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Advocacy from the Frontlines

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EDITOR'S FORUM

The Power of Purpose: Why Every EM Trainee Needs a Niche

AUTHOR

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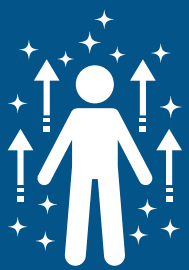
In all honesty, I think I suffered a bit of an identity crisis at the start of residency. After my fourth year of medical school, where I had the chance to apply all the knowledge I'd accumulated, I suddenly found myself in the fishbowl on my first shift: overwhelmed by learning a new system, caring for a hallway full of boarded patients, and navigating an EMR where my orders no longer needed a co-signer. Those first months were sink or swim, baptism by fire, or whichever cliché you prefer.

Once I settled in, I began thinking about longevity in our career. Burnout is no secret in emergency medicine, and I knew I wanted to be deliberate in my approach to training so I wouldn't lose the excitement that had brought me to the specialty. I realized that when people talk about burnout, they usually mention workload, administrative burden, or staffing issues. What's discussed less is the loss of meaningful identity within a demanding specialty. Developing a personal niche can act as a protective buffer against that erosion.

The culture of EM is that we are all-things-to-all-people. That versatility is a point of pride, but it can also blur your sense of self. When everything feels like your responsibility, nothing feels like your passion. While we often talk about "task fatigue" (documentation burden, endless orders, shift work), having a niche helps address the quieter problem of "purpose fatigue" — the feeling of being drained by a lack of meaning in your work. A niche isn't a burden or extra obligation; it's a professional home base. It's the part of medicine that makes you feel alive even when the department is overflowing. It's what restructures your relationship with the specialty, giving you back ownership, mastery, and meaning.



When it comes to developing your niche, start small. Notice not just what you're good at, but the things that make you want to linger in the department when the work is done. For me, I never anticipated falling in love with pediatrics. But one busy winter night filled with URIs, a kid came in with a heart-stopping post-tonsillectomy hemorrhage. In the middle of the chaos and fear, he smiled when I handed him a sticker book. My attending was standing next to me at the time and whispered, "This is why I love peds." I felt it too — the strange, naïve magic of caring for kids in terrifying moments. I realized I wanted more of that.

For you, it may not be a particular patient population. Maybe you're fascinated by toxicology, wilderness medicine, EMS, global health, pain management, palliative care, DEI, medical education, or simulation. EM is wide enough that everyone can find a corner that feels like theirs.

The next step is learning to say "yes" intentionally rather than reflexively. If you fill your time with everything that comes your way, you leave little room for what matters. Start with one small project that aligns with your interests: a new workflow, a teaching module, a case report, a simulation scenario. Don't think of it as a career-defining commitment — think of it as an experiment in meaning. Over time, you may become the go-to person in that area, and that sense of mastery is protective.

Just as important, though, is letting your niche evolve. What excites you as a PGY-1 may differ from what fulfills you as a PGY-3. Your niche isn't a marriage; it's a working hypothesis. The goal isn't to lock yourself in, it's to create direction and purpose so the rest of the job feels more intentional.

When you find your niche, something shifts. You gain a clearer sense of identity, community, and agency. In a specialty defined by unpredictability, your focus becomes an anchor — a piece of work that feels like it belongs to you. EM will always be demanding. But within those demands, there is room for each of us to carve out something that feels like ours. Burnout may be common, but it isn't inevitable. Sometimes the most powerful act of self-preservation isn't stepping back but stepping toward the part of the field that brings you joy.

So, take the first small step: email a mentor, sit in on a meeting, or join an interest group. Let your niche shape you. Let it remind you why you chose this path in the first place.✶

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PRESIDENT'S MESSAGE

Advocacy from the Frontlines: Anywhere, Anyone and Anytime

AUTHOR

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The beauty of being an emergency medicine physician is that we are at the frontlines of patient care. There is no better feeling than responding to an undifferentiated patient in a fast-paced, high-stakes environment like the emergency department. We are the first to respond to an unstable patient, the first physicians to establish care with any person who walks into the emergency department, and often the first to advocate moving a patient's care forward.

Our work is undeniably important in providing immediate, high-quality care, but there is an even more crucial role that we must consider in our roles as physicians: advocacy. A physician's role in advocacy goes beyond shaping health care policy, but also ensuring that our patients receive the absolute best care in an overwhelmed, overburdened, and — at times — an unjust system. Advocacy is not a class taught in medical school, and it is imperative for us as future physician leaders to engage in this work, make our voices heard, and ensure our seat at the table in discussions that affect the health of our patients, our communities, and our profession.

We are uniquely positioned to be effective advocates as physicians. The combination of our experience, education, and the ability to understand patient needs provides us with an unparalleled perspective that can influence public policy, health care reform, and community health initiatives. In a time when public trust is actively eroding within the health care system, advocacy allows us to step beyond the clinical setting and use our voices to ensure our communities are well-informed, to work toward systemic changes that enhance the quality of care patients receive, improve working conditions, and address social determinants of health that continue to disproportionately impact vulnerable populations.

END THE "WE'VE ALWAYS DONE IT THIS WAY" MINDSET

Identifying where we can get involved can, at times, feel like a Sisyphean task, especially as residents, medical students, and fellows when there simply isn't enough time in the day to tackle all of the responsibilities laid before us. It can be very difficult to change the status quo of our training because historically it has been encouraged that "physicians remain apolitical." Yet, by doing so, we have found ourselves in a health care system that no longer serves what is best for the patient, for the health care team, or for our broader communities because we have not pushed for our seat at the table.

It's so important to remember that what we do, no matter how big or small, at a local level can be just as impactful as national efforts. Establishing a foundation is more important for sustainability and commitment, and here are a few ways we can start that process.

1. **Informed Perspective:** As physicians, we have an insider's knowledge of the health care system. We are often the first to see the consequences of enacted policies in our emergency departments. Our insight into how policies impact patient outcomes are vital for informed decision-making by policymakers.
2. **Patient-Centered Care:** Advocacy allows us to fight for what's best for our patients on a larger scale. We are in a unique position to influence policy changes that directly affect their health and well-being because of what we see and do at the bedside.
3. **Strengthening the Medical Profession:** Advocacy is also crucial for defending the integrity and autonomy of our profession. From addressing physician burnout to ensuring adequate reimbursement for services rendered, engaging in advocacy helps protect the well-being of health care workers. As residents, we are not only preparing to become physicians but also to become leaders who will advocate for the future of medicine.
4. **Shaping Health Care Policy:** In many instances, policymakers lack the clinical expertise to fully understand the consequences of certain decisions. Most decisions, unfortunately, are made without physician input. By staying engaged and informed with local and state level government, we bridge the gap between the policymaker and the patient. Our involvement ensures that policy is based on sound medical knowledge and not just financial or political interests.
5. **Influence on Public Health:** Finally, as physicians, we can advocate for systemic changes that

References available online.

End the "We've Always Done It This Way" Mindset

improve public health outcomes. Whether it's through supporting vaccination initiatives, influencing laws that impact public health, or in today's climate, participating as an active voice against misinformation, our involvement plays a critical role in improving the overall health of society.

DON'T JUST RUN THE CODE, INFLUENCE THE PROTOCOL

Getting involved in advocacy doesn't require a political background or years of experience. Simple steps can lead to profound change. Here are a few ways emergency medicine residents can begin:

- **Join and Participate in Professional Organizations:** As a member of EMRA, there are several opportunities to get involved: our committees, our program representatives who make up our representative council, writing resolutions, and attending national conferences through scholarships that focus directly on advocacy, to name a few. National and state medical associations, such as the American College of Emergency Physicians (ACEP), are dedicated to advocacy efforts. As members of EMRA, we are also members of ACEP as well as our state ACEP chapters. Being an engaged member provides a platform for engaging with local chapter committees, opportunities for participating in legislative actions, and amplifying our voice on important issues.
- **Engage in Grassroots Advocacy:** Participating in grassroots campaigns, writing letters to legislators, or taking part in "lobby days" are excellent ways to start. Even as residents, we can advocate for issues affecting our training, the working environment, or issues like health care funding or physician reimbursement.
- **Stay Informed:** Read up on current health care policies, attend town halls or webinars, and participate in discussions on health care reform. Pay attention to the local and state bills that are being proposed, as these are often the policies that have a significant effect on us and our patient populations. The more informed we are, the better equipped we will be to advocate effectively.
- **Use Your Platform:** Whether it's social media, blogs, op-eds, or public speaking, there are countless ways to share your thoughts on advocacy issues and mobilize others to join the cause.

Advocacy is an essential aspect of being a physician, especially for those of us in training. It allows us to push for policies that ensure better patient care, safer working conditions for health care professionals, and a stronger health care system overall. While our primary role may be to treat individual patients, our responsibility extends to the collective well-being of the communities we serve. We must rise to the challenge and use our unique position to drive change. We need to be in the room where it happens. In doing so, we not only improve the lives of our patients but also the future of our profession. ✶

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Artificial Intelligence-Enhanced POCUS in the Emergency Department

AUTHOR

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A BRIEF OVERVIEW

Artificial intelligence (AI) has hastily transitioned from a theoretical promise of the future to a present-day reality impacting our lives in more ways than we even realize. One area in which the impact is being felt is medicine, a notoriously slow-moving field with regards to adopting new ways of thinking or doing things. Despite this historic resistance to change, the potential upside of this revolutionary technology is unequivocal, leaving even the most skeptical AI critics with just a limited few valid arguments against it. The implementation of AI in medicine thus far has offered improvements in illness diagnosis, provider workflow, and clinical decision making; some of the well-established ways in which AI is utilized include: AI-powered triage systems, medical imaging/lab interpretation, documentation/note writing, and billing and coding. While these examples highlight the more universal uses of AI, there also exist more niche use cases, specifically in the area of another technology that experienced its fair share of skepticism in its early days — Point-of-Care Ultrasound (POCUS).

AI IN POCUS: WHERE WE ARE TODAY AND THE PATH FORWARD

Emergency medicine has historically been at the forefront of adopting point-of-care technologies that enhance clinical efficiency, and over the past several years, POCUS has steadily climbed the hierarchy to position itself as one of the most useful and versatile diagnostic tools, particularly in the emergency department (ED) setting.[1] The ED represents perhaps the most fertile ground for AI-enhanced POCUS implementation due to several key characteristics that distinguish it from other clinical settings. The ED is particularly characterized by its unpredictable patient flow, variation in acuity, and the need for rapid diagnostics and decision-making. This fast-paced, high-pressure environment demands tools that can provide reliable information quickly and accurately, precisely what AI-guided POCUS aims to deliver.

As it stands today, the utility of POCUS is largely influenced by pre-programmed tools intended to assist operators in making sense of obtained images—tools ranging from as basic as a ruler to the broadly used M-mode for dynamic analysis (e.g., lung sliding, fetal heart rate) to more nuanced and exam-specific measurements like the Doppler feature for flow analysis (e.g., ejection fraction, vessel stenosis). Despite these tools, one of the biggest limitations of POCUS is the fact that it is a heavily operator-dependent diagnostic modality. Thus, great efforts have been made to minimize the variability of image quality seen between operators. Many publications have focused on the use of AI in one isolated aspect of POCUS—image interpretation. For example, one study published in late 2024 looked at the diagnostic accuracy of cardiac dysfunction by ultrasound fellowship-trained physicians versus an AI algorithm, both tasked with evaluating images obtained by expert sonographers. The results showed similar accuracy in diagnosing cardiac dysfunction between the two groups.[2] While a major step in the right direction, the majority of similar studies lack the true essence of AI — they are more akin to analytical software masquerading as AI. The other important but largely neglected aspect of POCUS is image acquisition, which requires hours and hours of human experience to become proficient. In contrast, deep learning models can be trained in a

References available online.

fraction of the time using large datasets, e.g., ultrasound images labeled "good" or "poor," designating the quality of the image. Some current AI models have been trained to identify anatomical landmarks, while others are able to sense the position of the probe relative to the patient's body. As a real-world validation of this advancement, a study published in early 2025 looked at the proportion of diagnostic-quality images obtained on lung ultrasound by expert sonographers without AI assistance versus non-expert trained health care professionals with AI assistance. The results showed a 98% success rate of obtaining diagnostic-quality images in the non-expert AI-assisted group without a significant difference when compared to the expert sonographer group.[3]

An early private competitor in this niche field aiming to bring this technology to the mainstream is UltraSight™, which previously completed a prospective multicenter study that compared the quality of echocardiographic exams between expert sonographers and inexperienced nurses and residents (i.e., no prior experience) and the results were unprecedented. With just minimal training, the inexperienced users were able to acquire images of diagnostic quality that approached those of experts.[4] Currently, UltraSight™, in conjunction with Bristol Myers Squibb, is in the recruitment stage for an upcoming study to expand its research based out of Cleveland Clinic that intends to utilize its Real-Time Guidance software in order to assess its efficacy/reliability in actively guiding non-sonographers in obtaining cardiac stroke volume measurements (i.e., left ventricular outflow tract velocity-time integral [LVOT VTI] measurements) compared to expert sonographers.[5] As mentioned, different AI models have unique capabilities, like identifying landmarks and sensing probe position. In combining the capabilities of multiple models into one, real-time guidance can be given to the ultrasound operator, such as "tilt the probe 15° right to avoid rib shadowing" or "move the probe 2 cm to the left to visualize the gallbladder" while at the same time auto-adjustments are made to optimize settings such as gain and depth to obtain the most ideal image. To take it a step further, visual representations of probe adjustments that need to be made can be displayed on the very screen being used to obtain the images, which is something that UltraSight™ has already accomplished and has incorporated into its software. The benefits of this type of interactive/generative algorithm are readily apparent for novice operators, but even the most experienced operators can benefit, as other factors like patient habitus and anatomical variations further complicate the ability to obtain adequate imaging.

In light of the promising future that AI-driven POCUS offers, challenges and limitations to its widespread adoption exist, owing to the major concerns regarding AI in medicine overall, which largely center around the ideas of patient privacy, bias (intentionally programmed or not), and effects on the patient-provider relationship.[6,7] Despite these barriers, the trajectory of one small but increasingly important aspect of medicine is clear — we are heading toward a future in which emergency physicians, and ultimately health care providers as a whole, can leverage AI-driven ultrasound to acquire and interpret diagnostic-quality images, regardless of experience or skill level. ✶

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Chemotherapy-Related Toxicologic Emergencies

INTRODUCTION

Chemotherapeutic, or antineoplastic, agents are the mainstay of treatment for many types of cancer. While they exert their therapeutic effect by killing malignant cells, they can also damage or kill noncancerous cells. Additionally, chemotherapeutic drugs generally have a narrow therapeutic index and are administered with high supervision to minimize off-target effects. Because they are often administered in infusion clinics or under supervision by a clinician, overdose of chemotherapeutics is rare.

With the expansion of chemotherapeutics to involve more cancers and an expanded scope, including in the treatment of autoimmune and other immunologic disorders, accidental exposure to these agents has been increasing.[1] While it is not necessary to know every chemotherapeutic agent, emergency physicians should be broadly familiar with these medications in order to diagnose and treat patients appropriately. This article briefly reviews the different classes of chemotherapeutic drugs and discusses two life-threatening oncologic emergencies: tumor lysis syndrome and methotrexate toxicity.

CLASSES OF CHEMOTHERAPY DRUGS

There are traditionally five categories of antineoplastic agents that encompass most chemotherapeutics used today: alkylating agents, antibiotics, antimetabolites, antimitotics, and platinum-based compounds (Table 1). The general mechanism of action of most chemotherapeutic agents is to disrupt cellular growth and proliferation. Each class accomplishes this goal through different pathways. Alkylating agents bind to certain nucleic acids, causing structural defects, strand breaks, mispairings, and ultimately arresting cell development at different points in the cell cycle.[1] Antibiotics are generally isolated from bacteria and inhibit RNA and/or DNA synthesis.[2] Antimetabolites are a broad category of medications that interfere with specific cellular metabolites to block DNA synthesis.[1,2] Antimitotics are derived from plant alkaloids and interrupt the assembly of microtubules, preventing cell division via interfering with RNA and DNA synthesis.[1,2] Platinum-based compounds inhibit DNA synthesis by causing cross-linking and structural defects.[3]

Two newer categories of chemotherapeutics include protein kinase inhibitors (ex. gefitinib) and monoclonal antibodies (ex. trastuzumab), which target specific cellular proteins, such as growth factor receptors.[1] These medications are engineered to target tumor cells specifically and are becoming more common with ongoing research and development into individualized cancer treatments. Less is known about toxicologic effects of these newer agents due to their relative infancy in use.

TUMOR LYSIS SYNDROME

Tumor lysis syndrome (TLS) is an oncologic emergency that occurs when tumors or malignancies rapidly break down. TLS is most often seen with the initiation of chemotherapy. However, it can also occur spontaneously in high-grade cancers with high tumor burdens. Patients with hematologic malignancies, such as lymphoma and leukemia, are at

CLASS	EXAMPLES
Alkylating agents	Busulfan, dacarbazine, ifosfmide
Antibiotics	Danorubicin, bleomycin, dactinomycin
Antimetabolites	Methotrexate, mercaptopurine, fluorouracil
Antimitotics	Paclitaxel, vinblastine, vincristine
Platinum-based compounds	Cisplatin, carboplatin, oxaliplatin

Table 1

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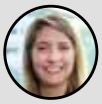

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higher risk than other types of cancer, as they generally have high proliferative rates and are highly sensitive to chemotherapy. However, TLS is also a well-reported phenomena in solid tumors.[4]

Marked electrolyte abnormalities are seen in TLS, including hyperkalemia, hyperphosphatemia, hyperuricemia, and hypocalcemia, due to rapid cell death and lysis of cancerous cells.[5] As a result, renal failure, cardiac arrhythmias, and cardiac arrest can occur. Because of these complications, it is important for emergency physicians to be aware of this condition and have a high clinical suspicion when taking care of both adult and pediatric patients with cancer.

In the ED, laboratory evaluation is crucial in diagnosing tumor lysis syndrome. Notably, it is important to obtain a complete blood count, metabolic panel, calcium, phosphorus, uric acid, lactate dehydrogenase, and urinalysis. Aggressive intravenous (IV) hydration is the mainstay of treatment. Rasburicase, which is a form of recombinant urate oxidase, may also be used to help break down uric acid and prevent complications caused by TLS. Hemodialysis and ICU admission for monitoring of electrolytes may be necessary in severe cases of TLS.

METHOTREXATE TOXICITY

Methotrexate is a structural analog of folate and is categorized as an antimetabolite. It works by inhibiting dihydrofolate reductase and thymidylate synthetase, which ultimately prevents DNA and RNA synthesis. It is used as a chemotherapeutic agent and in the treatment of various other medical conditions, including rheumatoid arthritis and ectopic pregnancies.[6]

While overdoses of most chemotherapeutics are uncommon, methotrexate overdose is well-reported and likely related to a higher frequency of methotrexate use beyond the treatment of malignancies. Methotrexate was the most common chemotherapeutic agent to be reported for overdose to the California Poison Control System from 2009-2019, which makes it particularly relevant to emergency physicians.[7]

Toxicity from methotrexate is secondary to effects directly from the drug itself, in addition to its metabolites 7-hydroxy methotrexate and 2,4-diamino-N(10)-methylpteroic acid. The most common side effects from methotrexate toxicity include nausea, vomiting, and elevations in alanine aminotransferase and aspartate aminotransferase, which can occur as early as a few hours after ingestion. More severe side effects include stomatitis, kidney failure, hepatitis, neurologic dysfunction, and myelosuppression, which may be delayed several days beyond methotrexate ingestion.[6] Patients with renal impairment are at a higher risk of experiencing methotrexate toxicity due to drug excretion in the urine, and as little as a single dose of methotrexate can cause severe toxicity in any patient on renal replacement therapy.[8]

Treatment of methotrexate toxicity primarily includes the antidote leucovorin, also known as folinic acid, to facilitate essential biochemical processes that require folate. Supportive care is also a cornerstone of the treatment of methotrexate toxicity. Urinary alkalinization with sodium bicarbonate and IV hydration may need to be used to mitigate renal effects, which can propagate toxicity via impaired excretion. Hemodialysis can be used to remove methotrexate.[6] Glucarpidase is a recombinant bacterial enzyme that can rapidly lower methotrexate levels, although this is not readily available and is generally used as a rescue therapy. Often initiating supportive care early on is necessary, as methotrexate levels may be either unavailable or undetectable when a patient is symptomatic. Granulocyte-macrophage colony-stimulating factor (GM-CSF) may also be considered in an inpatient setting in patients with refractory pancytopenia. Patients experiencing systemic effects from methotrexate toxicity should be admitted to the hospital, as many require intensive care unit admission.[6]

CONCLUSION

Chemotherapeutic emergencies such as tumor lysis syndrome and methotrexate toxicity are rare but can be life-threatening. It is important for emergency physicians to be familiar with chemotherapeutic agents and have high clinical suspicion for these pathologies in patients on active chemotherapy. ✷

References available online.

Paralyzed by Surprise: An Unexpected Case of Spinal Cord Infarction

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We report a case of an 89-year-old male who presented to the emergency department with acute bilateral lower extremity weakness after physical exertion. His clinical examination revealed paraplegia, and imaging studies suggested spinal cord infarction (SCI) secondary to presumed atherosclerotic embolism, despite the absence of traditional cardiovascular risk factors. The differential diagnosis for acute paraplegia in the elderly is broad, including conditions like stroke, spinal cord compression, transverse myelitis, and tick paralysis. This case highlights the diagnostic challenges of SCI, particularly when the patient lacks overt risk factors for vascular disease. Despite aggressive management, including permissive hypertension and anticoagulation, the patient remained permanently paraplegic, underscoring the severity of SCI and the importance of early recognition and appropriate care in optimizing outcomes.

Conflict of Interest: There was no funding related to this case report. The authors declare that they have no conflicts of interest.

INTRODUCTION

Spinal cord infarction (SCI) is a rare but devastating condition, accounting for only 1–2% of all strokes. It typically occurs in patients with significant cardiovascular risk factors or those undergoing aortic surgery. We present the case of an otherwise healthy 89-year-old male who developed sudden-onset paraplegia due to presumed atherosclerotic embolism, highlighting the diagnostic challenges and severe morbidity associated with this condition.

CASE REPORT

An 89-year-old male with no history of smoking, atrial fibrillation, or other known medical conditions presented to the ED with acute bilateral lower extremity weakness after walking one mile, performing sit-ups, and doing yard work. While raking leaves about 35 minutes prior to arrival, he experienced several seconds of dizziness and fatigue, sat down, and was unable to stand due to profound leg weakness. He denied back pain, chest pain, palpitations, bowel or bladder dysfunction, or recent illness. He had recently suffered a mechanical fall but landed on his hip, not his back, and had resumed normal activity afterward. The patient regularly followed up with his physician in India and happened to be visiting his son in the United States at the time of the event.

On examination, he was alert, hypertensive (170/92 mmHg), and with neurologic deficits of 0/5 strength and areflexia in the lower extremities. CT/CTA imaging, including reconstructed spine images, revealed only a 6x7 mm ulcerated aortic plaque. Further assessment revealed a loss of pain and temperature sensation in the lower extremities with preserved proprioception and vibration, consistent with anterior cord syndrome. Neurology and neurosurgery were consulted, and emergent MRI was performed. Initial imaging was inconclusive but repeat MRI with DWI/ADC confirmed infarction from T8 to the conus, presumed secondary to atherosclerotic embolism.

The differential for acute paraplegia in the elderly is broad, including stroke, spinal cord compression, transverse myelitis, Guillain-Barré syndrome, metastatic disease, and traumatic spinal pathology. As the patient was in New Jersey during peak tick season, tick paralysis was also considered. However, a thorough skin examination did not reveal any attached ticks, making this diagnosis unlikely.

The patient was admitted to the ICU for permissive hypertension to optimize spinal cord perfusion and initiated on aspirin, ticagrelor, and antihypertensives. Despite supportive care and rehabilitation, he remained permanently paraplegic with a neurogenic bladder.

References available online.

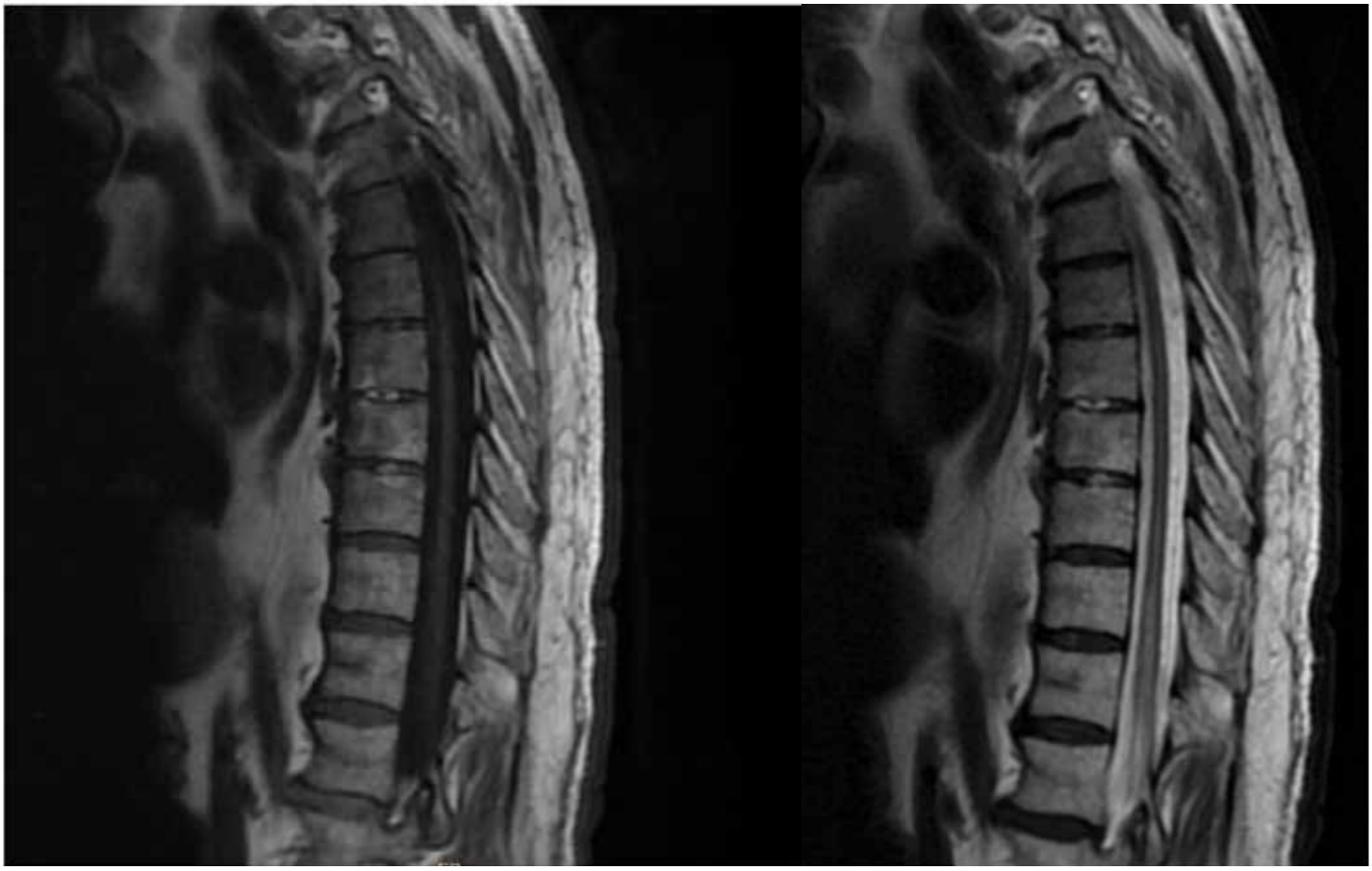


Figure 1: MRI of the Thoracic Spine (Without and With Contrast). High T2 signal intensity is noted in the spinal cord from T8 to the conus, consistent with a spinal cord infarction

DISCUSSION

The patient presented with acute bilateral lower extremity weakness and paraplegia, which was ultimately diagnosed as spinal cord infarction (SCI) from presumed atherosclerotic embolism. SCI is a rare condition, but its incidence is increasing as the population ages. It is known to account for 1–2% of all strokes, with most cases occurring in individuals with significant cardiovascular risk factors such as hypertension, diabetes, and atherosclerosis. However, as demonstrated in this case, SCI can occur even in patients without traditional vascular risk factors, making the diagnosis more challenging.

Incidence of Spinal Cord Infarction

Spinal cord infarction is uncommon, with an estimated incidence of 1–2% of all strokes. Most SCI cases are due to atherosclerotic disease, embolism, or occlusion of the arteries supplying the spinal cord, such as the anterior spinal artery or the radiculomedullary arteries. The condition is more frequently observed in individuals with a history of cardiovascular risk factors, including hypertension and atherosclerosis. However, SCI can occasionally occur in otherwise healthy individuals, as was seen in this patient. The incidence is expected to rise with the aging population and increased life expectancy, emphasizing the need for heightened awareness in emergency departments.[1]

Pathophysiology of Spinal Cord Infarction

The pathophysiology of SCI is associated with the interruption of blood supply to the spinal cord, often caused by embolic phenomena such as atherosclerotic embolism, thromboembolism, or vascular occlusion. The anterior spinal artery supplies most of the blood to the spinal cord, and its occlusion can result in infarction of the anterior portion of the spinal cord, leading to a condition known as anterior cord syndrome. This is characterized by the loss of motor function and pain and temperature sensation, while proprioception and vibration sense are typically preserved. The lack of a clear embolic source in some cases, such as the one presented here, can complicate the diagnosis, requiring thorough investigation and imaging to confirm the etiology.[2]

Presentation of Spinal Cord Infarction

The presentation of SCI is typically sudden and often includes acute paraplegia or quadriplegia, depending on the level of the infarction. The most common presenting symptoms

References available online.

As the population ages and the incidence of vascular disease increases, SCI will likely become more common in clinical practice, underscoring the need for emergency physicians to be vigilant in recognizing this potentially devastating condition.

are weakness, sensory deficits, and autonomic dysfunction. The differential diagnosis of acute paraplegia in the elderly is broad, including stroke, spinal cord compression, transverse myelitis, Guillain-Barré syndrome, and traumatic spinal injuries. In this case, the patient's sudden onset of bilateral leg weakness without associated back pain or chest pain made SCI a strong consideration. The absence of traditional vascular risk factors in this patient further complicated the diagnosis, requiring a comprehensive workup.[3]

Laboratory Studies

In SCI, laboratory studies are often unremarkable, but they can help rule out other causes of neurological deficits. A complete blood count (CBC) may show leukocytosis, particularly in cases where there is associated infection. Other tests, including electrolytes, renal function tests, and coagulation profiles, may be obtained depending on the clinical scenario. In this case, the patient's elevated blood pressure (170/92 mmHg) was notable and might have contributed to the ischemic event. Although blood cultures are not typically required unless there is suspicion of sepsis or infection, they may be considered in cases of complicated SCI with associated infections.[1]

Imaging

Imaging plays a critical role in diagnosing SCI and determining the extent of spinal cord damage. In this case, CT and CTA imaging revealed an ulcerated aortic plaque, which was a key finding in the evaluation. However, MRI with Diffusion Weighted Imaging (DWI) and Apparent Diffusion Coefficient (ADC) mapping was crucial for confirming the diagnosis of spinal cord infarction. MRI remains the gold standard in diagnosing SCI, providing detailed visualization of the spinal cord and identifying areas of infarction. In patients with suspected embolic sources, vascular imaging is essential to evaluate the presence of atherosclerotic plaques or other embolic phenomena that could compromise spinal cord perfusion.[2]

Management

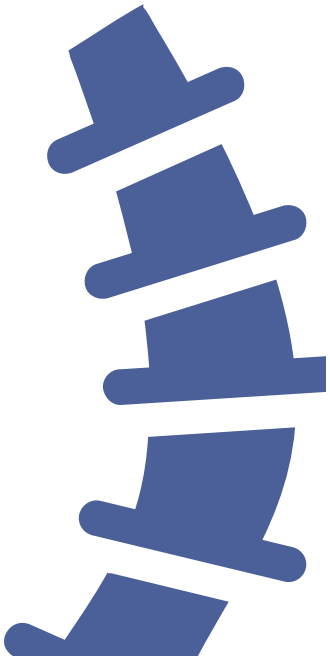
The management of SCI is primarily supportive and focuses on optimizing spinal cord perfusion and preventing further ischemic damage. In this case, the patient was managed with permissive hypertension to maintain spinal cord perfusion and was started on anticoagulation therapy with aspirin and ticagrelor. Management of SCI often requires a multidisciplinary approach, including neurology, neurosurgery, and rehabilitation teams. Despite intensive management, including early rehabilitation, SCI carries a poor prognosis, with most patients experiencing permanent neurological deficits, as was seen in this patient.[1]

Surgical Treatment

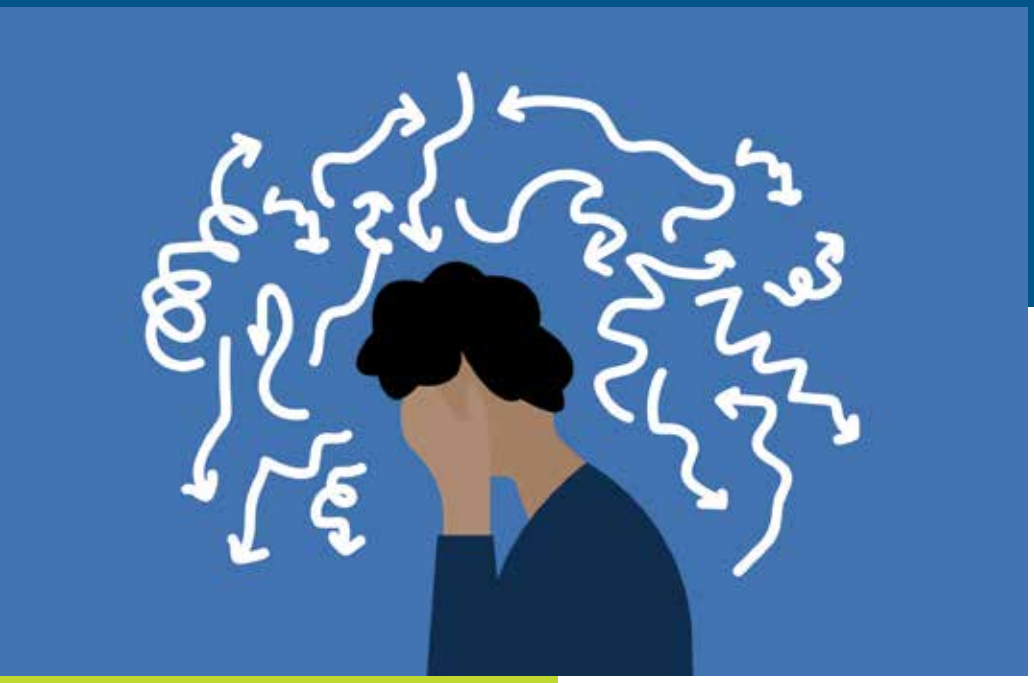
While surgical intervention is not typically indicated in cases of ischemic SCI, surgery may be required if there is an identifiable cause of compression, such as a herniated disc, vertebral fracture, or other structural pathology. In this patient, the diagnosis of SCI due to atherosclerotic embolism did not warrant surgical intervention, as there was no evidence of spinal cord compression or other treatable causes of the acute paraplegia.[2]

CONCLUSION

This case highlights the importance of considering spinal cord infarction in the differential diagnosis of acute paraplegia, even in the absence of traditional risk factors for vascular disease. The diagnosis of SCI can be challenging, and prompt recognition, appropriate imaging, and timely management are crucial for optimizing outcomes. As the population ages and the incidence of vascular disease increases, SCI will likely become more common in clinical practice, underscoring the need for emergency physicians to be vigilant in recognizing this potentially devastating condition.✶



Paroxysmal Sympathetic Hyperactivity: What to Know about This Complex Diagnosis in the Critical Care Unit



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Your patient is a 2-year-old female who is in the Pediatric Intensive Care Unit after suffering an out-of-hospital cardiac arrest. She is currently intubated and sedated. The team is providing post-cardiac arrest standard of care. Advanced neuroimaging 48-72 hours after her arrest revealed that the patient suffered a significant hypoxic ischemic brain injury. About one week into the treatment course, after having no significant changes in mental status, the patient begins to exhibit tachycardia, random eye movements, dilated pupils bilaterally, and hyperventilation. These symptoms lead you to be concerned that the patient is experiencing an intracranial hemorrhage leading to a possible herniation. You order mannitol to be administered STAT and rush the patient to the CT scanner.

GENERAL OVERVIEW

Paroxysmal Sympathetic Hyperactivity (PSH) describes the dysregulation of the sympathetic nervous system. This disease process typically occurs in the setting of severe acquired brain injury, which can include traumatic brain injury, anoxic brain injury, stroke, tumors, etc. In general, patients with severe PSH symptoms are more likely to suffer from poorer neurological outcomes. PSH is characterized by sudden, recurrent episodes of excessive sympathetic nervous system activity. These episodes are typically brief, intense, and often triggered. Previously, PSH has been referred to by various terms, including "sympathetic storming," "autonomic storming," and "paroxysmal autonomic instability with dystonia."

PATHOPHYSIOLOGY

Autonomic dysfunction is a result of disconnection of one or more cerebral centers and/or disturbances in cortical and subcortical regions caused by focal or diffuse injuries. PSH arises when inhibitory pathways are disrupted, resulting in dysregulation of the sympathetic nervous system. Ultimately, the anatomic basis of the pathogenesis of PSH remains undefined.

CLINICAL PRESENTATION

PSH manifests as simultaneous, paroxysmal transient increases in sympathetic and motor activity. The six core features include tachycardia, tachypnea, hypertension, hyperthermia, hyperhidrosis, and dystonic posturing. PSH can present as a spectrum of these clinical symptoms over time. Even within the clinical course of one patient, the presentation may fluctuate.

Triggering events are not predictable and may include both noxious and non-noxious stimuli including pain, suctioning, passive motion, bladder/bowel distension, etc. It is unknown when PSH will first present within the clinical

DIAGNOSES TO CONSIDER	OVERLAPPING SIGNS/SYMPTOMS	MANAGEMENT NEXT STEPS
Seizure	Posturing, hypertension, tachycardia, gaze deviations and pupillary exam changes	EEG monitoring and administration of antiepileptics
Pulmonary Embolism	Tachycardia, tachypnea	Tachycardia, tachypnea
Elevated intracranial pressure	Pupillary dilation, hypertension, irregular breathing pattern	CT Head, hypertonic saline/mannitol, hyperventilation, elevation of head of bed
Pain or agitation episodes	Tachycardia, hypertension, rigors, tachypnea	Analgesia
Drug withdrawal and intoxication syndromes (i.e. alcohol, cocaine, meth, opioids)	Hypertension, tachycardia, tachypnea, hyperthermia	Symptomatic management
Serotonin syndrome or neuroleptic malignant syndrome	Hyperthermia, tachycardia, hypertension, posturing/rigidity, changes in reflex testing, pupillary dilation	Review of medication list and symptom control
Thyrotoxicosis	Tachycardia, hypertension, tachypnea, changes in reflex testing	Ancillary hormone testing (TSH, T4 free, T3)
Sepsis	Tachycardia, hyper/hypotension, tachypnea, agitation, hyper/hypothermia	Serum testing (CBC with diff, CMP, lactic acid, blood cultures), antibiotics
Pheochromocytoma	Hypertension, tachycardia, diaphoresis	Alpha and beta blockade, CT imaging to identify source

Table 1

course of a patient recovering from brain injury. Some patients experience PSH one week into the clinical course and others will experience PSH weeks to months into recovery. It is also difficult to predict the duration of each episode and for how long a patient will continue to experience these paroxysmal events. Episodes may last from a few minutes to 2 hours and occur frequently throughout the day; some patients may experience PSH for several weeks to months to years.

Signs and symptoms associated with PSH:

- Tachycardia (present in ~98% of cases)
- Hypertension
- Tachypnea
- Diaphoresis
- Pupillary dilation
- Hyperthermia
- Dystonic posturing
- Agitation

DIFFERENTIAL DIAGNOSIS

Because the presentation of PSH is broad, unpredictable, and nonspecific, other disease states should be considered (Table 1).

Ultimately, PSH is a clinical diagnosis of exclusion.

TREATMENT/MANAGEMENT

Treatment is largely supportive and relies on counteracting the sympathetic overdrive with a combination of abortive and preventive medications. The goal is to reduce the frequency and severity of episodes. Ideally, pharmacologic treatment will be initiated in the ICU and tailored to individual needs.

Abortive Therapy (Managing Acute Episodes)

- **Opioids:** Morphine (2–8 mg IV); responsiveness supports the PSH diagnosis. Fentanyl (25-100 mcg IV) offers a faster onset.
- **Propofol:** GABA agonist; good option in intubated patients; a 10–20 mg IV bolus can abort episodes.
- **Benzodiazepines:** GABA agonist; diazepam (5–10 mg IV) or midazolam (2–5 mg IV).

Preventative Therapy (Reducing Episode Frequency)

- **Propranolol:** A lipophilic non-selective beta-blocker that crosses the blood-brain barrier; doses range between 20-60 mg PO every 4-6 hours.
- **Gabapentin:** Addresses neuropathic pain and allodynia; starting dose is 100-300 mg PO three times daily.
- **Alpha-2 agonists:** Clonidine (0.1 mg PO every 8 hours) or dexmedetomidine infusions can modulate central sympathetic activity.

References available online.

Supportive Care

- **Trigger Avoidance:** Minimize stimuli such as environmental temperature changes, bladder distension, etc.
- **Nutritional Support:** Address increased metabolic demands due to heightened sympathetic activity.
- **Fluid Management:** Counteract volume depletion from insensible losses due to hyperventilation or diaphoresis.
- **Temperature Control:** Use physical cooling methods, as fevers may not respond to antipyretics.
- **Medication Caution:** Avoid antipsychotics, which may increase the risk of neuroleptic malignant syndrome in PSH patients.

DISPOSITION

- **ICU Monitoring:** Patients with PSH require close observation, especially during the acute phase.
- **Long-Term Outlook:** PSH episodes typically resolve within a year; however, some patients may experience prolonged symptoms.
- **Rehabilitation:** Early involvement of multidisciplinary teams can aid in recovery and functional improvement.
- **Prognostication:** PSH is associated with worse long-term functional outcomes. There is limited data to determine the directionality of this relationship though it is worthwhile to note that patients with PSH often have increased duration of hospital stay, higher rates of tracheostomy, and/or longer ventilator dependence.

SUMMARY/TAKE-HOME POINTS

- Paroxysmal sympathetic hyperactivity (PSH) is a serious but treatable complication of acute brain injuries.
- The clinical presentation includes recurrent episodes of tachycardia, hypertension, tachypnea, hyperthermia, diaphoresis, and dystonic posturing. Episodes are unpredictable and rapid in onset.
- The diagnosis is based on clinical features.
- It is important to consider a broad differential diagnosis, given PSH shares many overlapping symptoms with other severe pathologies.
- Management includes supportive care and pharmacologic therapy.
- PSH is associated with a worse prognosis for recovery in patients with severe traumatic brain injury as well as a higher likelihood of complications.

CASE RESOLUTION

Imaging reveals no new lesions or intracranial abnormalities. The patient returns to their room. Over the course of the same day and the next week, these episodes of sympathetic response occur more frequently and become regular events. It is deduced from the clinical picture and continuous monitoring that the patient is "neuro-storming," also known as paroxysmal sympathetic hyperactivity. The patient is started on a dexmedetomidine infusion and has morphine added as a PRN medication for when the episodes occur. ✷

References available online.

CASE REPORT: ORTHOPEDIC AND EMERGENCY MEDICINE MANAGEMENT

Impaled Spiral Shank Nail Removal from Thumb

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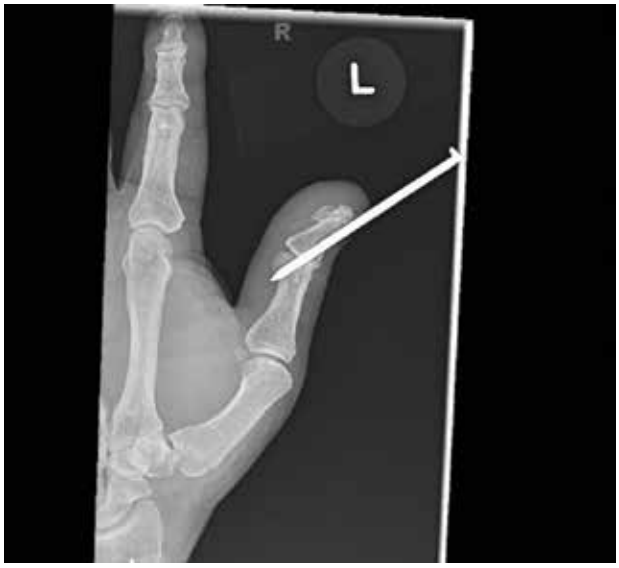
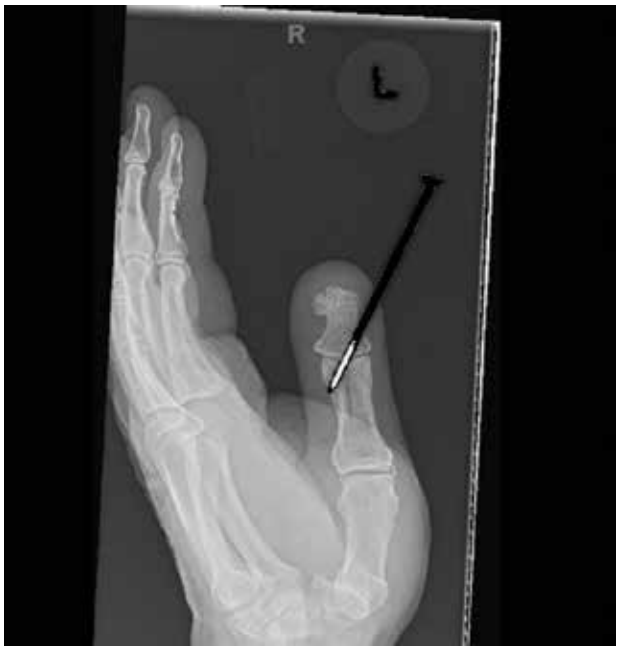




CASE

A 68-year-old right-hand dominant male with a past medical history of hypertension, type 2 diabetes mellitus presented to the ED after sustaining a nail gun penetrating trauma to the left thumb. The patient reported that approximately 3 hours prior to arrival to the ED, he was using a nail gun to work on a home renovation project when he accidentally impaled himself with the nail gun in his left thumb. The patient felt immediate pain at the left thumb and was unable to pull the nail out of his digit himself. He reported adequate hemostasis with a soft dressing applied to the site of injury. He sought help at a local urgent care prior to arrival to the ED, stating that they were unsuccessful in removal of the impaled nail. He reported that the nail was a threaded nail, and not a simple screw. The patient reported he was up to date on his tetanus vaccination and had a booster administered within the year. He denied any new onset paresthesias, numbness, or tingling into the distal aspect of the left thumb. The patient reported no use of anticoagulants. He denied history of injury, trauma, or prior surgeries to the left thumb.

On physical exam, he was in no acute distress, resting comfortably sitting upright in an ER chair having ambulated well into the ED. He was vitally and hemodynamically stable. Focused exam of his left thumb was significant for an adequately perfused digit that was warm, with capillary refill <2 seconds with palpable radial and ulnar pulses. Sensation was intact to the distal most aspect of the left thumb with intact 2-point discrimination to <5mm. His left thumb had a large threaded metal nail, measuring approximately 7.5cm in length and 3.2mm wide, protruding from the distal aspect of the digit. He was unable to demonstrate the ability to actively flex at the interphalangeal joint of the thumb. Pain was managed with Hydrocodone 5-325 mg in the ER, and he received prophylactic 2g IV Cefazolin antibiotic for soft tissue injury and bone penetration.

INVESTIGATION & MANAGEMENT

Radiographs were obtained including anterior-posterior and lateral views of the left thumb which demonstrated a penetrating injury of a metallic object (in this case, the threaded nail). The nail on X-ray did appear to pierce the base of the distal phalanx with extension through

References available online.

the interphalangeal joint into the thumb proximal phalanx with an associated vertically oriented split fracture of the proximal phalanx, evident with increased radiolucency on these films. No gas within the soft tissues or other identified foreign bodies; fractures, dislocation, or other acute bony abnormalities were noted. The hospital site has an orthopedic surgery residency program, and the orthopedic surgery resident was consulted given the bony involvement and the recommended outpatient management with an orthopedic hand surgeon.

The management of this case was bedside removal of the foreign metal nail. A Betadine scrub brush was used with sterile saline to copiously wash and irrigate the surrounding area of penetrating metallic nail. In sterile fashion, and using sterile pliers, the metallic nail was removed using counterclockwise rotation in order to disengage the nail from the penetrated bone. The wound was again copiously irrigated with sterile saline and scrubbed again with Betadine. The thumb was dressed using sterile Adaptic and bacitracin ointment. A left thumb spica cast was applied for immobilization of the digit and to maintain appropriate anatomic alignment. The patient tolerated the removal of the metallic nail, washouts and application of the cast well. He was neurovascularly intact following the treatment.

Post-foreign body removal with cast application X-rays were obtained which redemonstrated the vertically oriented, longitudinal fracture of the left thumb proximal phalanx extending into the interphalangeal joint. Removal of the foreign metal nail also allowed for appreciation of an intra-articular fracture at the distal ulnar aspect of the proximal phalanx where the metallic nail had been previously located, and a distal phalanx base fracture as well. No retained metallic foreign bodies were identified. Of note, there was no involvement of the metacarpal phalangeal joint of the thumb, making this an isolated injury involving only a single joint of the thumb.

Post procedure, he was neurovascularly intact following the removal of the metal nail and after application of thumb spica cast. He was discharged in stable condition from the emergency department with PO antibiotics of Cefalexin 500mg 4 times daily for 10 days and PRN pain management with acetaminophen and or ibuprofen as needed, including rest, ice, and elevation of the affected thumb. The patient was given thorough cast care instructions, including education about compartment syndrome, education for signs and symptoms of potential infection, and strict return precautions discussed.

DISCUSSION

The management of removal of foreign objects from the extremities and phalanges is essential in emergency medicine management; in particular, understanding of the mechanism of injury and details about the object impaled is important. In this case, fasteners such as nails and screws vary between driven-in with a hammered or direct force of motion, versus a rotational force, which is often used with screws. The metal nail described in this case was one with a spiral thread on the shank, beneficial for home renovation projects as it creates a thread-like interlock and increasing withdrawal capacity.[1] Further, penetrating nail gun and screw injuries to the hand commonly occur in both professional and nonprofessional settings, where 14% of nail gun injuries that occur at home involve a hand or finger trauma.[2]

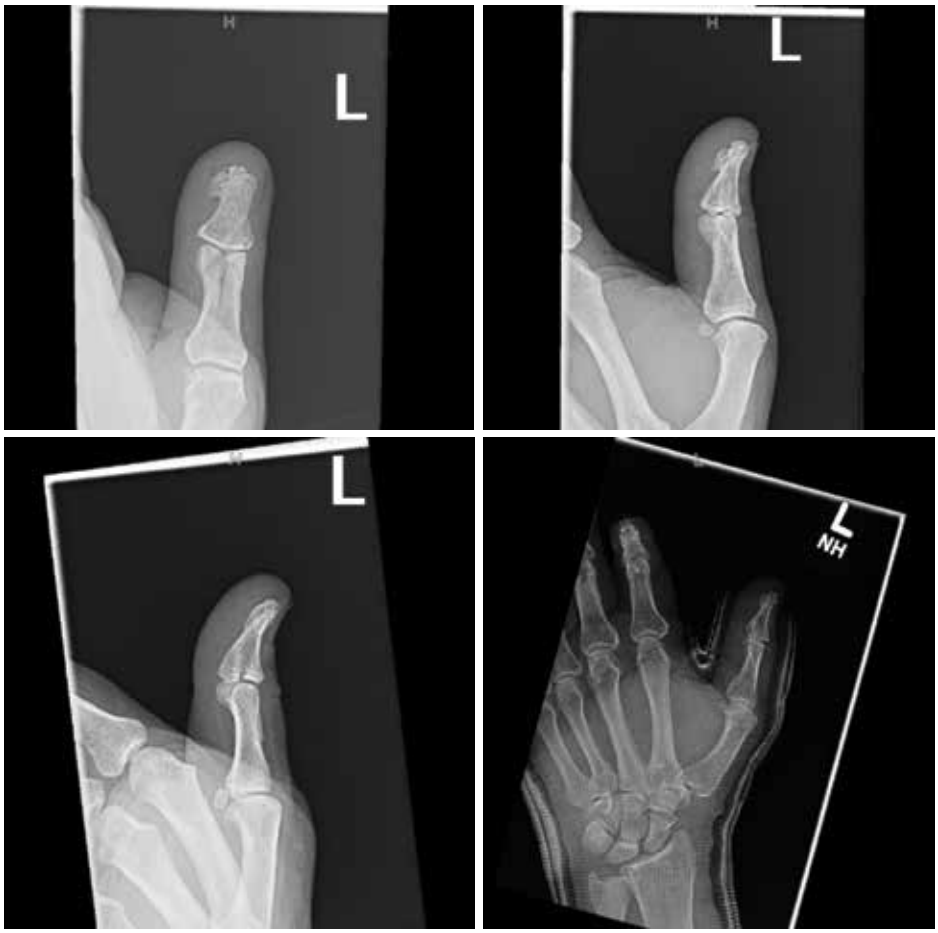
These injuries can be complicated if there is bony, tendinous, vascular,

"The metallic nail was removed using counterclockwise rotation in order to disengage the nail from the penetrated bone."

References available online.

or joint involvement. However, most cases involve a retained nail or screw with injury to surrounding soft tissue. Extraction can be complicated by barbs or threads. In the instance of barbed or threaded nails, typically the head of the nail is removed and then extracted in the direction of entry.[3] Furthermore, one case described an injury of a barbed nail penetrating the volar soft tissue completely through the distal phalanges of the second and third digits. On radiographic imaging there was no bony involvement identified, and no barbs were embedded in the soft tissue of the digits. In that case, the removal of the foreign body was performed in the operating room with fluoroscopy to confirm the absence of retained foreign bodies. Irrigation was performed with pulse lavage.[4] A similar case presented involved a nail embedded deeply through the first, second, and third digits. The patient was neurologically and vascularly intact with no evidence of bony involvement and the nail was also removed in the operating room in retrograde fashion with confirmation of no retained foreign bodies via X-ray and finished with irrigation and left open.[4]

Another case discusses a barbed screw impaling the mid left palm in line with the third digit in close proximity to Kaplan's line of the palmar arch. In this case, the barbs extended through the overlying lumbrical muscle and flexor tendon of the middle finger. Once again, no fractures were identified, but there was median nerve compression secondary to traumatic edema at the mid-carpal tunnel area. Open exploration was performed in the operating room and extraction under direct visualization followed by irrigation with sterile normal saline and then closed with sutures.[5] Many of these cases have similar methods of extraction, but published literature describes a new method proposing tying a thick suture around the distal aspect of the nail, so as the nail is removed in retrograde fashion, the suture pulls through. Furthermore, this allows identification of the tract for directed debridement and irrigation.[6]



TAKE-HOME POINTS

Management of hand injuries due to nail guns further includes pain management, ensuring a Tetanus vaccination update if indicated and administering antibiotics, preferably with anti-staphylococcal and anti-pseudomonal coverage, both in the ED prophetically with the patient and continued outpatient.[7,8] The case discussed here, similar to a previous study of hand injuries, presents an efficient method of extraction of a threaded screw in a patient digit with bony involvement that offers successful patient outcomes while efficiently avoiding extensive resources, including that of operating room costs, equipment, staffing, resources and patient cost and time.[9] ✶

References available online.

A CASE REPORT

The Utility of Computed Tomography (CT) Imaging in Recurrent Esophageal Food Impactions

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Esophageal food impaction is a common emergency, typically linked to intrinsic esophageal pathologies. While most cases stem from issues like Schatzki's ring or strictures, rare instances can arise from extrinsic structural compression. This report details an unusual case caused by such an extrinsic factor and the utility of CT imaging in guiding the diagnosis.

CASE REPORT

A 62-year-old woman presented with a 12-hour history of food impaction, a recurring issue that had previously resolved spontaneously but failed to do so this time. A contrast-enhanced CT scan revealed a food bolus at the C6–C7 level, notably adjacent to an anterior C6–C7 osteophyte. After conservative measures proved ineffective, the food bolus was successfully removed via endoscopic removal.

CONCLUSION

This case highlights a rare but significant cause of esophageal food impaction: extrinsic structural compression by an anterior C6–C7 osteophyte. It underscores the importance of considering less common etiologies, particularly with recurrent impactions or when standard treatments fail. Advanced imaging, like CT scans, is crucial for identifying these atypical causes, guiding appropriate management, and ultimately improving patient outcomes.

INTRODUCTION

Esophageal food impaction is a common gastrointestinal issue that often presents in the emergency department. The incidence ranges from 13 to 25 cases per 100,000 people per year.[1,2] Most cases present similarly: patients report dysphagia, odynophagia, globus sensation, regurgitation, and/or chest discomfort after ingesting meat.

These impactions are typically caused by underlying esophageal pathologies such as Schatzki's ring, peptic strictures, or eosinophilic esophagitis. For individuals with such conditions, the recurrence rate of impaction is approximately 21%, and as high as 50% in those with eosinophilic esophagitis.[2]

Initial evaluation relies heavily on a thorough history and physical examination. Imaging is generally not required unless there is a concern for radiopaque foreign bodies (e.g., bones) or to assess for complications such as esophageal perforation. Incomplete obstructions may be managed conservatively. Interventions such as glucagon and carbonated beverages have shown limited benefit. However, if the impaction persists for more than 12–24 hours, or if there is complete obstruction leading to pooling of secretions or airway compromise, emergent endoscopy becomes necessary.[3]

While most esophageal food impactions stem from intrinsic esophageal abnormalities, rare cases may be due to extrinsic structural causes. This case report highlights one such instance.

CASE

A 62-year-old female presented with a 12-hour history of food impaction following pork chop ingestion. She reported the sensation of food not passing completely into her stomach. She had experienced multiple similar episodes in the past but had always been able to regurgitate the bolus spontaneously. This time, repeated attempts to induce vomiting were unsuccessful. She had never previously required endoscopic intervention.

Her past medical history included atrial fibrillation (on rivaroxaban), chronic obstructive pulmonary disease (COPD), hypertension, hyperlipidemia, chronic neck and back pain managed with opioid-based analgesics, and tobacco use.

Upon arrival and throughout her stay in the emergency department, vital signs remained stable. Physical examination was largely unremarkable. There was no pooling of secretions, and the airway was patent and intact.

Laboratory tests—including complete blood count, basic metabolic panel,

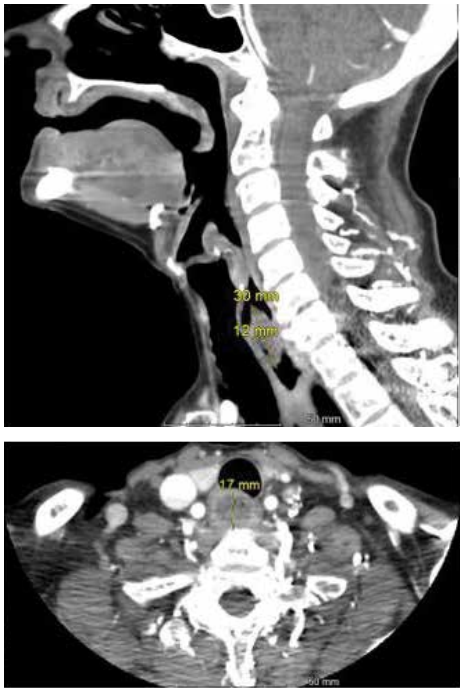

Figure 1. Sagittal and transverse views of esophageal food bolus impaction.

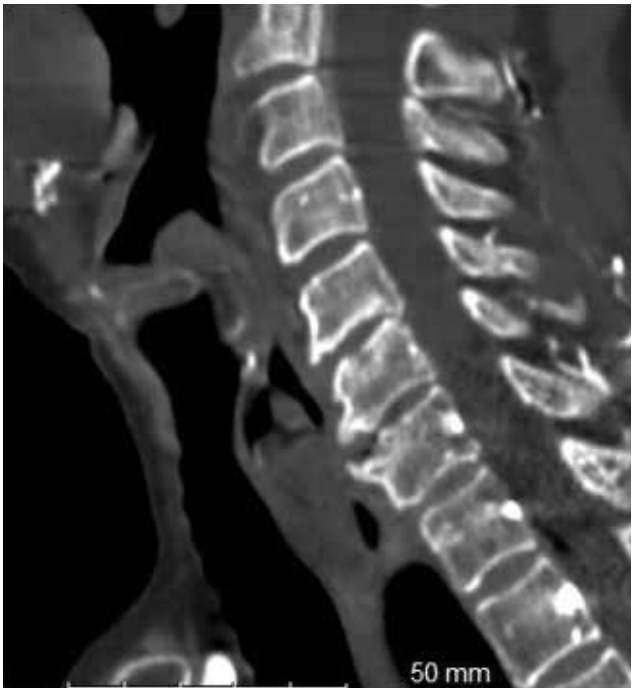

Figure 2. Sagittal views of C6-C7 anterior osteophyte.

liver panel, and lipase—were within normal limits. A chest X-ray revealed no radiopaque foreign bodies. A contrast-enhanced computed tomography (CT) scan of the neck and chest identified a 3.0 × 1.2 × 1.7 cm food bolus (Figure 1) lodged at the C6–C7 level, adjacent to an anterior C6–C7 osteophyte (Figure 2).

While in the emergency department, the patient attempted to drink a carbonated beverage without relief. Glucagon was administered, but her symptoms persisted.

Gastroenterology was consulted, and the patient was admitted for emergent endoscopy. She was started on an intravenous proton pump inhibitor (PPI) and subsequently underwent esophagogastroduodenoscopy (EGD) with successful removal of the food bolus. She was discharged home on an oral PPI and referred for outpatient follow-up with gastroenterology for further evaluation.

DISCUSSION

This case is particularly noteworthy and important because it highlights a rare cause of esophageal food impaction: an extrinsic structural compression from an anterior C6-C7 osteophyte. While most such impactions are attributed to intrinsic esophageal pathologies like Schatzki's ring or eosinophilic esophagitis, this case serves as a crucial reminder for clinicians to consider less common etiologies. The patient's history of recurring impactions, despite always self-resolving previously, underscores the need for thorough investigation when typical management fails. The use of a contrast-enhanced CT scan was instrumental in identifying the osteophyte, demonstrating the value of advanced imaging in atypical presentations. This case contributes significantly to the medical literature by broadening the differential diagnosis for esophageal food impaction. Recognizing such uncommon causes can prevent diagnostic delays and guide appropriate, individualized management, ultimately improving patient outcomes. It emphasizes that while conservative measures are often first-line, persistence of symptoms warrants a deeper look for underlying structural issues, even if they are extrinsic to the esophagus.

The World Society of Emergency Surgery (WSES) Guidelines estimate a false negative rate of up to 85% for esophageal food bolus impactions. Furthermore the WSES provides Grade 1B recommendations for CT imaging to be performed in patients with suspected perforation or other complications that may require interventional endoscopy, and states that CT is an essential tool in suspected ingestion of bone fragments with negative X-rays.[4]

According to Liu et al, CT demonstrated 100% sensitivity, 92.6% specificity, 100% negative predictive value and a 97.9% positive predictive value in assessing the presence of esophageal foreign bodies and suggested a reduction in complication rates and severity of complications prior to endoscopic evaluation.[5] Additionally, Ma et al found statistical superiority of CT imaging versus plain radiographs in the diagnosis of patients found to have pointed or sharp thoracic esophageal foreign bodies.[6]

The current literature focuses on the ability of CT imaging to help establish the diagnosis of esophageal foreign bodies and reduce subsequent complications of a relatively frequent emergency department complaint. Not only did CT imaging help establish the diagnosis of an esophageal food impaction in our patient but also provided further information regarding the anatomical environment of the site where the patient had frequent and recurrent food impactions. Evaluation of the surrounding anatomy using CT imaging established a diagnosis of an anterior osteophyte at the level of the food impaction which gave further information for endoscopic and/or surgical planning prior to intervention. ✶

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FaceTime as a Tool for Remote Communication in Sudden Death and Resuscitations

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In the chaos of a prolonged resuscitation, it can be easy to lose sight of the human story unfolding behind the curtain. It is well documented in the literature that family members who are present at a resuscitation and a loved one's death will often experience better psychological outcomes in hand with less depression, anxiety, and PTSD. The value of being able to witness a passing has been thought to help loved ones make sense of a loss, offer a sense of closure, reduce feelings of helplessness, and promote meaning.

Unfortunately, as it is well known to emergency teams, particularly in hubs of tourism, tragedies happen when least expected and typically when family members are not present. So, how does this opportunity to involve loved ones in end-of-life transitions extend into virtual platforms such as FaceTime? With technology mitigating the barriers that distance might hold, video platforms may offer providers the ability to connect compassionately with patient's families while delivering shocking and difficult news.

The utility of this was recently highlighted during a prolonged resuscitation in a young adult. This young male was on vacation and suffered a sudden cardiac arrest, likely secondary to a PE given the clinical scenario. Resuscitation efforts lasted around 1 hour and attempts to contact loved ones were made. Upon reaching his parents, they were appropriately reactive and having a hard time understanding how their healthy child had left their home and might die on vacation. With the family's permission, connection via FaceTime was made so the parents could witness the efforts being made by the care team, for the mother to see her son's face one more time and for her to say goodbye. A student was able to hold the phone and just as any other scenario in which a patient's loved one was welcomed into a resuscitation, this patient's parents were welcomed to express their feelings and watch as time of death was declared. Mom later expressed a sense of gratitude and closure that did not seem attainable prior to video streaming.

While the benefits of FaceTime are apparent, on a technical note, FaceTime is not HIPAA compliant. It offers a fast and easy opportunity in emergency situations and can be used relying on the "confidential communications exception" within HIPAA. Avoid using any PHI when discussing the case with family and request that family is alone in a private location for the call. When utilizing the exemption, it is advised to put the request to receive confidential communications via FaceTime in writing. It's imperative to warn the individual that FaceTime lacks the administrative controls to comply with HIPAA, and request that the individual acknowledges the warnings surrounding breaching security of PHI. Given that these would classically be emergency situations, weigh the risks and appropriateness of these conversations in the specific situation. Use situational context to assess safety and awareness around how we utilize virtual tools. If a TeleHealth or IT Secure video streaming platform is available at your institution, this would take precedence. Look to your hospital IT security leadership for guidance or consider Zoom for Healthcare or Doxy.me. Further, it is important to note that video calls may be screen-recorded or either intentionally or unintentionally broadcasted. Given the risks of misinterpretation of these critical moments and the growing integration of social media features into communication apps, such as live streams, consider the privacy, dignity and safety of your patient before initiating or sharing any communication.

When considering real-time video calls in these scenarios, please also consider how cultural and individual factors might influence these decisions or if witnessing a traumatic or poorly managed death might increase distress. Prepare a loved one for a video call in a similar manner as you might prepare them for what to expect during a code in an in-person scenario. Always give your team a heads-up and make sure everyone is on board and prepared to welcome a loved one into the room.

As technology evolves, we must also evolve and learn how to better serve our patients with all available resources. Particularly in busy tourist hubs, virtual platforms may offer opportunities for loved ones to be offered a sense of closure and move through grief when losing family members separated by distance. When delivering difficult news on the phone, don't be afraid to hit that video option if consent is given. ✶

References available online.

A CASE REPORT:

Posterior Reversible Encephalopathy Syndrome in the Setting of Hypotension, Hypothermia, and Fentanyl Use

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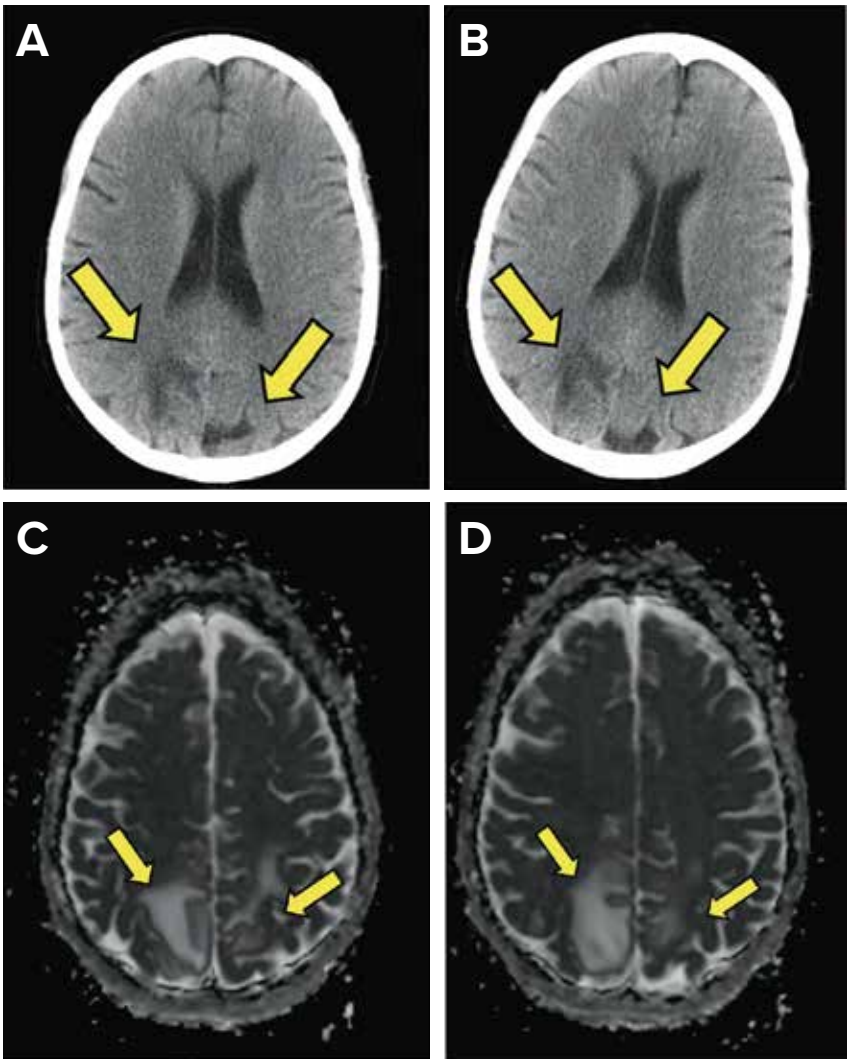

INTRODUCTION

A 50-year-old female with a past medical history notable for opioid and alcohol use disorder, chronic hepatitis C, microcytic anemia, and complicated alcohol withdrawal presented to the emergency department of a Level I trauma center after being found by medics unresponsive outside in a snowbank. Initially, she had pinpoint pupils and was given 2 mg of intramuscular naloxone with immediate improvement in mentation. She was combative with paramedics and hospital staff, initial vitals were notable for a rectal temperature of 88.7°F, and the remainder of vitals were within normal limits with blood pressure at 122/89. The patient was minimally interactive during examination, though no focal neurologic deficits were noted. The patient was very cold to the touch and was quickly wrapped in warm blankets and given a warm water bath, with warmed intravenous fluids initiated. Glucose was 177. The initial differential included opioid overdose, hypoglycemia, alcohol withdrawal seizure, and hypothermia. Less concern was given for potential head injury, or cardiac or respiratory compromise, as the patient's vitals were initially within normal limits save for her temperature as no obvious injuries or tenderness were noted.

Figure 1: Computed Tomography and Magnetic Resonance Imaging Demonstrating Posterior Reversible Encephalopathy Syndrome (PRES).

Initial (A) and next-day (B) CT imaging of concerning for PRES, with bilateral parietal vasogenic edema noted. MRI demonstrated expansile T2/FLAIR hyperintense signal in the posterior frontal and parietal lobes, favored to be PRES (C and D). Arrows correspond to areas of interest.

References available online.

Posterior reversible encephalopathy syndrome (PRES) in the setting of opioid use has been reported in the literature, both among patients with opioid use disorder and among patients receiving narcotics during surgery.

DIAGNOSIS AND MANAGEMENT

Initially, only basic blood work and an electrocardiogram were obtained, which were notable for a creatinine of 1.6 and sinus bradycardia with rate of 54 beats per minute with QTc of 489 ms. During the rewarming process, the patient's temperature approached normothermia after multiple hours, though she became hypotensive to around 95/55 despite multiple warmed fluid boluses. She ultimately received 3L of warmed normal saline, with a BP nadir of 86/53. The patient continued to be somnolent but rousable, oriented to person, place, and time, with no neurologic deficits or respiratory depression.

At this point, further workup was initiated: complete metabolic panel, magnesium, phosphorous, thyroid stimulating hormone (TSH) level, ethanol, urinalysis (UA), and urine drug screen (UDS) were obtained, which were notable for improved creatinine of 1.0, calcium of 7.8, mildly decreased TSH of 0.384, nitrite positive UA, and UDS positive for barbiturates, benzodiazepines, and opiates. Non-contrast head CT demonstrated bilateral vasogenic edema in the posterior parietal lobes read as concerning for posterior reversible encephalopathy syndrome (PRES; see Figure 1A). The patient was admitted after consultation with neurology for observation and an MRI.

A few hours after admission she ultimately eloped during shift change. She returned to the same ED the next day after being found unresponsive outside again, was given Narcan en route as well as in the ED for bradypnea, and ultimately started on a naloxone drip, though she remained saturating well on room air. The initial temperature was 97.8°F and the initial BP was 121/83. Repeat head CT demonstrated the same vasogenic edema as seen previously (see Figure 1B). The patient was admitted again and remained normotensive. MRI with and without contrast demonstrated expansile T2/FLAIR hyperintense signal in the posterior frontal and parietal lobes, favored to be PRES (see Figure 1C and D).

The next day the patient was weaned off her naloxone drip and maintained good respiratory effort and normal BP. The patient was started on levetiracetam 500 mg twice per day and became insistent that she be discharged. She was sent home with outpatient follow-up, though was ultimately lost to follow-up.

Posterior reversible encephalopathy syndrome (PRES) was first described in 1996 by Hinchey et al in the context of patients with acute hypertension and in more than 50% of the included patients, renal impairment.[1] Traditionally it has been described as presenting with altered mentation, visual disturbances, and seizures, usually in the setting of hypertension with systolic pressures reported in the literature between 150 and 190 mm Hg.[2] PRES in the setting of opioid use has been reported in the literature, both among patients with opioid use disorder and among patients receiving narcotics during surgery.[3,4,5] Among these cases patients were either hypertensive, normotensive, or did not have mention of the patient's BP. There is a case of pediatric methadone overdose in which the patient presented hypoxic and hypotensive, and was later found to have both PRES and acute cerebellitis.[6] No other case to date has demonstrated PRES in the setting of significant hypothermia and concomitant opioid overdose.

PRES in general is a presentation emergency physicians should be familiar with, as prompt treatment has been associated with decreased neurologic sequelae.[7] Treatment is generally focused on managing the seizures and hypertension that traditionally accompanies this disease presentation, through the use of benzodiazepines and calcium channel blockers for instance. Multiple theories exist for the pathophysiology of PRES, all involving endothelial dysfunction, disruption of the blood-brain barrier, and vasogenic edema. In the above case, it is likely the combined use of fentanyl and significant hypothermia and hypotension, perhaps with other illicit substances, led to the ultimate vasogenic edema noted on imaging.

TEACHING POINTS

- Posterior Reversible Encephalopathy Syndrome (PRES) is a neurologic disorder that traditionally presents with altered mental status, visual disturbances, headaches, and seizures in the setting of hypertension, though cases such as the one in this article demonstrate PRES can be associated with opioid use and present in the setting of hypotension and hypothermia.
- Treatment of PRES should focus on the management of the life-threatening aspects of the disease, including BP management and treatment of seizures with traditional measures such as benzodiazepines and calcium channel blocks.
- In the case of PRES with associated hypothermia, hypotension, and opioid overdose, rewarming measures including warmed intravenous fluids and the use of opioid reversal agents titrated to control respiratory depression should all be utilized. ✶

References available online.

Intracranial Abscess and Importance of Head Circumference Measurements in Pediatric Patients

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INTRODUCTION

Intracranial abscesses are a rare pathology in which focal areas of brain parenchyma are necrotic secondary to an infectious agent, typically bacteria, with an incidence of 1,500-2,500 cases in the United States per year.[1,3] The incidence in children is likely even less, and unfortunately there is very little data on specific pathology. While extremely rare, it should remain on the differential when evaluating children who present to the emergency department with fussiness, altered mental status, and headaches. Specifically in infants, head circumference measurements provide a useful objective measurement that could guide the clinician toward intracranial pathologies, such as a brain abscess, in an otherwise undifferentiated fussy infant.

In this case report, we will present a case of a 2-month-old male who presented with fussiness and increasing head circumference and was ultimately found to have an intracranial abscess. In this case review, we hope to highlight the importance of cranial circumference measurements in the emergency department while reviewing this rare pathology.

CASE REPORT

The patient is a 2-month-old male, born at 37-weeks' gestation via spontaneous vaginal delivery without complication, who presented to the pediatric ED with increased head circumference, fussiness, and progressively increasing vomiting over the past week. The mother reported that he had recently started daycare and had mild nasal congestion. She denied fevers, but did endorse an elevated temperature of 99.8 for which she administered acetaminophen. Mom reports the patient had not yet had his 2-month vaccinations, but received all recommended medications at birth.

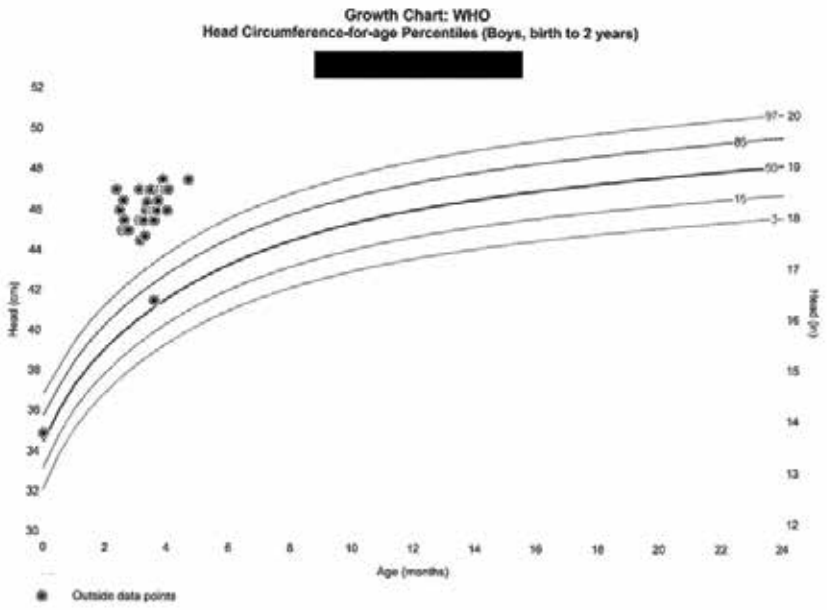

Figure 1

Vital signs were blood pressure 126/62, heart rate 149, respiratory rate 44, and pulse oximetry 100% on room air. On physical exam, the patient was irritable and had a bulging fontanelle with a large head circumference, 47 cm, greater than the 98th percentile. His previously recorded head circumference was 34.9 cm at birth, which was at the 63rd percentile (Figure 1). His pupils were 5 mm and equally reactive; however, he did have restriction of extraocular movements with a fixed downward gaze. He moved all four extremities equally. Skin exam was significant for an erythematous patch over the chest, consistent with a known birthmark. He had no bruising, abrasions, or lacerations concerning for trauma to his head. His heart and lung sounds were normal, and his abdomen was soft and nontender to palpation.

Laboratory evaluation was significant for a sodium of 128, potassium of 4.3,

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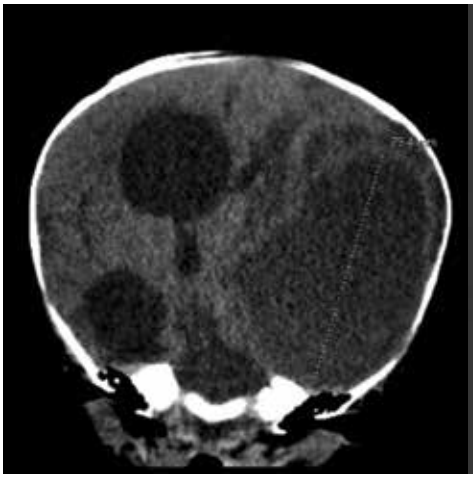

Figure 2

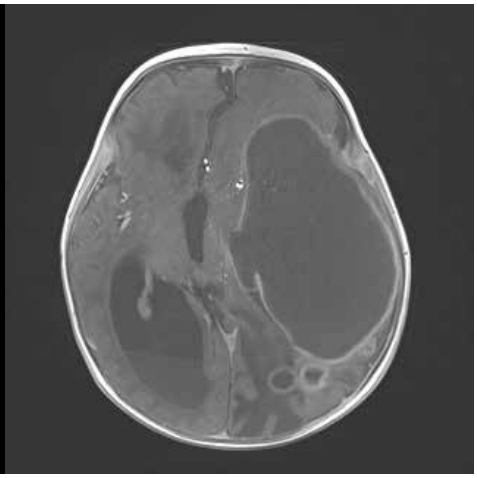

Figure 3

and creatinine 0.20. CBC was significant for a white blood cell count 19.0, hemoglobin 8.5, and platelets 1,086. Computed tomography of head without contrast demonstrated a large left-sided intracranial abscess with marked enlargement of the right lateral and third ventricles, concerning for obstructive hydrocephalus (Figure 2).

Neurosurgery was consulted, who recommended MRI and surgical management following advanced imaging. MRI revealed a large multiloculated left cerebral hemispheric abscess with marked mass effect including 1.5 cm of rightward midline shift, entrapment of the right lateral and third ventricles with associated transependymal edema, and left uncal herniation resulting in compression of the midbrain (Figure 3).

The patient was admitted to the pediatric ICU for close neurologic monitoring prior to neurosurgical intervention. Neurosurgery performed a craniotomy with washout of the abscess. On surgical inspection, frank purulent fluid was within the ventricles. Extensive washout was performed and an extraventricular drain was placed. Cultures were obtained from the intracranial abscess and ultimately grew Bacteroides fragilis. He was treated with vancomycin, cefepime, and metronidazole, which was eventually transitioned to vancomycin and meropenem. Several days later, a ventriculoperitoneal (VP) shunt was placed. After a 13-day hospitalization, he was discharged on a course of outpatient parenteral antibiotic therapy of meropenem and vancomycin. Upon review of subsequent outpatient pediatric visit notes, the patient was noted to be doing well overall with mild developmental delays.

DISCUSSION

This is a unique case of a spontaneous intracranial abscess in an infant without significant past medical history. Brain abscesses are a rare pathology, caused by an intracranial collection of purulent fluid within the intraparenchymal space. Etiology of the abscess typically arises from direct local spread, such as sinusitis or acute otitis media or from hematogenous spread from other primary infection sites, most commonly pulmonary infections.[2] Empiric broad spectrum antibiotic therapy is recommended and should be initiated in the emergency department. Ceftriaxone, metronidazole, and vancomycin are the preferred initial therapy regimen. Once culture results are available, the patient can be transitioned to a pathogen-specific regimen and will typically require a 4-6 week oral antibiotic course.[3] Surgical management is often required; however, if the abscess is <2cm, there are multiple abscesses, there is no significant mass effect from the abscess, or the patient does not have significant neurologic deficits, antibiotic therapy alone may be sufficient.[4]

This is a unique case, as it appears that the patient had no preceding infection such as otitis media, upper respiratory infection, or ocular infection. In addition, the patient had no systemic signs of infection, including fever, and his blood cultures were negative. He underwent an extensive immunologic evaluation during his hospitalization and he was found to have no significant immunosuppressive pathology. It is unclear why this patient developed such an atypical pathology with an unusual pathogen.

While this case demonstrates a unique pathology of a spontaneous intracranial abscess in an infant, it highlights the importance of the use of head circumference measurements in the emergency department. Changes in head circumference can be critical for the early detection of other intracranial pathologies such as intracranial malignancies, hydrocephalus, meningitis, or benign enlargement of the subarachnoid spaces in infancy (BESSI). This measurement is a routine assessment in the outpatient pediatric setting and is typically obtained alongside weight and height. However, this is not commonly done in the emergency department, which could lead to missing subtle changes that could be the result of severe intracranial pathology. Trends in head circumference are particularly important as a rapid increase in head circumference is more indicative of intracranial pathology, as demonstrated in this case.

CONCLUSION

Head circumference measurements are a helpful objective tool that can aid in the diagnosis of many intracranial pathologies, as described in the case above, with a rare case of intracranial abscess. Obtaining head circumference measurements in the pediatric emergency department and comparing them to priors can be useful to aid in diagnosing intracranial pathologies early that may otherwise go unnoticed, particularly in an undifferentiated fussy infant. ✷

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Military-Civilian Collaboration for Search and Rescue Operations in Vermont

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INTRODUCTION

Across the United States, outdoor recreation has surged with 4.1% growth from 2023 to 2024 leading to 57.3% of Americans participating in outdoor recreation activities like hiking, biking, fishing, running, and camping.[1] The state of Vermont is no exception to this trend; in 2023, 15.8 million people visited Vermont, compared with just 10.7 million during the first year of the COVID-19 pandemic in 2020.[2] From mountain biking on the Kingdom Trails to hiking the Long Trail or skiing the state's backcountry slopes, more people are heading into the Vermont wilderness than ever before. Advances in outdoor gear and easily accessible trail information have made it possible for people of widely varying skill and experience levels to get outside quickly. However, with this increased activity comes an increased frequency of life-threatening emergencies; from 2015 to 2023, search and rescue incidents in Vermont increased 41% from 100 to 141.[3] Similarly, the Vermont Urban Search and Rescue Task Force has gone from responding to 10 calls per year in the mid-2010s to almost 24 calls in 2024, including rescues of 265 people during two years of floods.[4] In these critical moments, a rapid and coordinated emergency response can mean the difference between rescue and tragedy.

Civilian Search and Rescue

Vermont's civilian search and rescue (SAR) teams have proven themselves to be a solution to the increasing need for rescues. Local organizations such as Stowe Mountain Rescue[5] and Richmond Backcountry Rescue[6] are volunteer-driven units composed of some of the most skilled, experienced, and committed rescue personnel in the region. Their deep familiarity with local terrain, combined with year-round training, makes them the cornerstone of backcountry safety across the Green Mountains. They often work alongside other teams, like the State Police Search & Rescue Team[7] or the aforementioned Vermont Urban Search and Rescue Task Force.[4]

Vermont's mountainous terrain, while not towering by Western standards, still presents significant challenges. Dense forests, steep slopes, and rapidly changing weather conditions can turn even a short distance into a full-day trek for SAR ground crews, especially when carrying medical equipment and extraction gear. Injured individuals in such conditions face life-threatening dangers like hypothermia, internal bleeding, or worsening trauma. Approximately 1,200 people visit the ED every week due to injuries in Vermont, and 95% of calls for winter sports require EMS transport to the hospital.[8] When time is critical, air support may be the only option.

Sometimes, these situations can be remedied by civilian helicopter Emergency Medical Services (EMS) agencies, which are an excellent resource for quickly getting a patient to the hospital. Unfortunately, in Vermont, these services cannot search for a patient, have limited capability to land in austere locations, especially at night, and cannot hoist a patient from the forest.

Military Augmentation

In these rare but life-threatening scenarios, the Vermont Army National Guard's rescue unit, Charlie Company, 3-126, plays a vital role. Their crews are highly trained in both precision aviation and emergency medical response. They operate HH-60M Black Hawk helicopters, which are flying ambulances equipped with infrared sensors to locate missing individuals, and hoist systems to extract people without landing. Additionally, crews are trained to operate with night vision goggles, allowing them to fly in darkness or low visibility.[9] These are highly specialized capabilities that civilian EMS helicopters simply cannot offer.

References available online.

While both civilian SAR teams and National Guard aviation units are highly capable on their own, it is their coordination that ultimately saves lives. That level of teamwork, however, doesn't happen by chance. It requires regular training, strong communication, and a structured system to ensure smooth cooperation—all of which demand ongoing effort and familiarity.

Although Vermont has a formal process that allows SAR agencies to request helicopter support from the Vermont Army National Guard, effective use of that system depends on the agencies knowing how to activate it and understanding what support the Guard can realistically provide. Examples of this include collaborations between the Vermont Army National Guard and the Urban Search and Rescue Team for SAR after flood disasters in July 2023[10] and July 2024.[11] Recently, however, deployments and staff turnover on both sides have led to a loss of the necessary working familiarity, diminishing the effectiveness of what should be a seamless partnership.

To address this, members of two northern Vermont rescue agencies recently participated in a remote informational meeting with the National Guard.[12] The meeting covered the Guard's capabilities, activation procedures, response times, and the various factors that determine whether a helicopter can be launched. It was a critical first step in rebuilding operational trust and understanding.

Future Work

Looking ahead, the agencies plan to meet in person with Vermont Army National Guard personnel, tour the helicopters, and examine rescue equipment firsthand. The goal is to develop a mutual understanding of how these assets can best be used. Plans are also underway for a training exercise in which the Guard will land in a local field and conduct practice hoist operations. Civilian rescuers will get to experience what it's like to work in proximity to a live helicopter—something that can be intense and disorienting without proper exposure. This training is intended to pave the way for a future mountain-based scenario involving a simulated patient in need of aerial extraction. Importantly, this collaboration uniquely meets the needs of Vermont, but it may also represent a model for other states to follow as they consider how to save injured outdoor adventurers and those trapped by natural disasters.

CONCLUSION

As more people head into Vermont's backcountry, the state must be prepared for increasingly complex rescues in remote and challenging environments. The combination of ground-based civilian expertise and advanced military air support creates a powerful, life-saving alliance, but only if these teams are prepared to work together. Building relationships, refreshing training, and strengthening communication between civilian SAR and the Vermont Army National Guard isn't just a good idea; it is a vital investment in public safety that should be emulated in states nationwide.✷

References available online.

CRITICAL CARE DEVICE SERIES:

Pulmonary Artery Catheter, Part 1 of 3

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Critical care units decreased their use of pulmonary artery catheters (PACs) following the publication of two studies showing no benefit back in 2005. So why talk about them today? Today, they are considered a valuable diagnostic and management tool in cardiogenic shock and are still routinely used in this population.[1] For this application, their use is supported by recent evidence correlating their placement with a mortality benefit, and they are now a broadly accepted tool in cardiac critical care.[2,3] Furthermore, time from presentation to placement seems particularly important.[2,4,5] We believe that the ED clinician, and particularly the ED resident, should be familiar with PACs, and should learn to place them during residency.

In part one of this series on PACs, we will explore the literature on PACs, how things have changed over the last 20 years, and provide a brief overview of how they work. In part two, we will cover indications for placement and the procedure of placement. Part three will review how to interpret and act on the data PACs generate.

Why did the PAC popularity glide downward? The two negative trials which led to substantially fewer applications of PACs were published in 2005.[6,7] These trials found no difference in mortality with the use of PACs and an increased number of complications related to insertion. However, these trials either under-represented or did not include the patient populations for which PACs seem to have the greatest benefit. For instance, PAC-Man was a multicenter randomized trial that found no mortality benefit in patients admitted to an ICU who were managed with a PAC.[6] In addition, 10% of patients in the PAC group experienced complications from insertion. However, only 11% of their population were patients with cardiogenic shock and this study was not powered to detect sub-group differences. The majority of studied patients had acute respiratory failure and multiorgan dysfunction (13% and 66%, respectively). Ultrasound, now the standard of care for central line placement, was not used in placement and this probably led to the high number of complications. Similarly, the ESCAPE trial examined patients with acute decompensated heart failure, but excluded those in cardiogenic shock or undergoing evaluation for mechanical support.[7]

In 2025, we generally would not consider placing a PA catheter in a patient with isolated septic shock, nor would we advocate for use in a stable heart failure patient simply to assess volume status. This is primarily due to the ubiquity of point-of-care-ultrasound and the two aforementioned negative trials. Nowadays, we typically reach for PACs in cases of cardiogenic shock and place them using ultrasound or under fluoroscopy. Indeed, data support their use in this way.

A recent meta-analysis of over one million patients with cardiogenic shock found a statistically significant mortality benefit of 36% compared to 47% for patients who had a PAC placed (AOR 0.71). Patients with PACs were also more likely to be on mechanical circulatory support.[3] Another recent study (multicenter, retrospective, observational design) investigated whether PAC placement was associated with lower mortality in cardiogenic shock patients. This study found that placement of a PAC within the first 6 hours of presentation was correlated with only 17% mortality vs 28% with delayed or no placement, and PAC placement at any time was associated with a mortality benefit across all Society for Cardiovascular Angiography and Interventions (SCAI) stages of cardiogenic shock.[4] These data come from studies less than 10 years old and more accurately reflect modern utilization of PACs. It is our opinion that early PAC placement leads to better outcomes in certain patients and aids in management and disposition decisions. The objective data it generates and often streams into the electronic medical record (EMR) can help expedite access to definitive care and specialist involvement via resources such as mechanical circulatory support, cardiac catheterization, or shock teams.

Furthermore, the technology itself has changed considerably over time. Digital PAC data is more accurate than the older waveform data and can now stream into the EMR in real time.[8] Routine ultrasound use for line placement (especially internal jugular) has improved cannulation quality and safety.[9] Ultrasound is frequently used to view the distal tip of the catheter as it traverses the heart in real time, an

References available online.

advantage previously reserved for teams equipped with fluoroscopy.[10]

We hope this background dispels the frequently espoused adage that PACs "don't work" or "don't change anything," and that it also engenders some enthusiasm for why an EM resident might consider placing a PAC, even in the ED! Furthermore, an increasing number of EM residents are choosing careers in critical care, where they will routinely manage PACs. Like any diagnostic aid, applying PACs selectively and understanding how to interpret and act on the data is the key.

Where did the PAC come from? The PAC, also known as the Swan-Ganz catheter, is named after Drs. Jeremy Swan and William Ganz. They co-developed the device and first published about it in the 1970s. The catheter is a pressure-sensing, quadruple-lumen device that is inserted into a central vein via an introducer sheath, analogous to a transvenous pacing wire. The catheter ranges from 60-110 cm in length and 4-8 Fr in diameter, depending on patient characteristics and site of insertion. Similar to an arterial line, a Swan-Ganz is connected to an external pressure transducer for cardiac and vascular pressure monitoring. The catheter also features a thermodilution sensor (thermistor), which is used to measure cardiac output (CO).

The Swan-Ganz can also be used to directly measure central venous pressure/right atrial pressure (CVP/RAP), right ventricular pressure, pulmonary artery pressure (PAP), pulmonary capillary wedge pressure (PCWP), mixed venous O2 saturation (SvO2), and core body temperature. Additional hemodynamic variables, such as cardiac index, pulmonary vascular resistance, and systemic vascular resistance, can be calculated with data measured from the catheter.

The various lumens of the catheter terminate at different points along its length, with corresponding ports in its proximal end. To advance a Swan-Ganz to its destination—typically a branch pulmonary artery—a 1-1.5 cm balloon on the distal tip is used to "float" the

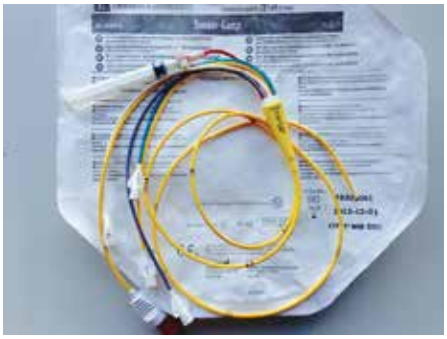

Fig. 1. Pulmonary artery catheter, Swan-Ganz *(image by ICUnurses, used with permission under Creative Commons Attribution share-alike license)*

catheter with the direction of blood flow. The pressure tracing will help to locate the catheter position as it is advanced from the right atrium to the pulmonary artery. Fluoroscopy (or more realistically in most EDs, ultrasound) can also be used to help guide catheter placement. Once in place, each opening on the catheter will sit in a specific cardiac chamber or great vessel.

The **blue lumen** is the RAP/CVP port and sits within the RA, 30 cm from the distal tip. Its functions include measuring RAP and fluid or medication administration. It is also known as the proximal injectate port, as this is where a volume of blood is injected for the thermodilution method of determining CO.

The **white lumen** is 31 cm from the distal tip and also rests within the RA. It is used for infusions, hence it is also called the proximal infusion port.

The **yellow lumen** is the pulmonary artery lumen or distal port. It sits slightly distal to the balloon in a branch pulmonary artery and represents the distal end of the catheter. It is connected to a pressure transducer that measures PAP or PCWP, depending on the inflation status of the balloon. When the balloon is deflated, the catheter measures blood pressure as it flows through the pulmonary circulation. As it sits within the pulmonary artery system, this measurement reflects PAP. However, when the balloon is inflated, it obstructs blood from the pulmonary artery into the microcirculation. The catheter is "wedged" in the artery. The resulting measurement distal to this occlusion is

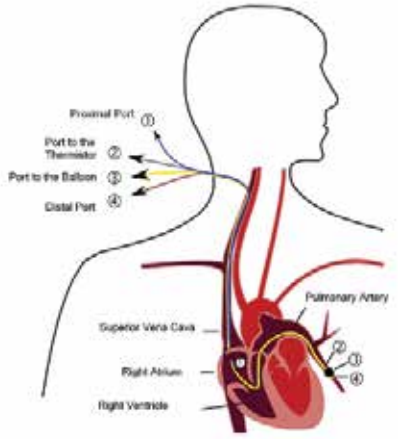

Fig. 2. Positioning of the pulmonary artery catheter *(Image by Tariq Abdulla, used with Creative Commons share-alike permission)*

the PCWP. A blood sample drawn from this lumen can be used to measure SvO2.

The **red port** is the balloon port, where air is introduced or removed to control balloon size. Its proximal end is connected to a small syringe. This port is identical to the balloon port on transvenous pacing wire.

Depending on the device model and manufacturer, a variable number of other connectors can be found in the proximal end. These typically include a thermistor connector and continuous oximetry monitoring.

Like other advanced procedural and diagnostic interpretation skills such as advanced echocardiography, repetitions and expert teaching are useful. We suggest you start now and adopt PAC use while you are still in training, and while there are expert clinicians to precept you! There is significant variability in physician abilities to accurately interpret data from a PAC.[11] Our hope is that this multi-part series will help educate the EM resident on when and how to gather, interpret, and utilize this data, so that we can re-educate a generation of EM clinicians on this useful tool. In part two, we will discuss indications and the procedure of placement, and in part three we will talk about data interpretation and how to use a PAC to help management. After reading this three-part series, we challenge you to find an appropriate patient, an appropriate supervisor, and "float a Swan!" ✶

References available online.

Fatal Anaphylactic Shock Following Ceftriaxone Administration: A Case Report

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INTRODUCTION

Ceftriaxone (Rocephin) is a third-generation cephalosporin that is widely used in the treatment of various infections in emergency departments. It is indicated for infections of the skin and soft tissue, intra-abdominal, urinary tract, those that are sexually transmitted as well as community acquired pneumonia.[1] Although comprehensive data on ceftriaxone utilization is limited, previous prospective studies have reported hospital utilization rates as high as 61%.[2] The widespread use of ceftriaxone is attributed to its broad-spectrum antimicrobial coverage and low incidence of adverse side effects compared to others with its same coverage. Although rare, side effects associated with ceftriaxone use include dermatologic, gastrointestinal, and hypersensitivity reactions. Hypersensitivity reactions, including anaphylaxis and serum sickness, account for less than 1% of cases.[1] The Alabama Department of Public Health and Pennsylvania Department of Health have recently issued health advisories regarding serious adverse events following ceftriaxone administration.[3,4]

CASE PRESENTATION

This case involves a 56-year-old Caucasian female with a past medical history of hypertension (HTN), chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), chronic back pain and spasticity requiring intrathecal baclofen pump, scoliosis, and bipolar 1 disorder. She presented to the emergency department with a chief complaint of abdominal pain, diarrhea, and urinary retention. The patient reported that her symptoms had been present for over three months. She had recently been evaluated at an outside facility for similar complaints; at that time, there were concerns of cord compression which was effectively ruled out. A prior computed tomography (CT) scan of the abdomen revealed a distended urinary bladder but no acute intra-abdominal pathology. Of note, the patient had received multiple doses of ceftriaxone for a urinary tract infection (UTI) during her hospitalization at an outside facility just one month prior.

Her past surgical history included shoulder replacement, tonsillectomy, laminectomy, hysterectomy, appendectomy, and baclofen pump implantation. Medication list includes furosemide, baclofen, Sumatriptan, omeprazole, metoprolol, lisinopril, alprazolam, bupropion, lurasidone, oxycodone, gabapentin, clonidine, isosorbide mononitrate, and aspirin. Documented allergies included bee venom protein, tissue adhesive, and vancomycin.

On presentation, the patient was hemodynamically stable. Physical exam was notable for diffuse abdominal tenderness. Labs were significant for leukocytosis, hypomagnesaemia, and hyponatremia. Urinalysis was consistent with a urinary tract infection. CT imaging of the abdomen and pelvis showed evidence of inflammation concerning for infectious colitis. These findings led to the administration of intravenous ceftriaxone for suspected

References available online.

Shortly after ceftriaxone began infusing, the patient was complaining of a sore throat and, within seconds, the patient became unresponsive and pulseless.

UTI and infectious colitis. Shortly after ceftriaxone began infusing, the patient was complaining of a sore throat and, within seconds, the patient became unresponsive and pulseless. Cardiopulmonary resuscitation (CPR) was initiated. Physical examination during CPR revealed diffuse wheezing, hypotension, as well as perioral and generalized cyanosis which was most prominent in the arm containing her peripheral IV catheter. These findings were consistent with anaphylactic shock. The patient achieved return of spontaneous circulation (ROSC) and was admitted to the ICU requiring epinephrine infusion for anaphylaxis and blood pressure support. Despite resuscitative efforts, her condition deteriorated, and the patient passed away within 24 hours.

DISCUSSION

Ceftriaxone is one of the most commonly used antibiotics in the emergency department and the recent rise in adverse reactions has warranted further investigation. Abodunrin et al. reported a similar case on a patient who went into cardiac arrest immediately after receiving ceftriaxone for community acquired pneumonia.[5] Mustafa et al. had a case of fatal cardiac arrest following ceftriaxone administration in a pediatric patient and recommended using intravenous infusion to reduce the risk of hypersensitivity reactions.[6] These cases further reinforce the need to remain attentive to potential side effects when administering ceftriaxone. This case should be analyzed in the context of limitations. The patient received intravenous iodine contrast less than 20 minutes prior to antibiotic administration. Of note, the patient did not have any documented history of contrast allergy but an additive or synergistic effect with ceftriaxone cannot be excluded. Another consideration is the patient's documented allergies of vancomycin, tissue adhesive, and bee venom, raising the possibility of a predisposition to hypersensitivity reactions. Further studies are warranted to assess the influence of different routes of administration and the potential benefit of pretreatment strategies in high-risk individuals to minimize adverse events.

CONCLUSION

Ceftriaxone is routinely used across hospital settings for an array of infections. This case has important clinical implications given the recent rise in reported adverse reactions. While its use will remain a cornerstone in the treatment for its breadth of coverage, adverse reactions—although rare—can still occur. Further data investigating this rise in adverse reactions is warranted. In the meantime, clinicians should remain vigilant for early signs of hypersensitivity, particularly in patients with a known history of allergy susceptibility. ✷

PATIENT CONSENT

Informed consent for publication was obtained from the patient's next of kin.

References available online.

What's in the Bag? Inguinal Hernia Containing a Mass in an Infant

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CASE

A 5-week-old female born at term at 40 weeks via vaginal delivery presents for evaluation of a palpable mass in the right inguinal region. Mother states she initially noticed the mass one week prior to presentation and at times seemed to get bigger when the patient was crying or agitated. The patient initially presented to a local clinic and was referred to the emergency department for further evaluation. The mother reported that the patient had been eating appropriately every 4 hours, was producing an appropriate number of wet diapers and stools daily and was up to date on vaccinations. The physical exam showed a soft, non-tender and non-distended abdomen with normal bowel sounds; the patient had no vital sign abnormalities and was overall well-appearing. The inguinal mass had no fluctuance, overlying erythema or induration.

Bedside ultrasound was performed and demonstrated an oval-shaped, heterogeneous mass in the right inguinal region. The differential diagnosis included a bowel- or fat-containing hernia, hernia with ovarian content, enlarged lymph node, malignancy, or vascular malformation. The mass was located superficial to the abdominal musculature. The bladder and pubic bone were visualized. Further ultrasound examination revealed a hernia sac extending toward the labia, containing a heterogeneous mass with multiple embedded anechoic cystic structures. Color and pulse wave Doppler demonstrated internal vascular flow.

The contralateral (left) pelvis was scanned, showing a similar structure consistent with a normal-appearing ovary in its expected location. On returning to the affected side, the right ovary was absent from the pelvis. The inguinal mass was identified as the right ovary, herniated into the inguinal canal.

Inguinal hernias are a more common finding in males (who make up 90% of cases) compared to females (who make up 10% of cases). Inguinal hernias with ovarian tissue occur when an incomplete closure of the processus vaginalis allows the ovary (and possibly the fallopian tube) to descend into the inguinal canal. It is a rare condition typically seen in female infants and young girls, though it is not unheard of in women of reproductive age. Incidence of inguinal hernias with

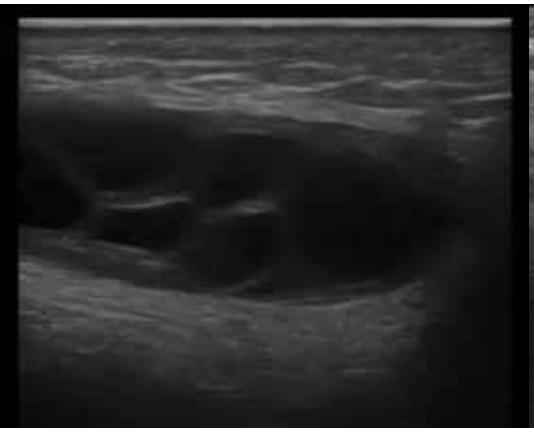


Image 1: Mass found on ultrasound

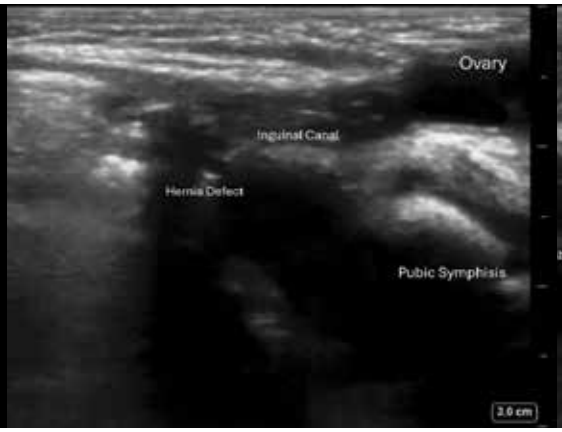


Image 2: Sagittal view. Hernia defect visualized with the hernia sac going towards the labia containing a heterogeneous mass, which appears to be an ovary.

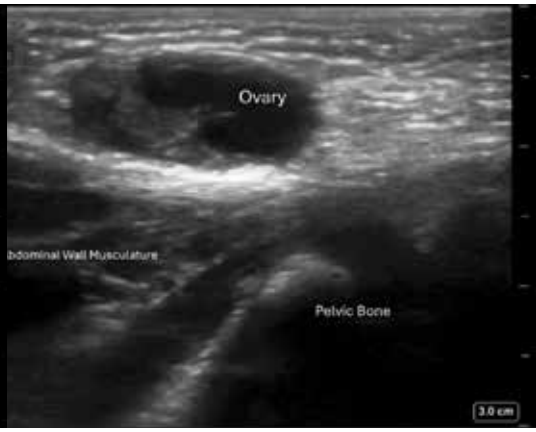


Image 3: Transverse view. The ovary is confirmed to be within the hernia sac and superficial to the abdominal wall musculature.

References available online.

ovarian or fallopian tube content is 71% in children under 5 and approximately 30% in adolescents and women of reproductive age.[3]

Patients with inguinal hernias typically present with a painless groin swelling that changes in size with crying or straining. Diagnosis is usually made via trans-abdominal or pelvic ultrasound showing ovarian tissue in the hernia sac. Doppler blood flow is also performed to assess for ovarian torsion. Ultrasound findings include absence of one ovary in the lower pelvis and a groin mass with several small sonolucent cysts consistent with an ovary. The corpus luteum may or may not be present. Ultrasound can also be used to check the unaffected side for comparison. It is minimal risk and can expedite further workup. If the ultrasound findings are not definitive, computed tomography (CT) can also be used for confirmation. In the absence of concerning signs or symptoms, these hernias can often be treated non-emergently with surgical reduction of the hernia contents, ligation of the hernial sac, and closure of the deep inguinal ring. Non-absorbable mesh is also placed at the posterior wall of the inguinal canal to provide additional support.

Symptoms such as continued or worsening pain, tenderness, and persistent swelling or erythema are more concerning for incarceration and require emergent surgical management. In the case of ovarian involvement, these symptoms indicate possible torsion requiring prompt surgical detorsion to preserve ovarian function and reproductive capabilities. Although ovarian herniation into the inguinal canal is rare, approximately 4-11% of hernias with gynecologic structure involvement have an irreducible ovary; these are usually found intraoperatively. Of these cases, 2-33% have ovaries that are infarcted.[2] This level of incidence highlights the importance of early diagnosis and treatment and explains why findings of ovarian involvement in the inguinal hernia are typically treated even if the patient is asymptomatic.

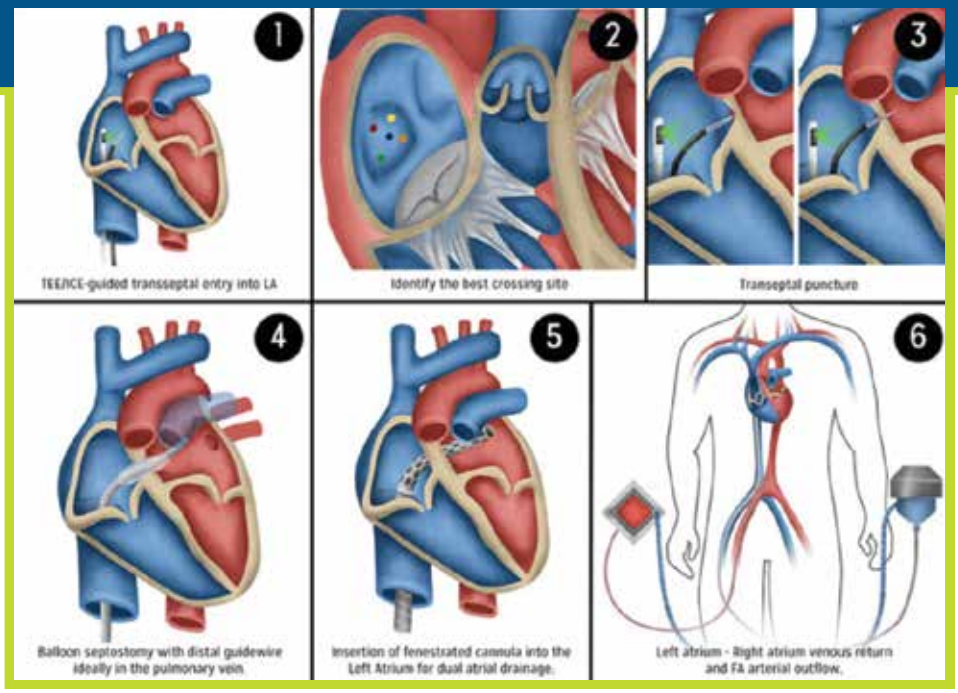
Given the patient's findings on ultrasound, there was concern for an inguinal hernia with ovarian content and transfer was initiated to a pediatric hospital for further evaluation and management. At the pediatric hospital, the patient was evaluated and admitted to pediatric surgery, no CT imaging was performed, and the patient underwent open right inguinal hernia repair and diagnostic laparoscopy. Operative note confirmed that "a sliding hernia with tube and ovary in the hernia sac." The ovary was described as pink and healthy. The hernia sac was placed into the abdominal cavity and the hernia defect was repaired. Per surgical report, the left side had no evidence of defect or hernia. The patient had an unremarkable post-operative course and was discharged the next day. ✳

KEY POINTS

- Inguinal hernias with ovarian contents are rare and are more common in the pediatric population than women of reproductive age.
- Inguinal hernias with ovarian content may appear on ultrasound as a small, round heterogenous mass with hypoechoic cystic structures. Bedside ultrasound can help with early diagnosis and management.
- Definitive treatment is almost always surgical management due to the high rates of irreducible and infarcted ovaries. A high index of suspicion must be maintained even in asymptomatic patients.

References available online.

ECMO 2.0: What's LAVA Got to Do with It? A Rapid-Fire Introduction to Left Atrial Veno-arterial ECMO (LAVA-ECMO)



It was 9 a.m. on my first day in the cardiothoracic intensive care unit (CTICU), a unit I had never set foot in before. As rounds began, we stopped at the bedside of a patient in his mid-50s with a history of biventricular heart failure. The attending casually mentioned he was on left atrial veno-arterial extracorporeal membrane oxygenation (LAVA-ECMO).

Now, I have read about veno-venous ECMO (V-V ECMO), veno-arterial ECMO (V-A ECMO), and their various cannulation strategies. But LAVA-ECMO? That one had not made it into my residency syllabus. Before I could discreetly reach for my phone to consult Dr. Google, the attending turned and asked, "Do you know what LAVA-ECMO is and how it's different?"

I admitted I did not.

But instead of being grilled for my ignorance, she took a moment to walk me through it and illustrated how LAVA-ECMO works, why it is used, and what makes it unique. That 5-minute teaching moment stuck with me.

This article pays that moment forward. We will break down LAVA-ECMO in a clear, concise, and high-yield way, so the next time you are in the CTICU (or hear the term during a code or sign-out), you will not only understand what is happening physiologically, but you will be ready to explain it to others.

ECMO is an advanced form of mechanical circulatory support (MCS) designed to provide temporary cardiopulmonary assistance in patients experiencing severe cardiac and/or respiratory failure that is refractory to conventional management. ECMO involves withdrawing blood from the venous system, directing it through an external membrane oxygenator for gas exchange, and subsequently returning the oxygenated blood to the patient's circulation. The specific configuration of ECMO depends on the site of blood return. In V-V ECMO, blood bypasses the lungs and is returned to the venous system, thereby supporting primarily pulmonary function, with potential indirect support for the right heart. In contrast, V-A ECMO returns blood to the arterial system, offering both cardiac and respiratory support by bypassing the heart and lungs. V-V and V-A ECMO represent the two principal modalities of ECMO, selected based on the patient's underlying pathology. It is critical to understand that ECMO does not serve as a curative treatment; rather, it serves as a bridge to recovery, transplant, durable mechanical support, or hemodynamic stabilization while the affected organs recover.

Over the past three decades, the global utilization of ECMO has increased significantly. Data from the Extracorporeal Life Support Organization (ELSO) registry indicate that more than 245,000 cases have been recorded to date, with the number of participating ECMO centers expanding nearly sevenfold since 1990.[1] Despite its lifesaving potential, ECMO remains a complex and resource-intensive intervention, and its optimal integration into broader health care systems continues to prompt important clinical and ethical discussions.[2]

For those looking to build a foundational understanding of ECMO, EMRA's *EM Resident* magazine offers an excellent primer by Lucas et al., titled "Critical Care ECMO Series: Introduction to ECMO." That series provides an in-

References available online.

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depth exploration of ECMO's core principles, modes of operation, clinical indications, and future directions. In this article, however, we will dive directly into a more advanced and specific V-A ECMO configuration: LAVA-ECMO.

A major limitation of V-A ECMO, particularly in the peripheral cannulation configuration, lies in its delivery of non-physiologic continuous retrograde blood flow into the aorta. This results in a significant increase in left ventricular (LV) afterload, placing additional strain on an already failing LV. When the LV is unable to generate sufficient pressure to overcome the elevated afterload, this can lead to progressive LV distension, impaired coronary perfusion, and stasis of blood within the left heart and aortic root. These conditions collectively increase the risk of thrombus formation and exacerbate pulmonary congestion. [3,4]

In response to these adverse hemodynamic effects, several strategies have been introduced to unload or vent the LV in order to reduce LV volume and thereby pressure. LAVA-ECMO has emerged as a hybrid approach that combines the benefits of conventional V-A ECMO with targeted LV unloading or venting strategies.

DISCUSSION

V-A ECMO, while providing robust systemic perfusion in cardiogenic shock, can significantly increase LV afterload. This retrograde aortic flow elevates myocardial oxygen consumption, LV end-diastolic pressure (LVEDP), and pulmonary venous congestion, potentially exacerbating pulmonary edema and impairing myocardial recovery.[3,4] To address these hemodynamic drawbacks, several adjunctive strategies have been employed, including inotropic support, intra-aortic balloon pumps (IABP), percutaneous ventricular assist devices such as the Impella, and surgical venting techniques[3,5] like atrial septostomy.

LAVA-ECMO represents an evolution of standard VA-ECMO, designed specifically to facilitate LV decompression through trans-septal venous drainage. In this approach, a fenestrated cannula is inserted across the atrial septum into the left atrium (LA), allowing for simultaneous right atrial (RA) and LA drainage into the ECMO circuit (technical steps illustrated in Figure 1).[6] This configuration aims to reduce pulmonary capillary wedge pressure (PCWP) and LVEDP by directly unloading the LV, thereby mitigating pulmonary congestion and myocardial strain. Importantly, this technique accomplishes these goals without requiring additional large-bore access or insertion of a second mechanical device.[6,7] Beyond hemodynamic optimization, LAVA-ECMO may also reduce the risk of intracardiac thrombus formation due to decreased stasis in the LV and may enhance myocardial recovery.

In patients with cardiogenic shock (CS) secondary to valvular heart disease (VHD), LAVA-ECMO provides distinct physiologic advantages by bypassing valvular lesions affecting both sides of the heart.[8] Compared to traditional V-A ECMO, LAVA-ECMO offers more targeted support by directly draining the LA, thereby reducing LV pressure and relieving pulmonary congestion. This is particularly beneficial in conditions such as severe aortic regurgitation (AR) or stenosis (AS), mitral regurgitation (MR) and post-infarction ventricular septal defects (VSD), where conventional V-A ECMO may increase afterload and exacerbate LV strain. In a retrospective study of 18 patients with VHD, LAVA-ECMO was associated with significant reductions in pulmonary artery (PA) systolic pressure, PCWP, LVEDP, and RA pressure.[8] Furthermore, LAVA-ECMO lowers afterload and mitigates pathologic shunting. Unlike V-A ECMO, which can elevate systemic pressures and worsen regurgitant or left-to-right intracardiac shunts, LAVA-ECMO improves overall hemodynamics by decreasing left-sided filling pressures. In addition, LAVA-ECMO can achieve both circulatory support and LV unloading through a single multistage venous cannula inserted transeptally, obviating the need for additional devices or arterial cannulation typically required with VA-ECMO and thereby reducing complications such as limb ischemia.[9]

Patient selection for LAVA-ECMO differs substantially from that of conventional V-A ECMO due to its distinct hemodynamic benefits and technical considerations. V-A ECMO is commonly indicated for a broad range of CS etiologies, including acute myocardial infarction, myocarditis, post-cardiotomy syndrome, and sepsis-induced myocardial dysfunction, and can often be initiated rapidly via peripheral cannulation without the need for intracardiac access.[10] However, a known limitation of V-A ECMO is its tendency to increase afterload, which may lead to LV distension and worsening pulmonary edema, particularly in patients with severe AR, MR, AS, or post-infarction VSD.[11,12]

LAVA-ECMO, by contrast, is particularly well-suited for patients with CS accompanied by elevated LA or LV filling pressures, especially in the context of VHD or structural cardiac lesions. By draining blood directly from the LA, LAVA-ECMO reduces both preload and afterload while avoiding the need for additional LV venting strategies, making it advantageous in clinical settings where conventional VA-ECMO may aggravate regurgitant lesions or intracardiac shunting.[13,14] The approach requires transseptal access and high-quality intracardiac imaging, making it most appropriate for patients with stable enough hemodynamics and suitable atrial anatomy to safely undergo the procedure.

References available online.

It is generally contraindicated in patients with isolated RV failure, mechanical mitral valves, or in situations requiring immediate deployment of circulatory support.[15]

While both modalities offer systemic perfusion support, LAVA-ECMO provides more physiologically targeted unloading in select patients with VHD-related shock, assuming technical feasibility and anatomical suitability.[13,16]

LAVA-ECMO is contraindicated in patients with severe RV failure without left-sided overload, as it primarily unloads the LA and indirectly the LV, leaving isolated RV dysfunction unaddressed. The presence of a mechanical mitral valve poses a significant risk due to potential obstruction or damage during transseptal cannulation. Additionally, anatomical barriers such as large atrial septal defects or thrombus, severe coagulopathy, active bleeding, and hemodynamic instability that preclude safe transseptal puncture are absolute contraindications. Relative contraindications include significant right-sided heart pathology requiring separate RV support, severe pulmonary hypertension, prior atrial septal interventions that complicate cannulation, limited imaging capabilities for transseptal guidance, and peripheral vascular disease affecting arterial access for VA-ECMO return cannulation. Furthermore, LAVA-ECMO is generally not advised in patients with end-stage multi-organ dysfunction where recovery or bridging is not feasible. These factors must be carefully considered to optimize patient selection and procedural safety.

The clinical utility of LAVA-ECMO is supported by a growing number of case reports and observational studies. In a 2021 case report, Singh-Kucukarslan et al.[17] described a 59-year-old male with inferior ST-elevation myocardial infarction (STEMI) and CS unresponsive to Impella and high-dose vasopressors. Escalation to LAVA-ECMO significantly improved hemodynamics, with mean PA pressures falling from 38 mm Hg to 10 mm Hg, and cardiac index rising from 1.8 to 5.1 L/min/m^2. Despite failed LAVA-ECMO weaning attempts, the patient remained stable on support and underwent successful orthotopic heart transplantation 11 days later.

Similarly, Jiménez-Rodríguez et al.[18] in 2023 reported a case of a 53-year-old man with CS secondary to post-infarction VSD. Initial support with IABP and V-A ECMO proved insufficient. Transitioning to LAVA-ECMO led to immediate hemodynamic stabilization, with reductions in PCWP and pulmonary (Qp)/systemic (Qs) flow ratio from 9.81 to 2.15. Although the patient later developed an ischemic and then hemorrhagic stroke, no evidence of thrombus was found on transesophageal echocardiography. Most recently, a 2025 single-center retrospective analysis by Giustino et al.[8] evaluated outcomes in patients with valvular CS managed with LAVA-ECMO. Among 18 patients treated between 2018 and 2023, the intervention was associated with significant reductions in RA pressure (–8 mm Hg), mean PA systolic pressure (–18.5 mm Hg), PCWP (–14.5 mm Hg), and LVEDP (–20 mm Hg), all with statistically significant confidence intervals. The intervention showed a 69.1% bridge-to-procedure rate and 44.4% survival to hospital discharge, with no procedural complications reported from trans-septal access.

Collectively, these cases underscore the hemodynamic benefits and feasibility of LAVA-ECMO as an advanced unloading strategy with venting capabilities. However, broader adoption will require prospective studies to validate its safety and efficacy in diverse patient populations. As such, consideration for LAVA-ECMO should be reserved for high-volume tertiary care centers with expertise in advanced ECMO management and trans-septal interventions. ✷

TAKE-HOME POINTS

- Understanding ECMO basics is essential, even in the ED: While V-V and V-A ECMO may not be initiated in the ED always, understanding their underlying physiology is critical during handoffs, transfers, or codes.
- Peripheral V-A ECMO increases afterload: Retrograde flow from peripheral VA-ECMO increases afterload on the LV, which may exacerbate LV distension, elevate PCWPs, and lead to pulmonary edema or thrombus formation. Be alerted to worsening oxygenation, increased pulmonary pressures, or persistently low LV output, even if the ECMO circuit appears to be functioning.
- LAVA-ECMO offers dual atrial decompression with V-A ECMO support: LAVA-ECMO integrates a trans-septal drainage cannula into the ECMO circuit, enabling direct unloading of the LA alongside RA drainage. This configuration reduces afterload and facilitates LV decompression without the need for an additional device, such as an Impella.
- LAVA-ECMO offers targeted circulatory support in VHD related cardiogenic shock by directly unloading the LA, reducing LV pressure and pulmonary congestion. It is especially advantageous in conditions like severe AR, MR, AS, and post-infarction VSD, where VA-ECMO may worsen hemodynamics. By avoiding additional devices and arterial access, LAVA-ECMO simplifies management while minimizing complications.
- LAVA-ECMO is unsuitable for patients with isolated RV failure, mechanical MV, or anatomical and hemodynamic conditions that preclude safe transseptal access. Relative contraindications include severe PAH, prior septal interventions, or limited imaging access. Careful patient selection is essential to ensure procedural success and minimize risk.
- Ask early and learn often: Detailed knowledge of ECMO and its various configurations, early in training, is not expected. However, asking questions ("Is this a LAVA-ECMO configuration?") shows initiative and creates meaningful opportunities to learn about advanced circulatory support and hemodynamics from your ICU team.

References available online.

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References available online.

NEW YEAR, NEW TO-DO'S:

Steps to Triage Your Financial Life

AUTHOR

Jordan Celeste, MD, FACEP
Integrated WealthCare
EMRA President, 2013-2014
EMRA Board, 2010-2015

At the start of the new year, many people make resolutions. But those never seem to stick. So in lieu of dramatic (and vague) pledges to "get your finances on track," I am providing a checklist of simple things you can do over the next few months to set yourself up for financial success — and not just for this year, but for the rest of your life.

With a new calendar year comes new IRS limits. Setting aside money as a resident is not easy, and for many it is not particularly exciting — but understanding these numbers will help you to take control of your finances and instill flexibility and success into your future.

For 2026, the maximum IRA contribution is $7,500. As a resident, you are likely in your lowest tax bracket for the foreseeable future, so it is recommended that you fully fund a Roth IRA if you can do so (being sure to build a cash emergency fund first, of course). Pay your relatively low taxes now and get this money tax-free in retirement.

The maximum 403(b) or 401(k) contribution for 2026 is $24,500, and this amount also applies to 457(b) accounts. These limits are likely to exceed what most residents can fund, but anything that you can set aside now will have more time to grow and compound. Time is the most powerful financial force you have as a resident, followed closely by your future earning potential.

If you are enrolled in a qualifying high-deductible health plan, the maximum HSA contribution for 2026 is $4,400 (for individuals). This money is a "triple tax threat" — it goes in pre-tax, grows tax-free, and can be withdrawn without tax for qualifying healthcare costs.

While we have just marked the beginning of a calendar year, in truth you are at the midpoint of your PGY year. If you are in the home stretch of your final residency (or fellowship) year, chances are you have signed on to your first attending job (or will do so very soon).

Review your contract and job details. Most residency programs have faculty members who are more than happy to examine documents and make sure that you ask the right questions.

Understand your compensation and benefits package. All of your hard work is now going to literally pay off! Know how you are going to be paid and be ready to participate in your new employer's retirement and health plans as soon as possible.

Obtain disability insurance to protect your income before leaving residency. As an emergency physician, you see people encounter the unexpected on almost a daily basis. Don't let an accident or illness that prevents you from practicing derail your future.

And now for some insider information about the end of residency and the start of your career from someone who has been in your shoes.

Remember — you are not making the big bucks yet! Things like moving expenses, rental deposits, taking some time off before your start date, and other things all cost money in addition to what you have been budgeting while in training. Your paycheck also does not come on day one of your employment. Don't get caught short!

References available online.

> ***Setting aside money as a resident is not easy, and for many it is not particularly exciting — but understanding these numbers will help you to take control of your finances and instill flexibility and success into your future.***

Over the final few months of your training, set aside some time to set goals and articulate what is important to you. Money is great, but it's what that money can do that is powerful. If you can align your values with your spending, you will quickly understand this.

The good news is that as a high earner, you can afford a few missteps and not suffer too much. The bad news is that as a high earner, you will also be tempted to keep up with the proverbial Joneses — this does not necessarily mean purchasing the same sports car as your neighbor, but more spending in ways that do not align with your personal values. Reflect on this now and be able to enjoy what you have worked so hard for!

Your training has prepared you to be a great emergency physician, and every patient will continue to shape your clinical practice. Life outside the emergency department will happen as well, and your goals will likely change over time. Some people are comfortable managing their finances in addition to all the other demands on their time (and physicians are certainly smart enough to do so). But the majority find value in establishing a relationship with a trusted fiduciary who understands their goals and concerns, develops and troubleshoots an action plan, and manages the results over time. ✳

References available online.

OPINION-EDITORIAL

Balancing Parenthood and Training: Why Parental Leave Matters

AUTHOR

Debra T. Linfield, MD, MS
Jackson Memorial Hospital / University of Miami

I am an emergency medicine resident, and I am also a parent of two young children. I had my daughter during medical school and my son during the intern year of my residency. My older sister had a child during internal medicine residency, and one of my younger sisters is currently navigating maternity leave during the intern year of her OBGYN residency. Through conversations with my sisters and peers, I have realized the crucial need for better support on a national level for pregnant and post-partum medical students and residents during their medical training.

Colleagues and I recently conducted the first national anonymous survey among EM residents regarding pregnancy, breastfeeding, and child care. We sent an anonymous survey to all EM residents, regardless of parental status, in ACGME-approved residency programs in the United States that utilized skip-logic, which means residents only answered questions pertinent to their personal experiences. While future research will be published analyzing the results, the free-text responses illuminate to me that my sisters and I are not alone in our experiences navigating residency.

The American Academy of Pediatrics (AAP) recommends 12 weeks paid family leave.[1] After the Accreditation Council for Graduate Medical Education (ACGME) updated its policy in 2022, all ACGME-accredited programs must offer residents and fellows six weeks of paid parental leave, which is half the time the AAP recommends.[2] As one survey responder wrote, "I had postpartum depression which made coming back to work incredibly challenging, and there [were] no built in protections for it." Furthermore, many of the male respondents had less than two weeks of leave. Male residents should be able to support their spouses and bond with their new child during this critical time. ACGME needs to further update its policy to include more time for paid parental leave to reflect the AAP recommendation.

Many programs have residents use their vacation and elective time for this leave. As many respondents wrote, "I had to use all of my sick and vacation days in order to get paid. Insurance lapsed after six weeks of leave. [I] have to make up five weeks after residency graduation" and "Only after union negotiations were we able to have any paid leave. I took mine unpaid and extended with vacation and elective time" and "too short… [I had] no vacation when I came back, [and] worked many more night shifts when I got back from leave." I too had to utilize all my vacation and sick days for my maternity leave.

Not having a break for the entire academic year leads to increased burnout and decreased work satisfaction. Parental leave is far from a vacation, and having to use these days is detrimental for resident well-being when they then do not have other breaks from their rigorous schedule. Parental leave should not require using vacation and sick days to prevent graduating late, which is not a possibility for those who want to do a fellowship. Furthermore, many residents are still required to participate in emails or events during their maternity leave. As two respondents wrote, "[I] still got emailed responsibilities during maternity leave" and "I still had to [keep] up with emails and administration related stuff, and when I wouldn't answer, this was used against me. I was not being 'professional'."

I was required to take the annual in-house training exam (ITE) three weeks postpartum during my maternity leave, while surviving on just a couple of hours of intermittent sleep in between nursing sessions. ACGME current guidelines have a "minimum of one week of paid time off reserved for use outside of the first six weeks of the first approved" leave.[2] While this is a step in the right direction, ACGME needs to update this guideline so it is within the same academic year as the parental leave. Furthermore, programs must understand that individuals on parental leave will not be answering their emails or participating in residency events.

A large part of the issue is that many programs have their own internal guidelines, so parental leave can be institution dependent. Indeed, many programs have created a supportive environment for residents: "My program was incredibly supportive, and I'm not sure if that is unique to my situation, or having a female program director with kids who truly understood the situation, but I am so grateful to have had the support" and "I am grateful for the support of my program and co-residents for supporting my leave." I am thankful to be at my residency program, which has worked tirelessly to help me during pregnancy, maternity leave, and nursing. However, having support should not be program dependent.

Through both program support and updated ACGME guidelines, I believe that residents can successfully balance their professional responsibilities with their personal lives, not only helping to improve the immediate training environment but also fostering a more sustainable and fulfilling career path for physicians. ✶

References available online.

Supporting Pregnant and Pumping Emergency Medicine Residents

AUTHORS

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Residency represents one of the most demanding periods in medical training. Emergency medicine (EM) residents are expected to manage high-stress situations, endure long and irregular hours, and quickly adapt to a rapidly changing work environment. Amidst these professional demands, many residents also navigate major personal milestones, such as childrearing. Many residents decide to grow their families while in training.[1,2] The complexities associated with competing demands of work and family—and the best ways to support these residents through their training—remain underexplored in the medical literature.

An anonymous survey was sent out to all EM residents in ACGME-approved residency programs in May-June 2024 (IRB 20240511). A total of 223 residents completed the survey. Demographic data are shown in Figure 1. Most residents who completed the survey are married or in a committed relationship, heterosexual, and white.

In this paper, we highlight survey questions that were asked to all participants. Subsequent papers will investigate the complexities of pregnancy and pumping while in the ED. All respondents were asked: "Have you thought about having a child (or another child) in residency, but then decided against it?" 71 respondents said "no," while 50 said "yes," of whom 15 identified as female, 34 identified as male, and 1 identified as other. Participants who said "yes" were then asked to identify all applicable reasons from a list of 10. Results are shown in Figure 2. The

References available online.

DEMOGRAPHICS	N = 223 (%)
PGY Year	
PGY1	81 (36)
PGY2	57 (26)
PGY3	62 (28)
PGY4	23 (10)
Duration of Residency	
4-year	80 (36)
Location of Program	
Midwest	55 (25)
Northeast	63 (28)
South	76 (34)
West	29 (26)
Sex	
Male	77 (35)
Race	
Asian or Pacific Islander	16 (7)
Black or African American	9 (4)
Hispanic or Latino	19 (9)
Multiracial or biracial	13 (6)
White or Caucasian	160 (72)
A race not listed	5 (2)
Sexual Orientation	
Heterosexual/Straight	196 (88)
Gay/Lesbian	6 (3)
Bisexual	18 (8)
A sexual orientation not listed	3 (1)
Marital Status	
Single	42 (19)
Married	134 (60)
Committed relationship	45 (20)
Divorce/Widow	1 (0)

Figure 1. Resident Demographics

primary concern among residents was child care availability. EM residents have constantly changing schedules with many evening, night, and weekend shifts. It is difficult to have reliable child care at all hours of the day. Many residents also worried about not having time with the child and the substantial time demands associated with parenting. The goal of residency is to become the best EM doctor that you can be, and personal wellbeing can significantly influence that goal, either positively or negatively. It is important that programs are supportive of residents who want to grow their families, such as offering a virtual elective following parental leave or providing schedules earlier in advance so that residents can make the required arrangements for child care. Financial concerns were also cited as a reason many residents decided not to have a child in residency. There is also a need for systemic advocacy, such as encouraging the ACGME to mandate increased resident salaries across institutions.

All respondents were asked: "Have you worked with a pregnant co-resident?" and subsequently, "Did you feel working with them was an imposition?" Of 198 residents who worked with a pregnant co-resident, 14 (7%) responded "yes," that working with them was an imposition. Furthermore, residents were asked, "Have you worked with a co-resident who was pumping?", and subsequently, "Did you feel working with them was an imposition?" While 160 residents responded that they have worked with a pumping co-resident, only 7 (4%) responded that it was an imposition. While less than 10% of residents found their pregnant and pumping co-residents to be an imposition on shift, pregnant and pumping residents felt themselves to be an imposition. Eight out of a total of 28 (29%) pregnant residents responded "yes" to "Did you feel like you were an imposition to your co-residents on shift while pregnant?" and 9 out of 10 (90%) responded "yes" to "Did you feel like an imposition to your co-residents while pumping on shift?" This stark contrast between perceptions related to pregnancy and pumping on shift highlights a key area in which programs can be more supportive of pregnant and pumping residents. If pregnant/pumping residents feel like an imposition to their co-residents, but their co-residents do not feel that this is the case, then even small gestures of support may have a meaningful impact. At the beginning of shift, co-residents might express support through simple comments, such as "I know you're pumping, please go whenever you need to", "Please do not overexert yourself, take breaks when you need to," or "Here, I got you a water bottle from the cafeteria so that you can remain hydrated during the shift." These simple acts will help create a more supportive work environment for your co-residents who have added stresses related to pregnancy and pumping, and, in turn, less burnout among this special resident population.

A nuanced understanding of these dynamics can help improve the training environment and also foster a more sustainable and fulfilling career path for future emergency medicine physicians. Ultimately, ensuring that EM residents can successfully balance their professional responsibilities with their personal lives will enhance their overall well-being, promote gender equity within the medical field, and improve patient care outcomes. ✶

REASON	N = 50
Fertility issues	5
Financial concerns	32
Concerns about residency scheduling while pregnant	21
Concerns about working night shift while pregnant	8
Concerns about residency scheduling post-partum	18
Concerns about child care	36
Concerns about not having time with child	33
Concerns about the time commitment	33
Do not want to extend residency	26
Want to have a child in a future year of residency	12

Figure 2. Survey Responses

References available online.

Opinion: A Counterintuitive Approach to Combating Imposter Syndrome—An Intern's Perspective

AUTHOR

Noah Fiala, DO
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Picture this: It's your second month of residency, and you're deep into a hectic ED shift. The pressure is on—you're managing patients, making decisions, and trying to get better. Then, a mistake happens. Not one that results in significant harm to the patient, but maybe you miss a diagnosis, fumble a procedure, or are just overwhelmed in general. You know failure is part of growth, but that doesn't make it any easier. Suddenly, doubts creep in: "Am I the only one messing up? Is this normal? When does it get better?" Before you know it, you're spiraling into imposter syndrome. Sound familiar? You're not alone—I've been there too.

Having supportive seniors and faculty certainly helps, but it never fully alleviates that nagging (and destructive) habit of comparing yourself to people at your same level of training. Surely, they aren't making the same mistakes... right?

But what if I told you there's a simple way to break this cycle? Instead of letting imposter syndrome take over, you can reframe your mistakes as a normal part of being an intern. A way to prove, definitively, that mistakes are part of the process and happen to everyone. The solution? Hop on your group text or WhatsApp and tell your co-residents about your mistake.

WHY THIS WORKS

At first, this may seem completely counterintuitive. Why would you willingly share your "failures" when you're already worried about how you're perceived? Won't this just confirm your fear that you're behind? Wouldn't admitting your mistake only exacerbate the feeling of inadequacy? On the contrary, I can tell you the act of sharing is what helps curb those feelings once and for all. Turns out it isn't only my personal experience but also research that supports this.

THE POWER OF DOWNWARD SOCIAL COMPARISON

The concept of downward social comparison—where individuals compare themselves to those perceived as worse off—can be a powerful tool in residency. If we start from a premise that nobody will argue (that we all make mistakes), we can see how this unfolds. When you share a mistake, you are subconsciously reinforcing the idea that it is not something to be ashamed of, but rather a normal everyday experience. This fosters a sense of normalcy, reducing isolation and reinforcing the idea that mistakes are a universal part of growth.

At first glance, this may seem like it causes feelings of superiority or unhealthy competition, but research suggests otherwise. In high-stress environments like residency, downward social comparison is a natural way to cope with self-doubt. By voluntarily engaging in this practice, you help create a culture of openness, where acknowledging struggles strengthens camaraderie rather than fueling insecurity.

This is not a new idea in psychology. Wills first described downward social comparison as a method for self-evaluation and stress management.[1] Numerous studies show that it helps individuals reframe their struggles, maintain emotional well-being, and recognize that their challenges are shared.[1] A 2018 study in *Personality and Social Psychology Bulletin* found that this mechanism reduces negative emotions tied to failure and self-doubt.[2]

Furthermore, research in medical education indicates that residents who openly discuss their struggles experience greater resilience and lower burnout rates.[3]

References available online.

By sharing your mistakes, you unknowingly create a cycle—your peers feel reassured, and in return, they begin sharing their own struggles. This reciprocity not only normalizes struggle but also builds a stronger, more supportive residency culture.

HOW THIS BUILDS A STRONGER RESIDENCY CULTURE

If you're hesitant, I get it. Initially, I worried that this approach would promote arrogance or unhealthy competition. But I now believe that openly engaging in this practice is one of the healthiest and most effective ways to build a positive culture in residency. **Here's why:**

It Humanizes You. Imposter syndrome thrives on comparison. Sharing your struggles normalizes the challenges of residency and demystifies the false narrative that others are doing significantly better.

It Creates a Culture of Openness. Taking the first step in vulnerability signals to others that it's safe to be honest about their struggles. Over time, this creates an environment where openness is the norm rather than the exception.

It Strengthens Trust and Cohesion. Residency is a team effort. Acknowledging challenges collectively builds trust and support, reinforcing that no one is in this alone.

It Cultivates Real, Sustainable Confidence. True confidence isn't about never making mistakes—it's about understanding that mistakes don't define you. Embracing failure openly allows you to gain a deeper, more sustainable sense of self-assurance.

TAKE-HOME POINTS

Imposter syndrome is not a new idea; we are all well aware of its effects. What I propose is a practical way to deal with it—one you can implement immediately. Residency is hard enough without the weight of imposter syndrome dragging you down. By normalizing failure and fostering open conversations, we can shift the culture from silent self-doubt to collective growth.

So, what's stopping you? Be that culture shift in your program. Take a leap of faith—talk about your failures, voluntarily.

Normalizing mistakes fosters resilience, strengthens team trust, and creates a supportive learning environment. The next time you make a mistake, I challenge you: Send that message. Share your experience. Tell someone about it.

Chances are, you'll feel a lot better after. ✳

EMRA Representative Council Spring Meeting Returns to In-Person Event

Sunday, April 26: 10 am - 12 pm
Grand Hyatt Washington

EMRA's 2026 Representative Council (RepCo) Spring Meeting will make the leap from virtual to real-world this spring, and we ask ALL programs to participate.

The EMRA RepCo Spring Meeting will take place Sunday, April 26, from 9-11 am, at the Grand Hyatt Washington in Washington, D.C. The RepCo meeting will precede the EMRA/ACEP YPS Health Policy Primer at the ACEP Leadership and Advocacy Conference. **ACEP is extending a $75 registration fee to all EMRA resident and student members to attend LAC.** While LAC registration is not required to participate in the EMRA RepCo Meeting, we encourage all trainees to take part in LAC. Visit www.acep.org/lac for details.

WHY PARTICIPATE IN REPCO

Emergency medicine trainees face significant changes in training, certification, program requirements, practice models, reimbursement, and more.

EMRA represents the trainee voice in all those conversations — and RepCo outlines what our organization can say. We need programs to show up and set the course for all of EMRA's responses and strategies.

POLICIES AND DIRECTION

EMRA makes it easy to propose new policy. Just use the online EMRA Resolution template to set forth your position and policy requests.

Submit resolutions for the Spring Meeting by March 5.

WHO REPRESENTS YOU?

Please make sure your program names an EMRA Representative and Alternate Representative to vote on behalf of all trainees at your institution. Update your EMRA Program Rep here.

Deadline to update representatives: March 27.

EMRA Spring Medical Student Forum 2026

The EMRA Medical Student Forum is all-virtual this spring - making it easy and convenient for every medical student interested in the specialty to zoom in!

Block your calendar for Saturday, Feb. 28, starting at 9:30 am Central, to take advantage of a morning full of key speakers from EM programs around the country.

This perennial favorite event offers advice for medical students at each level of training, direct from EM faculty and program leaders. It's free for medical students and offers plenty of Q-and-A time.

Register for free by using the QR code!

Compete in the EMRA Quiz Show!

EMRA's bringing back the Quiz Show to CORD Academic Assembly 2026 in Orlando, and we want your program to represent!

We're looking for 4-person teams to compete in a zany take on the board exams. Show off your knowledge, get cool prizes, and win bragging rights. (Audience: you get prizes, too!)

- **Compete March 27, 7:30-9 pm (following CORD Poster Presentations)**
- Team sign-up deadline: Feb. 15 at midnight - and send in your **best trash-talk video**
- Event includes light appetizers, cash bar, prizes galore

The EMRA Quiz Show, started more than a decade ago, gives our programs a chance to participate in a fun, interactive board exam prep event, all while connecting with colleagues from around the country.

Thanks to Rosh Review for sponsoring this event.

Practice Essentials: The Essential Adjunct to Training

Practice Essentials of Emergency Medicine is a high-yield digital resource that will help you confidently navigate the landscape of health care business and economics.

- **FREE for all EMRA members**
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- Operations *(3.5 CME)*
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- EM Informatics *(1.75 CME)*
- Risk Management *(2 CME)*
- Leadership & Innovation *(3.25 CME)*
- Legal & Regulatory Issues *(2.75 CME)*
- Personal Finance *(3.75 CME)*

Many thanks to our content creators, led by Course Directors Nicholas Cozzi, MD, MBA; Nicholas Stark, MD, MBA; and Scott Pasichow, MD, MPH, FACEP, without whom this resource would not have been created.

References available online.

Cash in on Your EMRA Benefits

EMRA members, make life easier with two valuable new member benefits designed to help you be the best doctor you can be.

BOUNCEBACKS! YOUR GO-TO MEDICO-LEGAL BOOK

The authoritative resource for medico-legal insight is back with a new anniversary edition, and **EMRA members get 20% off**, while simultaneously earning money for EMRA to reinvest in you. **TO GET THE DISCOUNT:** Scan the QR code and use discount code "EMRA" when purchasing.

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For more insight, listen to our EMRA*Cast episode with Dr. Weinstock! (Find it on your favorite podcast platform or visit www.emra.org/emracast.)

RAPID SEQUENCE RADIOLOGY MED ED: RADIOLOGY FOR EMERGENCY MEDICINE

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STRONGER TOGETHER

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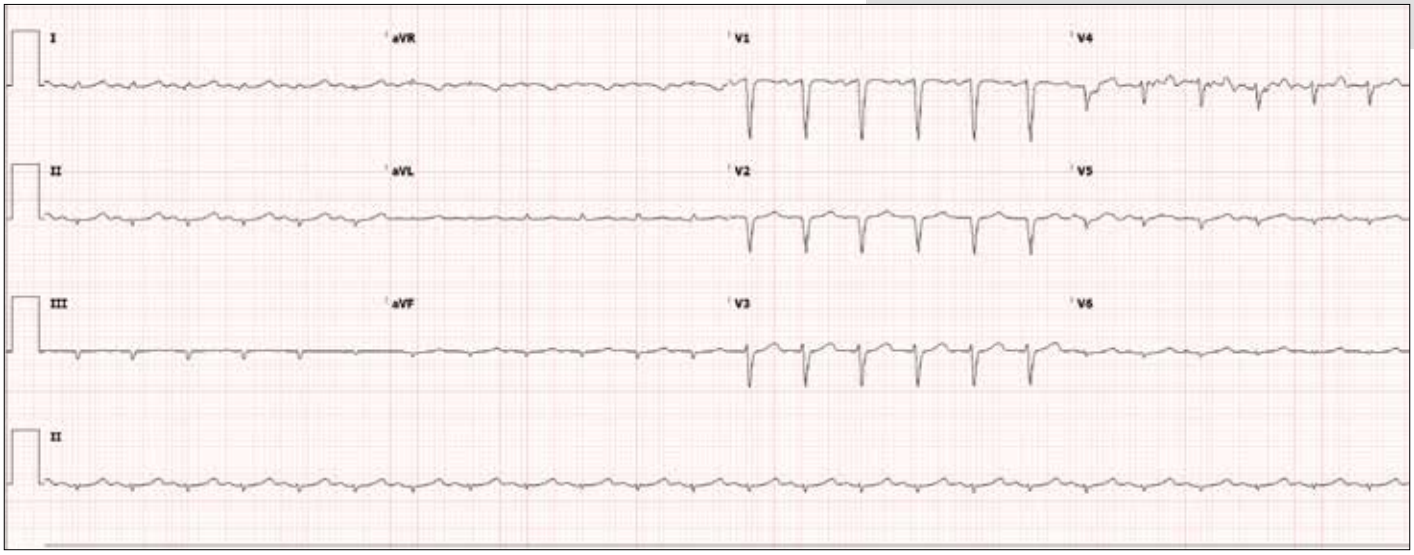

CASE

A 43-year-old female with PMH of stage IV cervical cancer presents with SOB. What is your interpretation of her ECG?

ANSWER ON PAGE 54

References available online.

ECG Challenge: Answer

This ECG shows sinus tachycardia with a ventricular rate of 146 bpm, left axis deviation, normal intervals, poor R-wave progression, and low QRS complex voltage.

The total distance from the top to the bottom of the QRS complex can be described as amplitude, measured in millimeters, or voltage, measured in millivolts. The 3-sided rectangle on the left side of the ECG is called the calibration signal box. It represents the calibration of the recording speed (x-axis) and voltage (y-axis) of the ECG. Time is represented by the width of the rectangle and is set for 0.2 sec. Voltage is represented by the height and is set for 10 mV (except for Nigel Tufnel's, which goes up to 11). Standard calibration is 25 mm/sec (i.e., 1 small box = 1 mm = 40 msec) and 10 mm/mV (ie, 1 small box = 1 mm = 0.1 mV).

The QRS complex voltage represents the magnitude and direction of ventricular depolarization. It is influenced by the amount of viable myocardium generating the signal, the distance and medium through which the signal passes before reaching the electrode, and the orientation of the signal. The diagnostic criteria for low voltage are typically defined as either QRS complex amplitude < 5 mm in all of the limb leads or < 10 mm in all of the precordial leads.

There is a broad differential for low voltage, but this can be simplified conceptually into intracardiac or extracardiac causes. The etiologies range from relatively benign to life threatening, so it is important to recognize this ECG finding and identify the underlying cause.

Intracardiac causes result from decreased generative potential of the myocardium and include loss of viable myocardial tissue as well as infiltrative and connective tissue disorders.

- Loss of viable myocardium
  - Myocardial infarction
  - Dilated cardiomyopathy (often late stage)
  - Severe malnutrition
- Infiltrative/connective tissue disorders
  - Infiltrative cardiomyopathies (e.g., amyloidosis, sarcoidosis, hemochromatosis, scleroderma)
  - Constrictive pericarditis
  - Myxedema heart disease

Extracardiac causes are due to disruption of current between the myocardial cells and the electrode, whether by fluid, air, or soft tissue.

- Acute respiratory distress syndrome
- Anasarca
- Chronic obstructive pulmonary disease
- Constrictive pericarditis
- Obesity
- Pericardial effusion
- Pleural effusion
- Pneumomediastinum
- Pneumonia
- Pneumopericardium
- Pneumothorax
- Pulmonary edema
- Subcutaneous emphysema

This ECG also shows poor R-wave progression (PRWP). There is no universal definition for PRWP, but a common criterion is R-wave amplitude in lead V3 ≤ 3 mm. Other criteria include R-wave < 2-4 mm in lead V3 or V4 and R-wave in lead V3 > lead V4 or lead V2 > lead V3. In a normal ECG, the R-wave amplitude should progressively increase from V1 to V6 as the leads move closer to the left ventricle. PWRP suggests a disruption of the normal physiologic forces, and—similar to low voltage—is a descriptive finding rather than a diagnostic finding. The differential diagnosis for PRWP includes:

- Dilated cardiomyopathy
- LAFB
- LBBB
- LVH
- Misplaced precordial leads
- Normal variant
- Pre-excitation syndromes
- Prior anterior myocardial infarction
- RVH

CASE CONCLUSION

This patient's ED workup was notable for a large left pleural effusion. She was admitted to the hospital for thoracentesis and further workup.

LOW VOLTAGE LEARNING POINTS

- QRS complex voltage < 5 mm in the limb leads or < 10 mm in the precordial leads
- Low voltage + electrical alternans = pericardial effusion until proven otherwise

POOR R-WAVE PROGRESSION LEARNING POINTS

- No universal definition, but common criteria include:
  - R-wave in lead V3 ≤ 3 mm
  - R-wave < 2-4 mm in lead V3 or V4
  - R-wave in lead V3 > lead V4 or lead V2 > lead V3
- Etiologies include:
  - Dilated cardiomyopathy
  - LAFB
  - LBBB
  - LVH
  - Low voltage
  - Misplaced precordial leads
  - Normal variant, especially in the elderly
  - Pre-excitation syndromes
  - Prior anterior myocardial infarction
  - RVH (eg, from COPD)

References available online.

Board Review Questions

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1. A 33-year-old woman presents with a tight, band-like pain around her head that started slowly about a week ago. She denies fever, photophobia, phonophobia, nausea, and vomiting. What is the most likely diagnosis?

A. Cluster headache
B. Migraine headache
C. Tension headache
D. Trigeminal neuralgia

2. A 60-year-old man presents with chest discomfort. His history is moderately concerning for acute coronary syndrome. His vital signs are normal. The ECG demonstrates normal sinus rhythm with no ST-segment or T-wave abnormalities. Initial therapy is started, and laboratory tests are ordered. The patient remains stable, and the initial troponin level is normal. What is the correct approach to treatment, observation, and reassessment?

A. Intravenous heparin, oral clopidogrel, and oral aspirin with immediate exercise stress testing
B. Intravenous heparin, oral clopidogrel, and oral aspirin with serial troponin and 12-lead ECG sampling
C. Oral aspirin therapy with immediate exercise stress testing, with or without nuclear imaging
D. Oral aspirin therapy with serial troponin measurement and 12-lead ECG sampling

3. A 52-year-old man presents with shortness of breath and hoarseness following a fire in an industrial plant. The physical examination reveals a very hoarse voice, difficulty speaking, occasional audible stridor, and significant wheezing in all lung fields. His vital signs are BP 102/54, P 108, R 28, and T 37.1°C (98.8°F); SpO2 is 90% on room air. What is the best next step in management?

A. Administer albuterol 5 mg by nebulizer
B. Administer decadron 10 mg IV
C. Initiate BiPAP
D. Perform immediate RSI

4. A 37-year-old man presents with ataxia, headache, and nausea. He says he was using a gas-powered generator indoors "and passed out cold." His vital signs are normal, but his carboxyhemoglobin level is 26%. What is the best first step in management?

A. Arrange for exchange blood transfusion
B. Perform serial carboxyhemoglobin measurements
C. Provide supplemental oxygen
D. Transport to the nearest hyperbaric oxygen facility

5. Which physical examination finding indicates a cribriform plate fracture after trauma to the face and nose?

A. Clear nasal discharge
B. Epistaxis
C. Hemotympanum
D. Septal hematoma

PEERprep For Physicians

References available online.

ANSWERS
1=C; 2=D; 3=D; 4=C; 5=A

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