

Critical decisions

in emergency medicine

THE 2021 LLSA LITERATURE REVIEW



The LLSA Literature Review

Synopses of articles from ABEM's 2021 Lifelong Learning and Self-Assessment Reading List

FROM THE EDITORS

Since April 2003, *Critical Decisions in Emergency Medicine* has included the bonus feature "The LLSA Literature Review." The impetus for this section was our desire to provide ACEP members with yet another tool to use when preparing for the continuous certification initiative of the American Board of Emergency Medicine (ABEM), specifically the Lifelong Learning and Self-Assessment (LLSA) tests. Each year, as part of this program, ABEM publishes a list of articles focused on selected portions of the emergency medicine core content. These articles become the LLSA reading list for that year, and the questions for the tests are drawn from these articles.

Since November 2019, each monthly issue of *Critical Decisions* has provided a summary of one of the articles from ABEM's 2020 reading list, with bullets highlighting the elements relevant to emergency medicine practice. This online supplemental issue includes a full collection of those summaries, which are intended to highlight the important concepts of each article. We are pleased to offer this benefit FREE to ACEP members, and hope you find it useful. ACEP members also can download full versions of the articles by logging in at acep.org/llsa.

If you would like to see what else *Critical Decisions* has to offer (clinical lessons, ECG and imaging reviews, drug reviews, and more), we invite you to explore a sample issue online at www.acep.org/cdem.

Best wishes,

Andrew J. Eyre, MD, Section Editor
Harvard Affiliated Emergency Medicine Residency
Brigham and Women's Hospital

Michael S. Beeson, MD, MBA, FACEP
Northeastern Ohio Universities

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EDITOR-IN-CHIEF

Michael S. Beeson, MD, MBA, FACEP
Northeastern Ohio Universities,
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EDITORIAL STAFF

Mark Paglia, Senior Manager
mpaglia@acep.org

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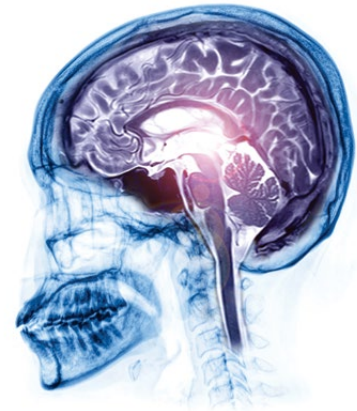
Neurologic Emergencies

By Daniel Du Pont, MD, MBE; and Michael E. Abboud, MD, MEd

Department of Emergency Medicine, University of Pennsylvania

Reviewed by Andrew Eyre, MD, MHPEd

Edlow JA. Managing patients with transient ischemic attack. *Ann Emerg Med.* 2018 Mar;71(3):409-415.



Transient ischemic attack (TIA) has been recently redefined as “a transient episode of neurological dysfunction caused by focal brain, spinal cord, or retinal ischemia without acute infarction.” Symptoms usually last for less than an hour, and most patients who are diagnosed with a TIA are asymptomatic with a normal neurologic exam upon presentation.

Without treatment, the incidence of acute ischemic stroke within 48 hours of an emergency department visit for TIA is 4.8%. With proper testing and treatment, however, as many as 80% of these subsequent strokes can be prevented.

Any patient who presents with a possible TIA should undergo basic laboratory testing, brain imaging, and an ECG. They should also be put on cardiac telemetry, as atrial fibrillation causes approximately 20% to 25% of TIAs. MRI with diffusion-weighted imaging is preferred to noncontrast CT because MRI can help identify patients at higher risk of recurrent stroke. CT only shows TIA and stroke mimics that are present in a minority of cases; however, this modality should be used when MRI is unavailable or difficult to obtain.

There is some controversy regarding vessel imaging. The American College of Emergency Physicians recommends obtaining vascular imaging and regards it as the most important test in the TIA workup. Symptomatic carotid stenosis greater than 50% significantly increases a patient's risk of stroke, but this pathology can be treated with urgent revascularization. CT angiography (CTA) and MR angiography (MRA) are preferred; while carotid ultrasonography is acceptable due to its ability to detect carotid stenosis, it cannot evaluate the vertebral or intracranial arteries.

Echocardiography should only be obtained in patients with specific risk factors: no other cause found on initial evaluation, no indication for full anticoagulation, suspected cardioembolic cause, suspected small vessel disease, or a known previously abnormal echocardiogram.

Treatment for TIA is straightforward and can significantly decrease acute stroke risk. All patients should be started on aspirin and a statin, and blood pressure should be controlled in cases of hypertension. If the patient has a contraindication to aspirin, clopidogrel can be used. Those in atrial fibrillation or who have another suspected cardioembolic etiology should be started on an anticoagulant unless a strong contraindication exists; the choice of anticoagulant should ideally be made in consultation with the outpatient provider. Patients should also be counseled on smoking cessation.

Disposition depends on a few factors. Notably, existing risk-stratification tools (eg, the ABCD² score) should not be used to determine individual dispositions. Any patient with multiple TIAs prior to presentation or who has recurrent symptoms during their evaluation should be admitted. Those who are found to be in atrial fibrillation, have another significant arrhythmia, or have a TIA while on full anticoagulation should also be admitted.

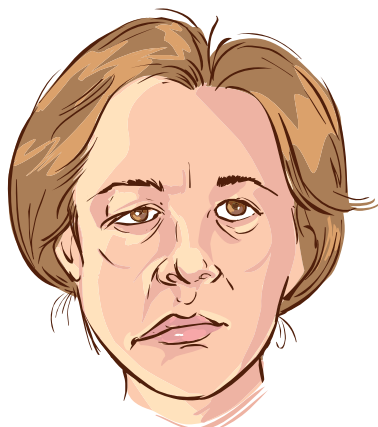
Finally, any large-vessel atherosclerosis (intra- or extracranial) should prompt admission for possible intervention. Patients admitted for TIA should be seen by neurology during their stay; otherwise, those who receive a full workup and can be seen promptly by their primary care provider or a neurologist to initiate ongoing cardiac monitoring can be discharged.

KEY POINTS

- The incidence of acute ischemic stroke within 48 hours of an emergency department visit for TIA is 4.8%, but secondary stroke-prevention measures can reduce this rate by as much as 80%.
- All suspected TIA patients should undergo basic lab testing, an ECG, brain and vessel imaging, and cardiac telemetry. MRI with diffusion-weighted imaging is preferred. A subset of patients should undergo echocardiography.
- All TIA patients should be started on an antiplatelet agent (usually aspirin), a statin, and an antihypertensive as needed. Those in atrial fibrillation or with a suspected cardioembolic cause should be started on full anticoagulation.
- Most TIA patients require observation or admission, but those who have an unremarkable workup, no red flags, and reliable follow-up can be discharged.

Peripheral Facial Palsy

By Ivan Zvonar, MD; and Laura Welsh, MD
Boston University Medical Center, Massachusetts
Reviewed by Andrew Eyre, MD, MHPed



Garro A, Nigrovic LE. Managing Peripheral Facial Palsy. *Ann Emerg Med.* 2018;71(5):618-624.

Although acute-onset peripheral facial nerve palsy is a common presentation in the emergency department, most patients (>70%) achieve a full recovery. To properly diagnose and manage these cases, clinicians must conduct a careful history and physical examination to ascertain identifiable etiologies. Antibiotic treatment should be considered for patients in Lyme-endemic regions, while corticosteroids remain the mainstay of treatment for idiopathic (Bell's) palsy.

Acute-onset peripheral facial nerve palsy (either unilateral or bilateral) must first be differentiated from central facial nerve palsy, a disorder that should prompt an evaluation for stroke. Findings of peripheral facial nerve palsy include impaired eye closure and a loss of eyebrow and forehead movement. These complications are absent in cases of central facial nerve palsy due to bilateral cortical motor neuron innervation. Specific findings of disfigured facial asymmetry or incomplete eye closure with full effort define severe facial nerve palsy and are implicated in treatment decisions. Fewer than 10% of peripheral palsies will be accompanied by other cranial neuropathies.

The treatment of peripheral facial palsy begins with the investigation of identifiable etiologies. Otitis media is a common culprit in children. Signs of local trauma and postsurgical complications should be noted on the patient's history and physical exam. Although neoplasms and sarcoidosis are rare, acoustic neuroma should be considered in those with associated hearing loss or gait ataxia. Patients with Ramsay Hunt syndrome, a rare neurological disorder that involves the reactivation of the varicella zoster virus, often present with associated ear pain and vesicles.

If no identifiable cause is discovered, treatment depends on suspicion for early-disseminated Lyme disease caused by the bacterium *Borrelia*, which is transmitted through the bite of infected blacklegged ticks. Endemic regions include the northeastern and north-central United States. Physicians should have increased suspicion for Lyme disease during peak local seasons and when evaluating any patient with erythema migrans or bilateral facial nerve palsy. The diagnosis is made by two-tier serology testing (ELISA followed by a confirmatory immunoblot).

High suspicion for Lyme disease necessitates empiric antibiotic coverage with doxycycline. Amoxicillin should be considered for pediatric patients and those with allergies. Of note, lumbar puncture is not indicated unless there is concern for concomitant bacterial meningitis. For patients in whom there is a low to moderate

suspicion for Lyme disease, idiopathic (Bell's) palsy should be treated with methylprednisolone dose packs. Prednisone or prednisolone can be used for children.

Although the benefits of corticosteroids are largely derived within the first 72 hours of treatment, steroids should be initiated in patients with severe presentations regardless of the timing of symptom onset. In addition, severe facial nerve palsy should also be treated with antiviral agents to prevent the potential spread of herpes simplex virus. Valacyclovir and famciclovir are preferred due to their ease of dosing.

Finally, patients should be given artificial tears for home use and instructions for hourly manual eye closure. Patients should be instructed to lubricate and cover the affected eye with a patch when sleeping to prevent corneal ulceration and other ophthalmologic injuries.

KEY POINTS

- A careful history and physical examination can distinguish between peripheral and central facial nerve palsy and help detect identifiable etiologies of peripheral palsy.
- In adult patients in whom there is high suspicion for Lyme disease, empiric oral doxycycline should be initiated.
- The mainstay of treatment for idiopathic (Bell's) palsy involves corticosteroids; severe cases may require additional antiviral agents.

Bag-Valve-Mask Ventilation

By Rmaah Memon, MD; and Andrew Eyre, MD, MHPEd
Harvard-Affiliated Emergency Medicine Residency,
Boston, Massachusetts

Casey JD, Janz DR, Russell DW, et al; PreVent Investigators and the Pragmatic Critical Care Research Group. Bag-mask ventilation during tracheal intubation of critically ill adults. *N Engl J Med.* 2019 Feb 28;380(9):811-821.

Hypoxemia during tracheal intubation is a common but serious complication that can lead to poor patient outcomes and even death. During rapid-sequence intubation, there is typically a delay of 45 to 90 seconds between medication administration and laryngoscopy. The use of bag-valve-mask (BVM) ventilation after induction and prior to laryngoscopy has remained controversial, and the risks of aspiration associated with this approach are widely debated.



The multicenter PreVent trial studied adults (18+ years) undergoing induction and tracheal intubation in participating ICUs. Patients were split into two groups: those who received ventilation with a BVM device between induction and laryngoscopy, and those who received none.

Researchers focused on two outcomes: the lowest oxygen saturation observed during the interval between induction and 2 minutes after tracheal intubation, and the incidence of hypoxemia (oxygen saturation <80%) during the period between induction and 2 minutes after intubation. Additional outcomes included new opacities on chest x-ray within 48 hours after intubation and operator-reported aspiration events.

For participants in the

“no-ventilation” group, BVM ventilation could be used only after a failed attempt at laryngoscopy as a treatment for hypoxemia. Noninvasive ventilation was not allowed in either group during the interval between induction and intubation; however, preoxygenation using any method, including noninvasive ventilation, was permitted prior to induction in both groups.

The two groups were analyzed using an intention-to-treat comparison. The median lowest oxygen saturation was 96% in the BVM ventilation cohort and 93% in the no-ventilation group. The mean difference in the lowest oxygen saturation between the two groups was 4.7%, and the difference in lowest oxygen saturation was greater

for participants with a lower oxygen saturation at induction ($P=0.01$).

In addition, 10.9% of patients in the BVM ventilation group and 22.8% in the no-ventilation group had an oxygen saturation less than 80%; furthermore, 29.5% of those in the BVM ventilation group and 40.1% of those in the no-ventilation cohort had an oxygen saturation less than 90%. There was no significant difference in the presence of new opacities on chest x-ray in the 48 hours after intubation in either group and no significant difference when looking at operator-reported aspiration.

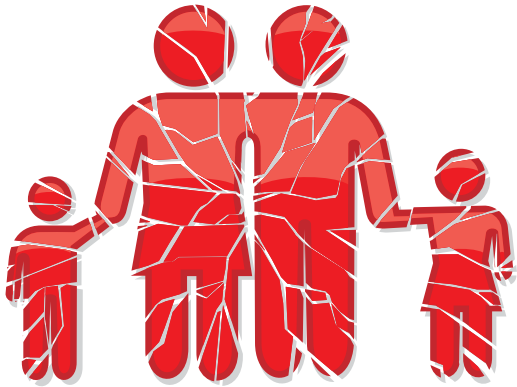
Overall, the study illustrates the benefit of BVM ventilation for preventing hypoxemia in patients undergoing tracheal intubation. A larger study population is needed to fully evaluate for operator-reported aspiration, as the incidence was low in this trial. Further research is needed before these results can be generalized to patients in the emergency department.

KEY POINTS

- Critically ill adults undergoing intubation who receive BVM ventilation after induction appear to have higher oxygen saturations and lower rates of severe hypoxemia than those who do not.
- The incidence of operator-reported aspiration was lower in the BVM ventilation group than in the no-ventilation group.

Intimate Partner Violence

By Katherine Dickerson Mayes, MD, PhD; and Andrew Eyre, MD, MHPEd
Massachusetts General Hospital, Boston



Miller E, McCaw B. Intimate partner violence. *N Engl J Med.* 2019 Feb 28;380(9):850-857.

The CDC defines intimate partner violence (IPV) as physical violence, sexual violence, stalking, or psychological aggression by a current or former intimate partner. Estimates show that roughly one-third of women (37.3%) and men (30.9%) have experienced IPV in their lifetimes. These numbers have remained steady for the last decade, presenting an important opportunity for public health intervention.

Demographics

IPV is most prevalent in young adults (18-24 years old). Research suggests a relationship between societal marginalization and violence, whereby certain populations, including sexual and gender minorities, people with mental and physical disabilities, and some racial and ethnic minorities, are most at risk. Victims of IPV may be medically nonadherent, as the psychological aggression and control tactics abusers employ can interfere with a victim's ability to seek medical care.

Health Effects

In addition to the immediate physical effects of violence, women who are undergoing abuse have more medical, gynecologic, and

stress-related symptoms. Chronic conditions like asthma, autoimmune disorders, cancer, arthritis, stroke, and cardiovascular disease are all higher among victims of IPV. Studies suggest this may be related to the effects of acute and chronic stress on the neuroendocrine and immune systems. Additionally, post-traumatic stress disorder, anxiety, suicide, and substance abuse have all been linked to IPV.

At-Risk Populations

IPV poses particular risks to women of reproductive age and their children. In particular, pregnant victims are at greater risk for obstetric and gynecological complications. Children exposed to parental abuse have a higher probability of physical

and mental health disorders; in addition, they are more likely to experience IPV in the future — either as perpetrators or victims. To prevent these long-term effects, home visitation programs and community-based social service referrals should be arranged as soon as possible.

Our Role

Emergency department staff are likely to encounter patients with a history of IPV quite often. The most effective screenings take place in safe and private settings, in which the clinician can create an opportunity for (but not insist upon) disclosure and offer tangible resources for support. Many victims may not immediately connect somatic symptoms to their history of abuse, but patient education can create a safe, confidential space for future disclosure.

Clinicians must be ready and capable of connecting patients to the wraparound social services required to prevent future IPV. Emergency departments are encouraged to compile a list of local and national resources for potential victims and confirm the enrollment procedures with social service providers prior to referral.

KEY POINTS

- Approximately one-third of women (37.3%) and men (30.9%) have experienced IPV in their lifetimes.
- Young adults, sexual and gender minorities, people with disabilities, Native Americans, multiracial individuals, and non-Hispanic Black women are at higher risk of IPV.
- Women of reproductive age and their children are considered high risk; these patients especially benefit from robust social service referrals.
- A host of mental and physical health conditions have been linked to IPV.
- It is exceedingly important for clinicians to identify high-risk individuals and provide them with empathetic care and tangible resources.

Anterior Epistaxis in Patients Taking Antiplatelets

By Kalen N. Wright, MD, MS; and Andrew Eyre, MD, MHPed
Massachusetts General Hospital, Boston

Zahed R, Jazayeri MHM, Naderi A, Naderpour Z, Saeedi M. Topical tranexamic acid compared with anterior nasal packing for treatment of epistaxis in patients taking antiplatelet drugs: randomized controlled trial. *Acad Emerg Med.* 2018 Mar;25(3):261-266.



Epistaxis is a common presentation that can be efficiently managed with a variety of techniques; however, patients taking antiplatelet drugs appear to have more severe and recurrent episodes. While rarely life-threatening, clear management guidelines for anterior epistaxis are necessary to improve patient outcomes and experiences.

This study compared the treatment efficacy of topical tranexamic acid (TXA) to anterior nasal packing (ANP) with 2% lidocaine with epinephrine (1:100,000) in patients taking antiplatelet agents (aspirin, clopidogrel, or both). In this randomized, parallel-group clinical trial, 124 patients with anterior epistaxis were separated into the TXA or ANP groups after continued bleeding despite 20 minutes of bilateral nostril compression. Patients with a history of concurrent anticoagulation use, traumatic epistaxis, INR >1.5, signs of shock, and inherited coagulopathies were excluded from the study.

The TXA group underwent treatment with a 15-cm cotton pledget soaked in 5 mL of TXA 500 mg packed into the affected nares. The ANP group received treatment with the same packing material soaked in 2% lidocaine with epinephrine (1:100,000). The primary outcome of this study was the proportion of patients whose bleeding had stopped 10 minutes after packing placement. Secondary outcomes included recurrence of epistaxis at both 24 hours and 7 days after treatment, length of stay in the emergency department, and patient satisfaction.

After 10 minutes of treatment, bleeding stopped in 73% of patients in the TXA group and 29% in the ANP group ($p < 0.001$). Median time to bleeding cessation was also significantly lower in the TXA group than the ANP group (10 minutes vs 15 minutes, $p < 0.001$). The TXA group had significantly lower rates of bleeding recurrence at the 7 day follow-up compared to the ANP group (5% vs 21%, $p = 0.007$) as well as shorter lengths of stay and higher patient satisfaction.

There were no serious adverse events in either group or significant differences in side effects. Topical applications of TXA have not been shown to significantly increase plasma concentrations nor contribute to systemic antifibrinolytic effects, making it a safe option in management of epistaxis. Notably, this study did not include patients with posterior epistaxis, so the role of TXA in the management of these patients cannot yet be determined. Treatment efficacy of TXA-soaked anterior nasal packing in patients taking antiplatelet agents was not compared to other devices used for epistaxis, such as nasal tampons, sponges, or balloon devices.

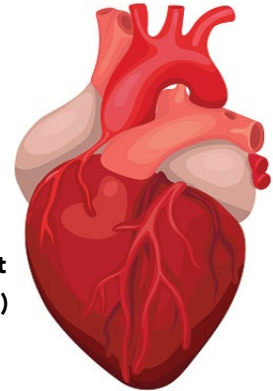
KEY POINTS

- In patients with anterior epistaxis taking antiplatelet agents, TXA-soaked anterior packing had a higher success rate of bleeding cessation at 10 minutes when compared to typical anterior packing.
- Patients randomized into the TXA treatment group had less recurrent bleeding at 1 week, a shorter length of stay in the emergency department, and higher patient satisfaction than those treated with typical anterior nasal packing.
- Further research is needed to determine TXA treatment efficacy as compared to other epistaxis management options including nasal tampons, tamponade balloons, and nasal sponges.

Ruling Out Acute MI and Acute Coronary Syndrome with a High-Sensitivity Troponin I Assay and Accelerated Diagnostic Pathways

By Matthew Lindgren MD; and Nicholas G. Maldonado MD, FACEP
University of Florida College of Medicine, Department of Emergency Medicine, Gainesville
Reviewed by Andrew Eyre, MD, MHPEd

Greenslade JH, Carlton EW, Van Hise C, et al. Diagnostic accuracy of a new high-sensitivity troponin I assay and five accelerated diagnostic pathways for ruling out acute myocardial infarction and acute coronary syndrome. *Ann Emerg Med.* 2018 Apr;71(4):439-451.e3.



Chest pain is one of the most common presentations in the emergency department and can stem from a myriad of etiologies, including acute coronary syndrome (ACS) and acute myocardial infarction (AMI), which may be life threatening.

The introduction of high-sensitivity cardiac troponin (hs-cTn), which allows for the detection and quantification of even small degrees of myocardial injury, has led to the advent of diagnostic pathways to risk stratify patients with suspected ACS and predict 30-day outcomes. This article describes the diagnostic accuracy of five accelerated chest-pain pathways (ACCPs) used in conjunction with the new Access high-sensitivity troponin (hs-TnI) assay and their ability to rule out AMI or ACS. If evidence supports favorable diagnostic characteristics, safe and expeditious disposition of these patients may be possible.

The five ACCPs evaluated in the study include the history, ECG, age, risk factors, and troponin (HEART) pathway; the modified accelerated diagnostic protocol to assess patients with chest pain symptoms using troponin as the only biomarker (m-ADAPT); the emergency department assessment of chest pain score (EDACS) pathway; the new Vancouver chest pain rule (VCPR); and the no objective testing (NOT) rule. The Beckman Coulter Access high-sensitivity troponin I (Access hs-TnI) assay was used to calculate each score.

The study examined 1,811 patients ≥ 18 years old who presented with ≥ 5 minutes of chest pain consistent

with ACS. The study protocol involved collection of baseline patient data as well as ECGs and troponin samples, taken initially on presentation and again two hours afterward. Using the new Access hs-TnI assay, this study defined an overall 99th percentile value of 18 ng/L, with cut points of 12 for women and 20 for men. Using the available clinical data and troponin values, scores were assigned using each of the five ACCPs, and patients were classified by risk level.

Overall, it was found that the VCPR and NOT rule had a high sensitivity that may safely rule out 30-day ACS in 25% to 30% of patients, allowing for safe and rapid discharge. Although it may not meet the general sensitivity standards for AMI or ACS, the use of the Access hs-TnI assay with m-ADAPT, EDACS, and HEART pathways may enable the classification of 50% to 60% of patients as low risk for 30-day AMI, allowing for rapid referral for objective testing. The data presented can be tailored to regional and individual clinician risk tolerance, accessibility to emergency department or close outpatient cardiology consultation, objective testing, and institutional policy.

KEY POINTS

- Combined use of hs-cTn and ACCPs may lead to the safe and expeditious disposition of patients with chest pain and suspected acute coronary syndrome (ACS).
- This study described the diagnostic accuracy of five accelerated chest-pain pathways (ACCPs) used in conjunction with the new Access hs-TnI assay taken at 0 and 2 hours after presentation.
- The use of this assay with either the VCPR or NOT rule is sensitive for ACS and may enable approximately one-third of patients to be safely discharged after 2-hour risk stratification with no further testing.
- The use of this assay with m-ADAPT, EDACS, or HEART pathways may enable a significant amount of emergency department patients to be rapidly referred for objective testing.



Diverticulitis

By John P. Baker, MD; and Nicholas G. Maldonado MD, FACEP
University of Florida College of Medicine, Department of Emergency Medicine, Gainesville

Reviewed by Andrew Eyre, MD, MHPEd

Young-Fadok TM. Diverticulitis. *N Engl J Med.* 2018 Oct;379(17):1635-1642.

The number of hospitalizations due to colonic diverticulitis is increasing in the United States, especially in patients greater than 60 years of age. Colonic diverticulitis is a spectrum of illness, and severity determines variations in presentation, radiologic findings, and management. This article provides an overview of diverticulitis, informs current recommendations, and highlights growing evidence of the need for further study that may alter future management strategies.

The process through which healthy colonic wall develops diverticula is an area of speculation, but it is thought to involve altered gut motility and intraluminal pressure. Factors that increase the risk of diverticular formation include age, smoking, NSAID use, physical inactivity, obesity, diets high in refined carbohydrates and red meat, and low fiber intake. Diverticulitis occurs when one or more diverticula become inflamed, and most commonly affects the sigmoid colon. Inflammation is theorized to occur through either 1) bacterial overgrowth with tissue ischemia or 2) stool accumulation within the diverticula, which then hardens and erodes through the diverticular wall. If contained and confined to mesentery, this process results in localized inflammation (simple, uncomplicated diverticulitis) with associated phlegmon or small abscess formation and presents with local peritoneal signs. If not contained, complicating features such as large abscess formation, abscess extension outside of the pelvis, free perforation, or purulent or feculent peritonitis can develop (complicated diverticulitis) and present with diffuse peritoneal signs. Notably, the designation of uncomplicated or complicated diverticulitis does not predict illness severity or need for surgery.

Clinically, signs and symptoms of diverticulitis include focal left-lower quadrant abdominal pain, fever, and leukocytosis with possible associated signs of altered bowel patterns and pelvic pressure; however, patients may also present with diffuse peritonitis and sepsis. The diagnostic test of choice is CT with intravenous and luminal contrast given its high diagnostic accuracy and identification of complicated disease. Radiologic features consistent with diverticulitis include colonic wall thickening and pericolonic fat stranding as well as abscesses, localized air bubbles, and free air or fluid.

Uncomplicated diverticulitis can often be managed on an outpatient basis with an antibiotic regimen of 7 to 10 days and pain control. Colonoscopy is currently recommended after resolution and should be considered if more than

2 to 3 years have elapsed since the last examination.

Complicated diverticulitis should be managed on an inpatient basis that includes intravenous fluid resuscitation, bowel rest, pain control, and broad-spectrum intravenous antibiotics to cover gram-negative and anaerobic bacteria. Percutaneous drainage should be considered in consultation with an interventional radiologist for cases of complicated diverticulitis with associated abscess where there has been failure of medical management or for larger abscesses that are anatomically amenable to drainage. Emergent surgery (open or laparoscopic) is indicated for diverticulitis associated with sepsis or peritoneal signs, and consultation with acute care or colorectal surgery should also be considered in cases of failed antibiotic therapy or percutaneous drainage.

KEY POINTS

- Diverticulitis most commonly affects the sigmoid colon.
- Clinical presentation ranges from a benign course with focal signs and symptoms to diffuse peritonitis and sepsis.
- CT with intravenous and luminal contrast is the preferred test for diagnosis.
- Uncomplicated diverticulitis can typically be managed as an outpatient with oral antibiotics, pain control, and referral for colonoscopy when indicated.
- Complicated diverticulitis requires inpatient management.
- Emergent surgery is indicated for diverticulitis associated with sepsis or peritoneal signs.

Pediatric Asthma

By Brittany Ockenfels, MD, LT, MC, USN;
and Daphne P. Morrison Ponce, MD, LCDR, MC, USN
Naval Medical Center Portsmouth, Virginia

Reviewed by Andrew Eyre, MD, MHPed

Batabyal RA, O'Connell K. Improving management of severe asthma: BiPAP and beyond.
Clin Ped Emerg Med. Mar 2018;19(1):69-75.



Children with acute asthma are primarily evaluated and stabilized in the emergency department. Some asthmatics can progress from symptom onset to respiratory failure in under two hours, so it is critical that emergency physicians are adept in management of these patients.

Standard Asthma Management

Corticosteroids, inhaled β agonists, and supplemental oxygen remain the mainstay of asthma management. Evidence demonstrates that early systemic corticosteroids (oral or intravenous) are imperative, and even a modest delay in steroid administration can increase the likelihood of hospital admission. Current guidelines recommend dexamethasone or prednisone orally, or methylprednisolone intravenously. If discharged, the patient should complete an outpatient course of systemic steroids. In addition to inhaled albuterol, a short-acting β agonist, ipratropium bromide, an acetylcholine receptor agonist should be prescribed. This combination improves lung function and reduces hospital admissions.

Severe or Unresponsive Asthma Management Continuous Albuterol

Continuous albuterol administration is recommended if the patient does not respond to initial administration. This approach improves clinical asthma scores and reduces hospital admissions; however, there are several potential side effects to consider including hypokalemia, dysrhythmias, tremors, diastolic hypotension, lactic acidosis, and tachypnea.

Magnesium Sulfate

Magnesium sulfate augments bronchodilation by relaxing airway smooth muscle. Recent meta-analyses found a significant decrease in hospital

admission rates in pediatric asthma patients who received magnesium. Administration of intravenous fluids may help lessen the side effect of hypotension. Recommended IV dosing is 25-75 mg/kg (max 2 g) over 20 minutes.

Epinephrine and Terbutaline

Epinephrine and terbutaline are indicated in cases of severe obstruction. Epinephrine rapidly stimulates α - and β -adrenergic receptors; it can also be used with wheezing in anaphylaxis. Terbutaline is a β_2 agonist and reserved for patients with severe respiratory decompensation who do not improve with nebulized therapies.

High-flow Nasal Cannula (HFNC)

HFNC increases FiO_2 and provides positive end-expiratory pressure, improving pulmonary compliance and reducing work of breathing. Recent small studies have shown some improvement in symptoms and avoidance of noninvasive ventilation; however, these are limited in size and generalizability, and more research is needed.

Noninvasive Positive Pressure Ventilation (NIPPV)

NIPPV provides positive airway pressure support, increasing FiO_2 and decreasing work of breathing; however, data is limited regarding its use in severe asthma. Initial settings should aim for a tidal volume of 5 to 7 mL/kg with FiO_2 titrated to SpO_2 of $>90\%$.

Heliox

Heliox has a lower density and may improve laminar flow when compared with plain oxygen. It does not have inherent bronchodilatory or anti-inflammatory effects and is instead used for respiratory support until other therapies take effect. Randomized trials have shown variable efficacy, but a 2014 meta-analysis reported decreased hospitalization rates and improved peak expiratory flow. It is currently recommended in life-threatening exacerbations; however, laminar flow decreases with increased oxygen content, so it is not appropriate for those requiring $>30\% \text{ FiO}_2$.

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KEY POINTS

- The mainstay of asthma management includes early corticosteroids, supplemental oxygen, and inhaled albuterol and ipratropium bromide.
- Magnesium sulfate significantly reduces hospital admission rates in severe pediatric asthma exacerbations.
- Consider terbutaline, epinephrine, and heliox in severe exacerbations unresponsive to other therapies
- NIPPV and HFNC require more research before recommendations can be made.



Tracheostomy Emergencies

By Donald Engle, MD, LCDR, MC, USN; and
Daphne P. Morrison Ponce, MD, LCDR, MC, USN
Naval Medical Center Portsmouth, Virginia

Reviewed by Andrew Eyre, MD, MHPEd

Bontempo LJ, Manning SL. Tracheostomy emergencies. *Emerg Med Clin North Am.* 2019 Feb;37(1):109-119

More than 110,000 tracheostomies are performed annually in the United States, and complications occur in up to 40% to 50% of patients. Although most complications are minor, 1% of all tracheostomies result in a catastrophic complication.

For the purpose of emergency management, tracheostomy complications are grouped into emergent life-threatening complications and urgent complications. Emergency situations include tube decannulation, tube obstruction, and hemorrhage, while urgent conditions include tracheoesophageal fistula (TEF) formation, tracheal stenosis, infection, and tracheocutaneous fistula formation.

Decannulation

Tracheostomy decannulation can occur at any time following placement; however, decannulations within the first 7 days are most concerning due to the lack of mature stoma formation and a narrower tracheocutaneous tract. Replacement of a tracheostomy <7 days old should only be attempted under direct visualization to reduce the risk of creating a false passage. If replacement is unsuccessful, oral intubation may be necessary. For decannulations occurring >7 days after placement, clinicians may attempt to replace a new tracheostomy tube of similar size through the stoma without direct visualization. If a replacement tracheostomy tube is not available, an analogous size endotracheal tube may be placed through the stoma.

Obstruction

Troubleshooting for tracheostomy tube obstruction requires a stepwise approach moving from external to internal sources. First, remove any external devices (speaking valve, humidifying devices, etc). Next, remove

the inner cannula, if present. At this point, suctioning the tracheostomy tube will clear most obstructions; however, if the obstruction persists, the cuff must be deflated to allow for airflow around the tracheostomy tube. If all of these measures are unsuccessful, the tube must be removed, as it no longer serves any useful function. If a definitive airway is needed, an endotracheal tube must be advanced beyond the tracheostomy site.

Hemorrhage

Bleeding from the tracheostomy site in the first 48 hours is usually related to the operation itself. Beyond 48 hours, the most critical and feared hemorrhagic complication is the development of a tracheoinnominate fistula (TIAF). Most TIAF bleeds occur within the first 3 weeks following placement, but may occur at any time. Up to 50% of TIAF bleeds will have a sentinel event, such as bleeding from the site, hemoptysis, or blood seen during suctioning; therefore, any hemorrhage must be considered a TIAF bleed until proven otherwise. Diagnostic options include bronchoscopy, CT angiogram, or local exploration. If a TIAF bleed is suspected, initial efforts to control the bleeding include overinflating the cuff and applying direct pressure over the artery from within the sternal notch. If an uncuffed tracheostomy is present, consider removing the tracheostomy and replacing it with a cuffed endotracheal tube, which can then be overinflated. These efforts should be taken while mobilizing vascular surgery,

interventional radiology, or ENT for definitive control of bleeding.

Urgent Complications

TEFs may manifest as persistent tracheal air leaks, aspiration pneumonia, cough with swallowing, and respiratory distress. Diagnosis is made via endoscopy or esophagram. Tracheal stenosis can occur at any time, but most instances present within 2 months of decannulation. Infections of the tracheostomy site are usually minor, but severe infections such as mediastinitis and necrotizing fasciitis are possible. A tracheocutaneous fistula is diagnosed if stoma track persists for more than 3 to 6 months following decannulation.

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KEY POINTS

- Replacement of a decannulated tracheostomy within the first 7 days should only be attempted under direct visualization.
- A completely obstructed tracheostomy tube must be removed to maintain airway patency.
- Beyond 48 hours, the most critical hemorrhagic complication is the development of a tracheoinnominate fistula (TIAF).
- Even minor bleeds must be considered a sentinel event for impending TIAF until proven otherwise.

Malpractice Risk and Mitigation

By Jillian Dorsam, MD, LCDR, MC, USN;
and Daphne P. Morrison Ponce, MD, LCDR, MC, USN

Naval Medical Center Portsmouth, Virginia

Reviewed by Andrew Eyre, MD, MHPEd

Ferguson, B, Gerald, J, Petrey, J, and Huecker, M. Malpractice in Emergency medicine – A Review of Risk and Mitigation Practices for the Emergency Medicine Provider. *J Emerg Med.* 2018 Nov; 55(5):659-665



Emergency medicine as a specialty is associated with a moderate malpractice risk. Medical decision-making is often driven, at least in part, by emergency physicians' concern for loss of time and money to litigation.

Malpractice risk is often thought to be random and simply associated with years in practice. Although these factors do increase a physician's exposure to claims, review of this data set found trends related to diagnoses, errors, and clinician characteristics. Physicians can mitigate risk through communication, documentation, and discharge follow-up.

Diagnoses

There are both high- and low-risk diagnoses that account for the majority of malpractice claims. Missed acute myocardial infarction, fractures, foreign bodies, and abdominal pain/appendicitis diagnoses are consistently associated with increased litigation incidence.

Error

Failure to document completely (eg, chart family history, decision-making, or reassessments) and poor communication lead to errors. Similarly, crowding and nursing flow can jeopardize clear communication and increase the likelihood of errors. Diagnostic error is difficult to study, but it correlates to supervision, handoffs, and physician training.

Physician Training

Formal emergency medicine training is a significant malpractice risk reducer, whereas a lack of training and reliance on residents confer greater risk. Night shifts are significantly associated with diminished physician performance and

mood. Along those same lines, the latter halves of all shifts are associated with increased errors.

Communication

Communication breakdown seems to be more predictive of malpractice litigation than the injury experienced. Physicians can improve patient satisfaction by increasing the time spent discussing treatment and health education, as well as time spent on physical exam. It is important to recognize feelings of disappointment in the event of a negative outcome.

Documentation

Preformatted charts and speech-to-text tools improve charting and decrease risk. Adherence to clinical practice guidelines — and documentation of clear reasoning for deviating from them — can protect against litigation and aid the physician in legal proceedings. Keeping diagnoses broad in charting allows a physician to recognize the possibility of more serious diagnoses.

Discharge Follow-Up

Physicians must verbally explain pending tests and the importance of follow-up appointments, and then document these discussions. Keeping language on discharge instructions as simple as possible may improve malpractice protection. Patients leaving against medical advice (AMA) represent a high-risk cohort, and the AMA

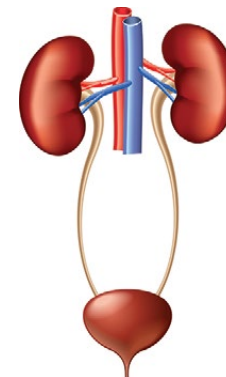
discussion must be clearly documented, including the patient's reasons for leaving, preferably in their own words. Reassessing for clinical sobriety prior to discharge significantly reduces malpractice risk, and finally, scheduled follow-up typically demonstrates reduced diagnostic error. The emergency physician should ensure follow-up is ordered for all diagnostic studies, as pending radiographs are associated with litigation.

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KEY POINTS

- Communication breakdown increases the risk for litigation.
- Missed myocardial infarction, appendicitis, and fracture are consistently associated with litigation.
- Clear communication, complete documentation, use of clinical guidelines, and keeping diagnoses general can help mitigate malpractice risk.

Imaging in Suspected Renal Colic



By Morgan Sehdev, MD; and Andrew Eyre, MD, MSHPEd
Harvard Affiliated Emergency Medicine Residency,
Massachusetts General Hospital/Brigham and Women's Hospital

Moore CL, Carpenter CR, Heilbrun ML, et al. Imaging in suspected renal colic: systematic review of the literature and multispecialty consensus. *Ann Emerg Med.* 2019; 74(3): 391-9.

Over the past two decades, it has become increasingly common for patients who receive the diagnosis of renal colic in the emergency department to undergo CT scanning as a part of their workup. However, rates of admissions, interventions, and other patient-centered metrics remain unchanged despite this increase in CT use. Ultrasonography, an effective imaging modality in the evaluation of renal colic, remains underutilized in comparison to CT scanning.

An extensive literature review on imaging in the diagnosis of renal colic informed a multidisciplinary expert panel seeking consensus on when CT use would and would not be appropriate in the emergency department.

As a part of the review, the authors found the reported evidence for radiology-performed ultrasonography to have a sensitivity of 3% to 98% in the diagnosis of renal colic, depending on the need for direct (stone) or indirect (hydronephrosis) ultrasonographic findings. Ultimately, they determined that radiology-performed ultrasonography was unlikely to miss stones requiring intervention. Point-of-care ultrasound, using presence of hydronephrosis as indirect diagnostic criteria, possessed a sensitivity of 70.2% and specificity of 75.4%. Given that CT was the reference modality, the review highlighted CT's ability to identify other acute, clinically relevant alternate diagnoses, which were determined to be present less than 5% of the time. Finally, the review yielded evidence that no significant difference exists between the initial imaging modality used in renal colic and the time to urologic intervention; and should CT ultimately be the preferred method, reduced-radiation-dose CT is recommended, as it still possesses a sensitivity of 90%-95% and specificity of 97%-99% in detection of renal calculi requiring intervention.

The authors constructed 29 brief clinical vignettes representing common scenarios in which renal colic may be

higher or highest in the differential diagnosis. Representatives from the American College of Emergency Physicians (ACEP), the American College of Radiology (ACR), and the American Urological Association (AUA) used a three-round modified Delphi consensus process with anonymous voting to determine the "optimal diagnostic imaging strategy" for each of the 29 vignettes. Possible options for this "optimal strategy" included (1) no (further) imaging, (2) point-of-care ultrasonography, (3) radiology-performed ultrasonography, (4) reduced-radiation-dose CT, (5) standard CT (noncontrast), and (6) CT with IV contrast.

The group reached at least moderate-level consensus for all vignettes (moderate = 5 out of 9 representatives agree). Perfect (9 out of 9) or excellent (8 out of 9) consensus was obtained for 80% of the vignettes. CT remained the recommended imaging modality in 7 of the 29 scenarios: younger patients (eg, 35 years) when pain is not adequately controlled with sufficient analgesia in a typical presentation with or without a prior history of stones, middle aged patients (eg, 55 years) without a history of stones or with an atypical presentation, all older patients (eg, 75 years) regardless of history. When CT is preferred, CT with a reduced-radiation approach was specifically recommended. For pregnant patients, pediatric patients, patients with prior stones or prior urologic intervention, or younger patients (eg, 35

years) with adequate pain control, ultrasonography, either radiology-performed or point-of-care, was the agreed upon optimal diagnostic modality.

This systematic review and consensus process is the first multi-specialty and evidence-based initiative to delineate a preferred approach to a patient presenting with flank pain and history concerning for renal colic. The consensus achieved by this work may subsequently inform enhanced diagnostic decision-making for patients with renal colic without negatively impacting rates of necessary admission and intervention, while also positively limiting patient exposure to excessive radiation and longer emergency department stays waiting for CT scans.

KEY POINTS

- Increased use of CT scans to diagnose renal stones has not affected patient-centered outcomes.
- Ultrasonography is underutilized in the workup of renal colic.
- Ultrasonography is the preferred diagnostic imaging modality for patients presenting with flank pain suspicious for renal colic if the patient is pregnant, pediatric, or younger (≤ 35 years) with a history of prior stones or typical history with adequate pain control in the ED.
- Low-dose radiation techniques are preferred if CT is being used to workup renal colic in cases of older patients (eg, 75 years), patients with atypical presentations or inadequate pain control, or middle-aged (eg, 55 years) patients without prior stones.