we get in EMS. Also, we tend to believe that if we are not told that we did anything wrong, we assume we are doing it right and those errors can be perpetuated.

- 4. Be on the Lookout for Teachable Moments.** We want to learn, so if you have a free moment or there is a good training opportunity, don't be afraid to pull us aside and teach us something helpful. EMT training can be as little as 160 hours so that on-the-job training is incredibly valuable.
- 5. Be Familiar with EMS Scope of Practice and Guidelines.** While it's not necessary to know the local EMS protocols by heart, having a working knowledge will give you a greater appreciation for what the EMS crew can and cannot do. Additionally, you may find that EMS crews are at the vanguard of care, especially in the areas of resuscitation and trauma. For us, it can be frustrating being criticized for practices where the hospital may be lagging behind.
- 6. Understand Our Limitations.** Remember that EMS providers do not find their patients laying on a hospital bed. It's a lot of work to get a patient from where they are found to the ambulance and then the hospital. Often, I find myself alone, in a non-sterile environment, on a bumpy road, while in a chaotic situation, and with limited information. Despite our best efforts, we won't be able to perform as well as a doctor with additional staff members and the equipment of the ED. Know that we are trying to do our best with the limited resources at our disposal and sometimes that means not everything can be done by the time the patient arrives at the hospital.
- 7. Patient Flow is In Your Hands.** Just as a backup upstairs can result in ED boarding, holding an ambulance crew in the ED awaiting a transfer of care can create a shortage of available personnel to respond to emergencies in the community. This practice can turn a hospital patient flow problem into an EMS system problem. Whatever you can do to free up stretchers so that crews can return to service can mean the difference between a rapid response and an extended response time.

- 8. Be a Clinical Leader.** In the eyes of most EMTs and paramedics, the EM doc is the be-all, end-all of clinical mastery, the person who the buck stops with in terms of treatment decisions. In many cases, we operate under your license, you determine our clinical guidelines, and you perform our QA/QI. Do what you can to stay up-to-date and expect the same of the clinicians you oversee.
- 9. Be a Champion for Improvement.** EM docs are uniquely positioned to advocate on behalf of the rest of the healthcare team. You are the changemaker and nothing can happen to advance EMS without physician support. The expectation is that EM physicians get involved with ED operations, figure out how to effect change within the department and in the field, are in contact with local EMS medical directors, and are out there teaching CME and setting an example.
- 10. Pass What You Know on to the Next Generation.** To senior residents and attendings, teach the next wave of aspiring EM docs about EMS, how to value them as part of the healthcare team. EMS and EM are both young specialties with the potential for significant growth. Each is rapidly maturing, evolving, and transforming. These changes have only been expedited by the current pandemic. It is increasingly becoming possible to envision a world where the ambulance is not only seen but operates as an extension of the ED. If we're going to be working together, we should learn from each other, support each other and collaborate on making prehospital and emergency care the best that it can be. I hope this letter is a part of that process and a spark of an expanding dialogue. ★

*Rob Canning got his start in EMS as a high school EMT in Darien, Connecticut, and is currently a paramedic at Hyattsville Volunteer Fire Department in Prince George's County, Maryland. Prior to medical school, he was also a transactional and regulatory attorney with Latham & Watkins LLP in Washington, D.C., advising health care and life sciences clients.*

# Navigating the Military Match through COVID

A Perspective from Army Medical Students Vying for a Spot as an Emergency Medicine Resident in the Midst of a Global Pandemic



**2LT Ryan M. Hodgeman, OMS IV, MC USA**

EMRA Government Services Committee  
Chair-Elect, 2021-22  
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**2LT Molly Sturlis, OMS III, MC USA**

Midwestern University Arizona College of  
Osteopathic Medicine  
Class of 2022

In a typical year, medical students commissioned in the United States Army, applying to match in emergency medicine, prepare to visit and interview at four programs spread across the country. This time functions as a vital, interactive 2-4 week-long interview in which both student and program can assess each other to form a synergistic “match.” In-person experience allows for holistic understanding of education, hospital setting, residency culture, and opportunity at each program.

This was not a typical year.

The military started to impose travel restrictions as a result of the widespread COVID-19 pandemic only a few months before interviews began. Medical students and program leadership were left unsure if there would be any meaningful interaction in the coming year. As a student involved in this military match, I interviewed 15 of my peers to get their perspective in order to share this unique experience and hopefully learn from the successes and challenges it presented.

Programs reacted quickly to the changing landscape. While uncertainty loomed, two programs specifically opened their virtual doors and invited us not only to sit in, but also to engage in their didactics. “Opening up grand rounds on Zoom for prospective students was a fantastic resource,” a student stated in an interview. One program created an entire curriculum experience termed “Medical Student Mondays”. During these sessions, students engaged in an emergency medicine-specific topic with residents and faculty. “It wasn’t just a chance to interact, but an opportunity for prospective students to see how the program functions,” another student remarked.

In addition to innovative virtual experiences, individual program leaders went above and beyond for this year’s interviewing class. Dr. Mark Riddle from the Carl R. Darnall Army Medical Center and Dr. Gillian Schmitz from Brooke Army Medical Center were celebrated by nearly every medical student I came in contact with. They were referred to as “huge game-changers” and it was noted that they “worked really hard to give us all an equal playing field.” “I have heard many other students say that they were calm because of those two,” one student summed up. Along with resources like Government Services EMRA (GS-EMRA) and Facebook, both names were at the top of everyone’s list when asked how they stayed informed during the myriad of changes that plagued the months leading up to the interviewing season.

Intertwined with the bright spots, there were also significant challenges that this cohort of students faced. Students that were limited by their university on the number of away rotations were six times more likely to feel disadvantaged by the whole process. When asked if COVID will affect the match results, one student who felt that they lacked support from their school said, “A hundred percent! There is no way not to. How are you supposed to have an equal playing-ground?” In addition, some students felt they had an advantage because their school was supportive. In contrast however, more

than half reported that they believe COVID would unlikely affect the overall results. Students with school support mostly acknowledged the discrepancy, “If my school had been different, I think all of my answers would be changed,” one student commented.

Another prominent challenge was finding the right person to connect with at each program. Students felt that gaining access to the programs and getting on the right email list was the rate-limiting step to overall success in scheduling rotations and feeling informed as changes occurred. One student referred to this as the “biggest barrier.” Another HPSP student put bluntly, “Once I got on the right lists and got in with the right people everything was good. It was hard to get to that point.” Students on the Health Professions Scholarship Program (HPSP) have minimal resources or channels of information universally distributed making it difficult to navigate even in a normal year. Since communication was of the utmost importance during a year clouded by a pandemic, programs that were slow to respond generated a significant negative image to some.

Finally, the loss of cultural, out-of-hospital interaction with the current residents was lamented by 9 of the 15 students I interviewed. “You are choosing a family,” one interviewee put simply. Most went on to admit this was just an unavoidable consequence of the situation we were in.

In the end, the most surprising theme from all of my interview sessions was a general feeling of positivity towards the process. It was clearly different and difficult. “I felt like a tumbleweed,” one student described, but like the others, this student felt the programs not only did the best they could, but exceeded expectations. Statements like: “Everyone was pretty understanding about the situation we were in,” and, “I never thought I was put in a position where I felt unsafe,” were echoed by the vast majority of students and I felt the same way.

The COVID-19 pandemic is unique — however, the consensus showed it didn’t

necessarily present new challenges, but rather it amplified existing areas of weakness. “So many of the challenges were probably not even related to COVID,” one student pointed out. When describing the difficulties of accessing a consistent line of communication from each program, another student astutely stated, “The year-to-year changes will be there, but that will stay the same.” Even the variability of collegiate regulations can have an effect on a “normal” year, but with the additional decision administration was forced to make as a result of COVID-19, this effect appeared to be more pronounced.

This year gave us an opportunity to improve the process for the future. External committees such as GS-EMRA and GS-ACEP have started to act as a resource for program information. Colonel Maurer, the current Deputy Director for Army Graduate Medical Education of the HPSP program, has increased direct communication with students via Facebook, which was praised by most of our cohort. When asked which of the changes made this year should remain, one student said, “Engage students even before interview season starts...the more exposure the better.” This sentiment, regarding continuing to open virtual doors prior to audition season, was echoed by 8 other students.

Difficult situations tend to reveal who we are as a people and as a group. One student summed up the year by saying, “I think the way the programs handled it, and how the applicants handled it, is a positive about the military and emergency medicine.” Both programs specialize in adaptability to the unknown. This mentality was certainly seen amongst both the students and the programs throughout a bizarre, unique, difficult, and revealing Match season. ★

***Acknowledgments: Support given by the GS-EMRA Committee.***

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# *Taking Action When the Tides Turn* **Medical Student-Led PPE Redistribution During the COVID-19 Pandemic**

**Hannah Day, MS**

Georgetown University School of Medicine  
Class of 2022

## His message was succinct: Find a way to increase PPE supplies now.

On March 17, 2020, my classmates and I at the Georgetown University School of Medicine (GUSOM) were in our homes watching an online lecture while eagerly awaiting an email from our deans determining if our clinical rotations would be delayed due to COVID-19. The start of clinical training was a moment all of us had looked forward to for months; naturally, it was a tension-filled day. I was sitting in my living room with an open laptop and a head full of questions. Like so many around the globe, I wondered: How much worse was this really going to get? What would happen if I got ill with the virus — living alone, thousands of miles away from my husband and family? What if the reverse happened? As a student, I wondered how the pandemic would affect my ability to learn clinical medicine, the formative next step in my medical education.

The news, when it came, was not surprising, yet still unsettling: Rotations were (at that time) delayed. The same afternoon, I received a text message from my mentor and friend, Dr. Debjeet Sarkar, an emergency physician in Maryland, who said his team was seeing rising numbers of patients sick with cough, fevers, and trouble breathing — all presumed COVID-19 — and thus were burning through personal protective equipment (PPE). His message was succinct: Find a way to increase PPE supplies now.

Dr. Sarkar asked me to mobilize GUSOM medical students to collect PPE from the community (dentists, research labs, pharmaceutical companies, etc.) and get it to hospitals in need. I saw the potential clearly. While medical students would be sidelined from working in the hospitals, we still had invaluable skills to organize, mobilize and problem-solve in the pandemic.

This urgent request shook me out of my state of disbelief. I went from simply reacting to the gravity of the situation to feeling confident we could actually help mitigate this critical problem jeopardizing healthcare workers and the public. I posted on our class Slack

channel a request for help. Four fellow third-year students stepped up and we held a teleconference meeting that night. Before we knew it, we were off and running, with more students quickly joining in to help.

We called our project Med Supply Drive (MSD). Quickly the team split up to accomplish different tasks: social media setup, website design, fundraising, emails and texts, and setting up databases to match donated PPE supplies with demand. Within only 2 weeks, we had built a team of 341 volunteers from 37 states, 41 universities, and 66 medical schools.

In the first weeks it was a challenge to balance our educational responsibilities with the breakneck speed of MSD's growth. But we understood that with any new venture, there is a steep learning curve. For example, our website got flooded with PPE requests that exceeded the donated supply. Our team did their best to match, by location and available local volunteers, where we could drop off supplies quickly because time was critical and shipping was often delayed. To do this efficiently, we set up team leaders in key medical schools that helped ensure smooth delivery of PPE.

We recognized our plan was a stop-gap solution since we could not manufacture PPE. As the weeks went on, it became harder to find supplies and with any money we raised, tracking down sources of PPE was not straightforward. Some sources were selling counterfeit products, while others offered legitimate items that got monopolized by larger groups with more capital. Even with these barriers, in just 10 days, the team re-distributed 4,700 surgical masks, 959 N95 masks, 200 shoe covers, 24,100 pairs of gloves, 501 gowns, and 950 hair covers. That total would only grow in the weeks ahead.

Another aspect of the project that proved to be critical was the role social media played in getting our message and plan out to others. We were featured in "Oprah" magazine after one of our team members reached out to a friend

who worked there. One of our original members appeared on NPR, another on Fox News, and our social media accounts generated enough buzz that similar organizations emerged, including one in the United Kingdom. The speed of our growth was directly related to the strength of our social media presence; using Instagram, Twitter, Facebook, and our website, we were able to share evidence of our successes, interact and collaborate with other COVID-19 relief organizations, reach potential volunteers and donors, get on the media radar, and inspire others to get involved.

As the organization grew, what came into larger focus was the type of entity we had created: MSD had rapidly built an infrastructure and supply redistribution chain across the United States. This was done by directly engaging and connecting hundreds of smart, conscientious, skilled, and hardworking medical students — and quickly, undergraduate and graduate students and other engaged citizens — for a common purpose. Furthermore, creating and running MSD allowed us to acquire new skills: human resource management, fundraising, negotiating with sellers, partnering with other groups, building a non-profit organization, and becoming savvy with social media and TV appearances — not typical skills associated with medical students.

At GUSOM all first-years take the P3 (Patients, Population & Policy) longitudinal course. We learn about the social determinants of health that create disparities by race, gender, geography, and wealth (to name a few). Looking back, I can see that P3 laid important groundwork supporting our initiative in forming MSD. The concepts we learned to think critically about in the course contributed to our ability to see beyond our lectures and in real-time, create a novel solution to a key component of a public health crisis. While the pandemic has largely been characterized by conflict and loss, it seems that one silver lining will be the innovative and dynamic leaders that will emerge in medicine. ★

# Defining Procedural Competency in Emergency Medicine

## *How Much Is Enough?*

**Richard Cunningham, MD**

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A recent retrospective review analyzing a group of academic, community and free-standing EDs published in *JACEP Open* showed that emergency physicians performed a median number of 3 intubations and 0 chest tube thoracostomies, CVC placements, and lumbar punctures per year.<sup>1</sup> In addition, 25% of the emergency physicians in the study performed 0 intubations.

This as well as other recently published studies that look at the frequency with which emergency physicians perform procedures<sup>2</sup> raise the question of how often is enough to maintain procedural competence. To dive a bit deeper into this issue, let's focus on what may be the most critical and high-risk procedures performed by emergency medicine clinicians: endotracheal intubation.

### Skill Acquisition

Before discussing skill maintenance, it would be prudent to take a look at skill acquisition. The Accreditation Council for Graduate Medical Education (ACGME) requires residents to perform a minimum of 35 endotracheal intubations prior to graduation.<sup>3</sup> Where does the ACGME get this number? The studies defining a learning curve for direct laryngoscopy are heterogeneous in their methods, settings, and definition of "competence." A systematic review performed in 2015 said that *at least* 50 intubations are needed to achieve a 90% success rate *within 2 attempts* in *elective* circumstances.<sup>4</sup> An often-cited study by Konrad *et al* in 1999 showed anesthesiology residents needed on average 57 intubations to achieve a 90% success rate within 2 attempts, but 18% of residents still required assistance from an attending after 80 attempts.<sup>5</sup> Bernhard *et al* showed that anesthesiology residents showed that first pass success steadily

increased from 67% within the first 25 intubations to 83% *after 200 intubations*.<sup>6</sup>

Taken together, it is reasonable to believe that 50 intubations is the bare minimum for "competence" at intubation and clinicians will still see improvements far beyond that. It is also likely that this number is significantly higher for intubation outside the OR, where hemodynamic instability, respiratory failure, and airway contamination can all complicate matters.

So how does the experience of EM residents compare?

A national survey performed in 1999 of EM residencies showed that residents perform an average of 75 intubations during residency, with a range from 13 to 180.<sup>7</sup> The most recent data was collected from a single center with a 3-year residency where residents performed an average of 28.91 intubations a year.<sup>8</sup> This indicates the average emergency physician achieves competence with intubation near the end of residency, and some perform as few as 13 intubations over a 3- or 4-year period.

The matter is further complicated by the introduction of video laryngoscopy, which is increasingly utilized in emergency medicine<sup>8</sup> and is now the most common method of intubation in some centers.<sup>9</sup> All the studies mentioned that have looked at the learning curve for intubation utilized direct laryngoscopy. While Macintosh or "standard-geometry" video laryngoscopes overlap in technique with direct laryngoscopy and can themselves be used to obtain a direct view of the glottis, hyperangulated laryngoscopes require a separate technique and have, presumably, a distinct learning curve towards competence. The more emergency physicians rely on these devices, the less they progress along the steep but prolonged learning curve of direct laryngoscopy.

### Skill Maintenance

Now let's turn towards skill maintenance. Literature is sparse, but one

study did look at this question among academic emergency medicine attendings. It found that performing 3 or supervising 5 intubations per year correlated with "proficient performance."<sup>11</sup> However, there are several limitations to this study. It utilized airway manikins in a simulated setting and defined competence according to a checklist of actions as well as a psychomotor adeptness rating scale from 0-10. Several studies have shown that airway manikins are not as "high-fidelity" as their manufacturers indicate,<sup>12,13</sup> and there may be a gap between intubating a manikin in a simulation center and intubating a live patient under less-than-ideal circumstances. How these findings translate to clinical practice is still up for debate.

Overall, there is much lacking in how we address the issue of acquisition and maintenance of procedural competency in emergency medicine. There is sure to be more discussion and research into these questions, but perhaps it is all much ado about nothing. We are the "jack of all trades and master of none (except resuscitation)." Emergency medicine is a dynamic and broad field that requires improvisation, creativity, and constant adaptation. It is the potential of lifelong learning that attracted many of us to our specialty, and the striving to always improve that keeps bringing us back. In a certain way, the ideal emergency physician is the one who has mastered the art of being "perfectly imperfect." While I may never be a perfect proceduralist, I will also never be a perfect historian, communicator, educator, patient advocate or clinician. Perfection, however, is the enemy of the good. At the end of the day, I'm happy with excellence, not perfection, and progression, not stagnation. That's why I love what I do, and that's why we as emergency physicians have the best job in the world. ★

# ECG Challenge

**Hayden Schenker, MD**  
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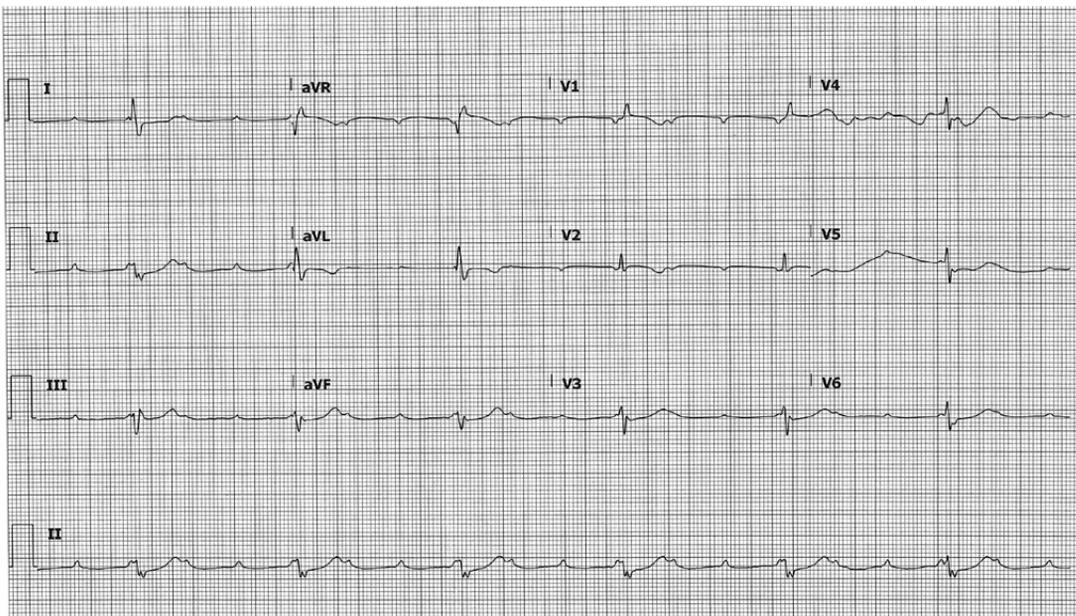
**Jeremy Berberian, MD**  
Associate Director of Resident Education  
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@jgberberian

**CASE.**

A 71-year-old female with history of aortic stenosis s/p transcatheter aortic valve replacement (TAVR) 3 days ago presents to the emergency department because of a syncopal episode earlier in the morning.

**What is your interpretation of her ECG?**

See the **ANSWER** on page 52



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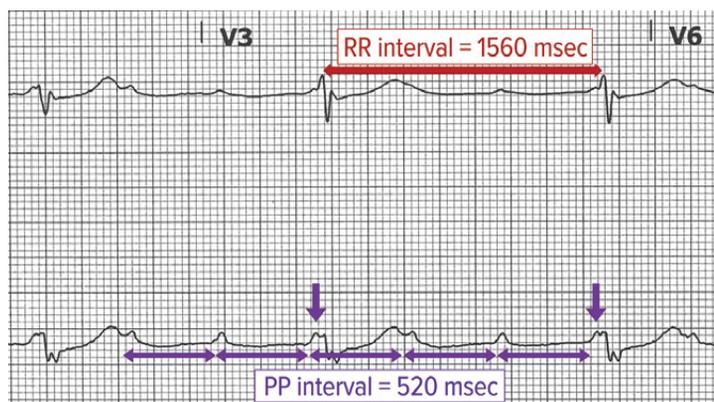
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# ECG Challenge

This ECG shows a 3rd degree AV block with a ventricular rate of 38 bpm, an atrial rate of 115 bpm, left axis deviation, and a prolonged QRS duration with a RBBB.

The key to interpreting this ECG is identifying the P-waves partially buried in the initial portion of the QRS complexes (see purple down-arrows in **Figure 1**). The rhythm is regular with 3 P-waves for every QRS complex, which narrows the possibilities to a 3:1 AV block or a 3rd degree AV block.



High-grade AV blocks, also called advanced AV blocks, describe when  $\geq 2$  sequential P-waves are not conducted. These blocks are most commonly a variant of a Mobitz type II but can be associated with a Mobitz type I. Since there are no sequential conducting P-waves to compare PR intervals, it is often impossible to determine if the underlying pathology is a Mobitz type I or type II. Note that while a wide QRS complex suggests an underlying Mobitz type II, it can also be seen with a Mobitz type I if there is a fixed or rate-related bundle branch block (eg, the patient has a bundle branch block at baseline). As well, a narrow QRS complex is not specific for an underlying Mobitz I, as it can be present in a Mobitz type II.

A 3rd degree AV block, or complete heart block, is defined by the absence of conduction through the AV node leading to complete AV dissociation. The atria and ventricles will typically march out at different rates, with the atrial rate being faster than the ventricular rate. Ventricular pacing can occur anywhere distal to the block, including the AV junction, the bundle of His, or a ventricular focus. Junctional escape rhythms typically produce a ventricular rate of 40-60 bpm and the QRS complex can be narrow in the absence of aberrant conduction. In contrast, ventricular escape rhythms typically result in rates of 20-40 bpm with a wide QRS complex.

This ECG shows an atrial rate that is 3 times the ventricular rate (see purple and red horizontal arrows in **Figure 1**), which suggests a 3:1 AV block. Note that the P-waves immediately preceding the QRS complexes (see purple down arrows in **Figure 1**) are partially buried in the QRS complexes, which means they are occurring at almost the same time. Accordingly, the QRS complexes cannot be due to normal conduction from the preceding P-waves, which points against the diagnosis of a 3:1 AV block. This suggests the presence of a 3rd degree AV block that coincidentally has an atrial rate that is 3 times the ventricular rate. Ultimately, differentiating between these two diagnoses is academic, since both warrant admission for evaluation for placement of a pacemaker.

## RD DEGREE AV BLOCK LEARNING POINTS

- A 3rd degree AV block, or complete heart block, is defined by the absence of conduction through the AV node leading to complete AV dissociation
  - P-waves “march out” (constant PP interval) and do not conduct to produce a QRS complex
  - PR intervals are variable
  - Atrial rate > ventricular rate
  - Ventricular rhythm is usually junctional or ventricular escape rhythm
- Etiologies include ischemia/infarction (often seen with inferior MI), hyperkalemia, endocarditis, drug-related (eg, AV nodal blocker toxicity, digoxin toxicity)
- Symptoms can include syncope/presyncope, DOE, chest pain, generalized fatigue
- Treatment includes:
  - Transcutaneous or transvenous pacing if unstable
  - All patients require admission and evaluation for pacemaker placement

## HIGH-GRADE (OR ADVANCED) AV BLOCK LEARNING POINTS

- 2nd degree AVB with  $\geq 2$  sequential non-conducted P-waves
  - Most commonly a variant of a Mobitz type II but can be associated with a Mobitz type I
  - PP and RR intervals should have a whole number ratio
- Named as ratio of P-waves to QRS complexes (ie, 3:1, 4:1, etc.)
- Can be seen after anterior MI or with significant pathology of the conduction pathway
- High risk of progressing to a 3rd degree AV block

## Case Conclusion

The patient's initial ECG in the ED (not shown) demonstrated normal sinus rhythm with a right bundle branch block. The case ECG was obtained when the patient reported dizziness after getting up to walk to the bathroom (note: serial ECGs are almost never a bad idea). A few minutes after obtaining the case ECG, the patient spontaneously converted back to sinus rhythm. The patient was admitted to the Cardiac ICU for placement of a permanent pacemaker. ★

# Board Review Questions



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1. A 78-year-old man presents with a newly elevated BUN of 56 and a creatinine level of 4.1. His medical history is significant for prostate cancer, and a physical examination reveals a tender suprapubic mass. Digital rectal examination is limited by the presence of a large nodular mass. What is the best next step?
  - A. Discontinue nephrotoxic medications and remeasure the creatinine level
  - B. Order abdominal and pelvic CT with contrast to evaluate the extent of the tumor
  - C. Order urine electrolytes to calculate the fractional excretion of sodium
  - D. Place a Foley catheter into the bladder to relieve the obstruction
2. What is the most likely cause of a single second heart sound with a harsh systolic ejection murmur in an infant?
  - A. Coarctation of the aorta
  - B. Tetralogy of Fallot
  - C. Tricuspid atresia
  - D. Truncus arteriosus
3. Which characteristic of a breast mass is most likely to represent fibrocystic changes?
  - A. Fluctuance
  - B. Nipple retraction
  - C. Nodularity
  - D. Skin thickening
4. A 2-year-old boy presents via ambulance in shock after his mother found him unconscious and pale. He arouses only to painful stimuli; icteric sclera is noted, and there is oozing from the intravenous line. The mother says he had vomiting and diarrhea 2 days ago that resolved overnight. He has no significant medical history, no allergies to medications, and no history of liver disease. The pH on a venous blood gas is 7.26. What is the best initial treatment?
  - A. Activated charcoal
  - B. Deferoxamine
  - C. Ipecac
  - D. Vitamin B<sub>6</sub>
5. What is a critical initial intervention in the emergency department for a patient with a high-pressure paint injection injury to the tip of the index finger?
  - A. Administration of tetanus prophylaxis
  - B. Early and aggressive cleansing of the wound
  - C. Early consultation with a hand specialist
  - D. Performance of a digital nerve block to relieve pain \*

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



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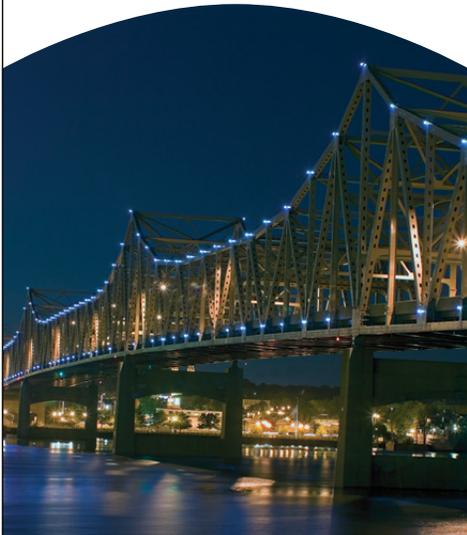
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