

Emergency Medicine Update

A Case-Based Review of Recent Impactful Literature

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About Me



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Disclosures

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Learning Objectives

1. Recognize and discuss Lyme Disease treatment options in pediatric patients.
2. Analyze risk versus benefit of venous thromboembolism prophylaxis in patients with closed ankle fractures.
3. Provide anticipatory guidance on concussion recovery & treatment.
4. Discuss treatment options in spontaneous pneumothorax.
5. Discuss the efficacy of the PECARN criteria in detecting clinically important traumatic brain injury in pediatric patients.

Topics



Lyme
Disease



Pneumothorax



Ankle
Fractures



Pediatric Head
Trauma



Concussions



Facial Burns

And more...

Case #1

A 5-year-old female presents to the ED in mid-summer in Connecticut with a bullseye rash on her thigh. Parents report she was hiking in the woods about 7 days ago; no attached tick was visualized.

No significant PMH.

Vital signs are all within normal limits. Physical exam with lesion pictured, no focal neuro deficits, normal cardiac & MSK exam.



Which of the following is an appropriate treatment?

- a) Amoxicillin PO x 14 days
- b) Cefuroxime PO x 14 days
- c) Doxycycline PO x 10 days
- d) Any of these

Lyme Disease

- *Ixodes* tick-borne, spirochete infection caused by *Borrelia burgdorferi*
- 3 endemic areas
- Erythema migrans is pathognomonic, however only present in 70-80% of cases
- Other symptoms: disseminated skin lesions, neuropathy, arthritis, cardiac arrhythmias, meningitis

Lyme Disease Prophylaxis & Treatment

- Treatment: antibiotics (doxycycline, amoxicillin, cefuroxime, ceftriaxone, azithromycin)
- Patients <8 years & pregnant or lactating historically not prescribed doxycycline because of risk of staining permanent teeth
- Newer studies do not show this association

Growing consensus that doxycycline is safe in kids

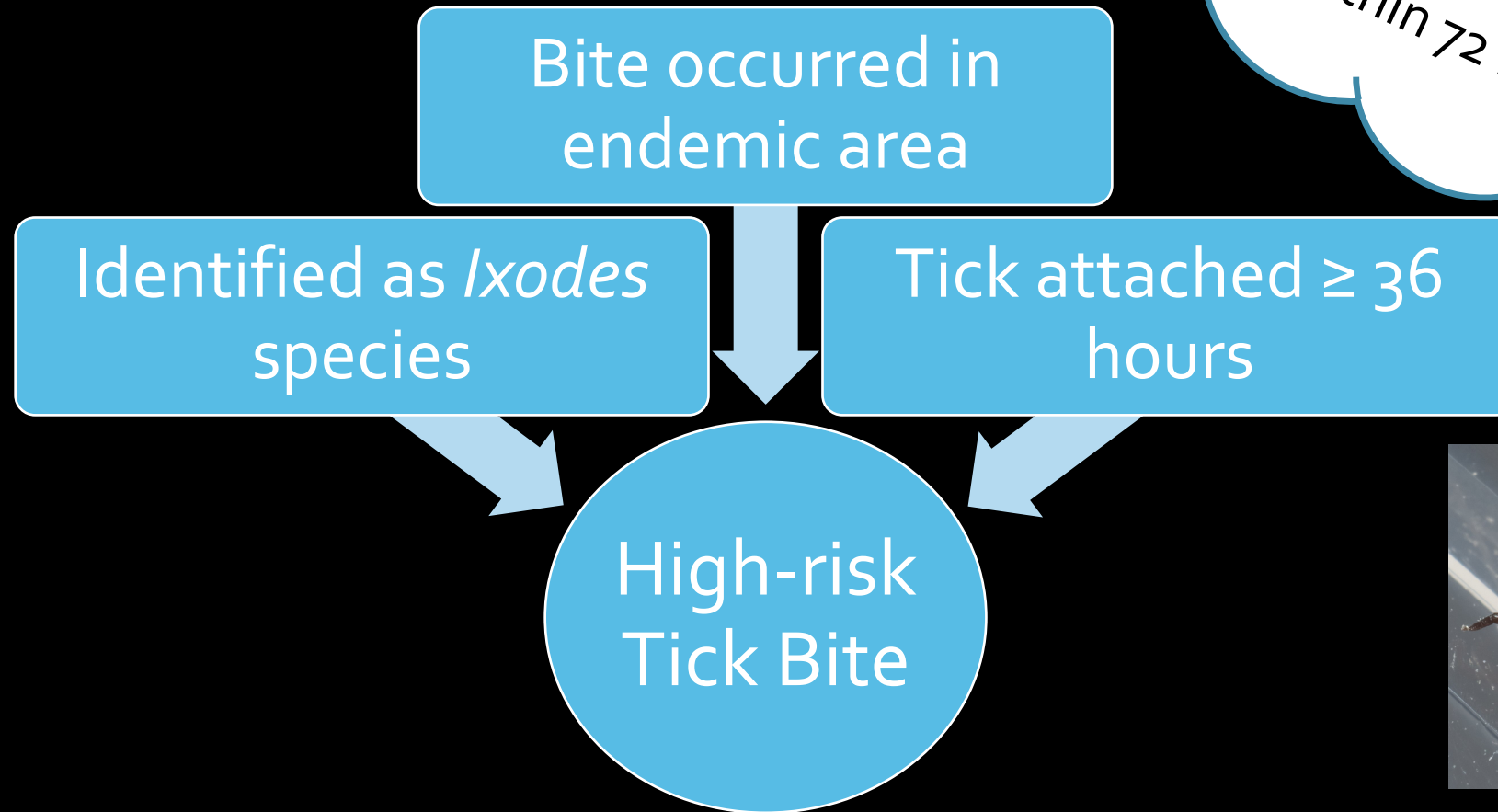
Lyme Disease Guidelines

- Infectious Diseases Society of America (IDSA) released new guidelines in 2020
- Treatment options for prophylaxis & erythema migrans in pediatric patients updated to include doxycycline
- Pediatric doxycycline dose: 4.4 mg/kg PO divided twice daily (max 200 mg/day)

Treatment by Disease Manifestation

Disease Manifestation	Drug	Duration
Erythema migrans	Doxycycline	10 days
	Amoxicillin or cefuroxime	14 days
	Azithromycin	7 days
Meningitis or radiculopathy	Doxycycline	14-21 days
	Ceftriaxone (IV)	14-21 days
Cranial nerve palsy	Doxycycline	14-21 days
Carditis	Doxycycline, amoxicillin or cefuroxime	14-21 days
	Ceftriaxone (IV)	14-21 days
Arthritis (initial tx)	Doxycycline, amoxicillin or cefuroxime	28 days

Lyme Chemoprophylaxis



Must meet all 3 high-risk criteria & have tick removed within 72 hours



Doxycycline PO x 1 – Adults 200mg, Peds 4.4 mg/kg (max 200mg)

Case #1 Takeaways

- Our 5-year-old had erythema migrans
- Reasonable treatment options included doxycycline, amoxicillin & cefuroxime
- Chemoprophylaxis for high risk bites is doxycycline for adults & kids PO x 1 dose
- Doxycycline <14 days likely safe for kids

2020 IDSA guidelines include doxycycline as a reasonable treatment for pediatric patients

Case #2

A 78-year-old female presents to the ED with an ankle injury after a mechanical fall down 3 stairs.

No prior DVT/PE or recent surgery.

The patient has a closed distal fibula fracture. She is neurovascularly intact.

A below-knee, sugar tong splint is applied.



What is the biggest risk factor for venous thromboembolism (VTE) in discharged ED patients with ankle fractures?

- a) Surgery in the previous 90 days
- b) Age over 65
- c) History of VTE or superficial VTE
- d) Pregnancy

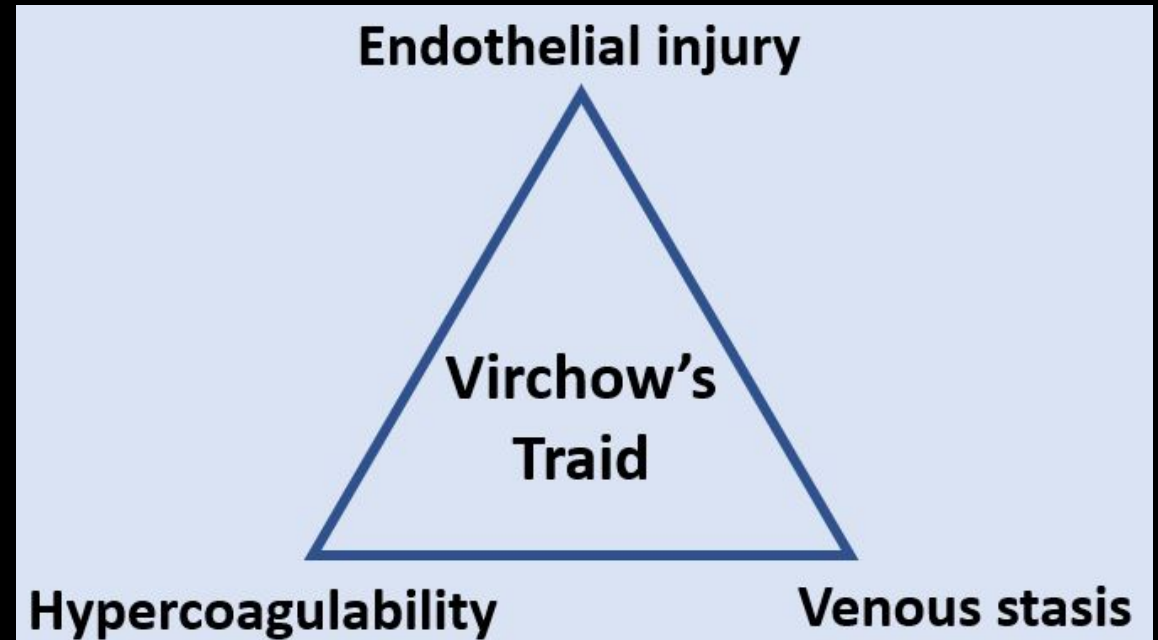
Venous thromboembolism (VTE)

Obstructive disease hindering venous return, most frequently involving lower limbs

Risk factors: Reduced blood flow, venous injury, hypercoagulability

May have history of pain, redness, swelling. Exam may show edema, red/warm skin, tenderness.

Treatment aims to prevent pulmonary embolism, usually with anticoagulation



Venous Thromboembolism in Patients Discharged from the ED with Ankle Fractures

Retrospective cohort study

Propensity score matched to 2 controls (finger wounds and wrist fractures) to compare relative hazard of VTE

90-day incidence of VTE among splinted, discharged ankle fractures was 1.3%

These patients had a 5.7-6.3-fold increased hazard compared to controls

Factors Associated with VTE	Hazard Ratio; 95% Confidence Interval (CI)
Age >65	HR 1.18 95% CI 1.00-1.39
History of VTE or superficial VTE	HR 5.18 95% CI 4.33-6.20
Recent admission	HR 1.33 95% CI 1.05-1.68
Recent non-ankle fracture surgery	HR 1.58 95% CI 1.30-1.93
Subsequent ankle fracture surgery	HR 1.80 95% CI 1.48-2.20

Case #2 Takeaways

Incidence of VTE in this study was overall low, but ankle fractures with immobilization did increase risk

Literature is unclear exactly which patients would benefit from thromboprophylaxis

Our patient was >65 and thus at even higher risk for VTE associated with her splinted ankle fracture

In most patients, risk of thromboprophylaxis outweighs benefit; however, it may be worth considering in patients with prior DVT/PE

VTE should be in the differential diagnosis for splinted ankle-fracture patients returning with leg redness or pain.

Case #3



A 13-year-old female presents to the ED following a head injury sustained in her soccer game today. She bumped heads with another player going for the ball. No LOC; she was pulled from play.

Initial nausea resolved. Current HA & “tired feeling”. No neck pain, vision changes, or gait changes.

VS WNL. Patient seems tired. Bruising/swelling on forehead. Neurologic exam WNL. **You diagnose the patient with a concussion.**

What anticipatory guidance do you provide for sports-related concussion?

- a) Strict bedrest
- b) Mostly rest w/ minimal activity allowed
- c) Subthreshold aerobic exercise
- d) Stretching

Early Subthreshold Aerobic Exercise for Sport-Related Concussion: a RCT

- 103 patients, age 13-18, within 10 days of sports-related concussion
- 20 mins. of: stretching (placebo) vs. subthreshold aerobic exercise on bike or treadmill
- No intervention until at least 48 hours post-injury
- Results:
 - Aerobic exercise asymptomatic at median of 13 days
 - Stretching asymptomatic at median of 17 days
 - $P = 0.009$
 - Lower incidence of delayed recovery in aerobic exercise ($P = 0.08$)

Case #3 Takeaways

- Our patient demonstrated persistent symptoms of concussion with no indication of moderate or severe TBI
- Advised 48 hours of rest followed by 20-mins sub-threshold, low-intensity aerobic exercise

Short duration, low intensity aerobic exercise may hasten sports concussion recovery in adolescents.

Case #4

A 22-year-old male presents to the emergency department with sudden onset dyspnea 20 minutes ago. No hemoptysis or fever. He smokes a pack daily.

RR of 22, SpO₂ 95% on RA, BP 120/80, HR 90

Hyperresonant to percussion with absent breath sounds over the left lung fields.

CXR reveals an approximately 50% left-sided pneumothorax (PTX). The patient has no history of PTX.

Does this patient require procedural intervention to manage his pneumothorax?

- a) Yes – all moderate-to-large pneumothoraxes requires it
- b) Maybe – it can resolve with conservative treatment
- c) No – because of his age and stability, intervention is not needed

Treatment of Spontaneous Pneumothorax

- Spontaneous pneumothorax is common in adults; over 1/3 of cases are primary
- Most common treatment is interventional drainage and chest tube placement
- Chest tube placement is painful & often requires hospitalization
- Adverse effects include organ injury, bleeding, infection, and need for additional surgery

Conservative vs. Interventional Treatment for Spontaneous Pneumothorax

- Open-label, multicenter, noninferiority trial of 316 patients randomized to immediate intervention vs. conservative management group
- Followed up at 1-3 days, 2 weeks, 4 weeks, 8 weeks with a CXR if not previously resolved
- Primary outcome: complete radiographic resolution within 8 weeks
- Numerous secondary outcomes, including adverse events, reoccurrence within 12 months, & patient satisfaction

Conservative vs. Interventional Treatment for Spontaneous Pneumothorax

Outcome	Interventional (N=154)	Conservative (N=162)	Non-inferiority
Resolution within 8 weeks	129 / 131 (98.5%)	118 / 125 (94.4%)	P=0.02
Outcome	Interventional (N=154)	Conservative (N=162)	Hazard Ratio (95% CI)
Radiographic resolution in days (IQR)	16 (12-26)	30 (25-54)	0.49 (0.39 – 0.63)
Outcome	Interventional (N=154)	Conservative (N=162)	Risk Difference (95% CI)
Any adverse event - no. (%)	41 (26.6)	13 (8.0)	18.6 (10.5 – 26.7)
Serious adverse event – no. (%)	19 (12.3)	6 (3.7)	8.6 (2.7 – 14.6)
Recurrence within 12 mos. – no. (%)	25 / 149 (16.8%)	14 / 159 (8.8%)	8.0 (0.5 – 15.4)

Case #4 Takeaways

Patient satisfaction was higher with conservative management.

- Our patient was stable with a moderate size pneumothorax; conservative treatment was an option
- Several limitations; results are modest and statistically fragile

Conservative management of moderate-to-large primary spontaneous pneumothorax may be non-inferior to interventional management

Case #5

An 18-month-old infant presents to the ED after falling off the couch 2 feet onto the floor and hitting his head 1 hour ago.

No LOC. The patient is acting normally, per dad.

Vital signs normal. Patient acting appropriately for age. No neuro deficits. No palpable skull fractures or hematomas.



How do you decide on neuroimaging in these cases?

- a) Clinical gestalt
- b) Clinical prediction rule
- c) Presence of LOC
- d) Image every kid with blunt head trauma

Pediatric Blunt Head Trauma

800,000 children present to ED with blunt head trauma annually in U.S.

Majority of children present with minor head trauma (GCS 14-15)

Of those with minor head trauma who undergo CT, most have no findings

Minimizing radiation exposure and/or risks of sedation is important



What to do? PECARN

PECARN Algorithms for Minor Head Trauma: Risk Stratification Estimates from a Prospective PREDICT Cohort Study

Secondary, prospective, multicenter analysis of
15,163 children with GCS of 14 or 15

Calculated clinically important TBI (ciTBI) rates
for each PECARN risk category

Very Low Risk Groups

- 0% risk of ciTBI in both groups

Intermediate Risk Groups

- Children 2+: All 4 risk factors highest risk (25%); combination of severe mechanism and severe headache 2nd highest (7.7%)
- Children <2: Insufficient data

High Risk Groups

- Children <2: highest risk factor was signs of palpable skull fracture
- Children 2+: greatest risk factor was signs of basilar skull fracture

Case #5 Takeaways

Risk estimates of ciTBI for each PECARN algorithm risk group were consistent with original PECARN study

Our patient was in very-low-risk category; no CT ordered after shared decision making with parent

PECARN algorithm is a helpful clinical decision tool in pediatric blunt head trauma with a GCS of 14-15.

Case #6

A 41-year-old male presents to the ED after a house fire.

HR 130, RR 25, SpO₂ 90% RA. He has singed facial hair, carbonaceous sputum, and hoarseness, but no overt facial burn.

Total body surface area (TBSA) burned 65%.



Which exam finding is most associated with inhalation injury?

- a) Hoarseness
- b) Burned nostril hair
- c) Cough
- d) Shortness of breath
- e) Abnormal chest x-ray

Inhalation injury

Smoke inhalation is common in patients exposed to fires

Damage is due to heat (to level of larynx) and chemical byproducts (airways, alveoli, or both)

Important to elucidate if exposure was due to flames, smoke, and/or chemicals.

Airway can become rapidly edematous, mucous production increases, bleeding is possible

Current guidelines advise endotracheal intubation for facial burn patients & consideration of early intubation for patients with physical exam findings concerning for inhalation injury.

Positive Signs on Physical Exam are Not Always Indications for Endotracheal Tube Intubation in Patients with Facial Burn

Retrospective analysis of 335 facial burn patients with & without intubation in ED

121 patients intubated in ED, including all patients with total body surface area (TBSA) >60% even without signs of inhalation injury

Only 60.3% of patients found to have inhalation injury on bronchoscopy

Independent risk factors for inhalation injury

Shortness of breath (p=0.027)

High TBSA (p=0.001)

Non-predictive risk factors for inhalation injury

Hoarseness

Burned nostril hair

Cough

GCS Score

Laboratory examinations

Abnormal CXR findings

Case #6 Takeaways

Our patient was intubated due to concern for inhalation injury & need for airway protection

Conventional physical exam findings may not predict inhalation injury & need for intubation

Airway protection may be needed in patients with facial burns without inhalation injury

In facial burns, shortness of breath & high TBSA are significant predictors of inhalation injury.

Case #7

A 12-year-old male presents to the ED with suspicion of a wood splinter in his palm.

No visible sign of splinter on exam. Diffuse abrasions present. Patient has mild tenderness to palpation of his thenar eminence.

No neurovascular injury patterns.



What is the best way to identify this potential foreign body?

- a) X-ray
- b) Ultrasound
- c) CT
- d) No identification necessary

Soft Tissue Foreign Bodies (FB)

Very problematic – easily missed & common cause of litigation

Can cause infection, hypersensitivity reactions, severe inflammation

Imaging necessary for suspected FB not identified on exam

Radiopaque vs. radiolucent is not binary

USUALLY Radiopaque

Metal

Gravel / rock

Glass (esp. leaded)

USUALLY Radiolucent

Wood

Plastic

Organic material

Ultrasonography in Soft-tissue FB Detection: a Phantom Study

740 chicken breasts prepared as phantoms (100 as controls)

FB: glass, porcelain, plastic, wood, pencil tip, chicken bone, iron, walnut, fishbone, rose thorn, cactus thorn, staples, pellets

Sensitivity >82.5% for all objects EXCEPT cactus thorn

Specificity > 90% for all objects EXCEPT cactus thorn

As the size of the FB increased, sensitivity increased



Case #7 Takeaways



Cacti & associated thorns are the worst

Surgery consult / exploration indicated for suspected
FB not identified on imaging

We ultrasounded our patient's hand – positive for 2
cm wood splinter, removed at bedside

Ultrasonography is a valuable adjunct to identifying soft
tissue foreign bodies.

A few other important/cool
emergency medicine studies..

Bacteremia From a Presumed Urinary Source in Hospitalized Adults with Asymptomatic Bacteriuria

- Cohort study of 11,590 patients in 68 hospitals admitted with asymptomatic bacteriuria (ASB)
 - Primary outcome: prevalence of bacteremia from a presumed urinary source
 - 72.2% (n=8364) received antimicrobial treatment for UTI
 - 1.4% (n=161) had bacteremia from a presumed urinary source
 - 0.7% (n=17) of patients with AMS and no signs of infection developed bacteremia
- Multivariate analysis: male sex, hypotension, 2+ SIRS criteria, urinary retention, fatigue, log of serum leukocytosis, pyuria were associated with bacteremia
 - No single factor associated with more than 2% risk of bacteremia
 - If 2% or higher risk was a cutoff for empiric antibiotics, 78.4% of antibiotic exposures would have been avoided

Bacteremia from a presumed urinary source is rare in ASB.

Association of Tramadol vs. Codeine Prescription Dispensing with Mortality and Other Adverse Outcomes

Retrospective, population-based, propensity score-matched cohort study

Tramadol vs. codeine new prescriptions on mortality and adverse clinical outcomes in outpatients

New prescription of tramadol was significantly associated with a higher risk of all-cause mortality, cardiovascular events, and fractures compared to codeine

Outcomes (n=368,960 patients; 184,480 propensity matched pairs)		
	Tramadol	Codeine
All-Cause Mortality (per 1,000 person years)	12.86	5.59
Cardiovascular events (per 1,000 person years)	9.97	8.62
Fractures (per 1,000 person years)	12.07	8.08
Risk of Falls	No significant difference	
Delirium	No significant difference	
Constipation	No significant difference	
Opioid Abuse / Dependence	No significant difference	
Sleep Disorders	No significant difference	

Early Restrictive or Liberal Fluid Management for Sepsis-Induced Hypotension (CLOVERS trial)

Multicenter unblinded superiority trial of restrictive fluids vs. liberal fluids for 24 hours

Restrictive fluid group = more vasopressors
Liberal fluid group = fluids before vasopressors

Randomization occurred within 4 hours after patients met criteria for sepsis-induced hypotension

Primary outcome: death before discharge home by day 90



Early Restrictive or Liberal Fluid Management for Sepsis-Induced Hypotension (CLOVERS trial)

Death before d/c home by 90 days:

Restrictive 109 (14%)

Liberal 116 (14.9%)

P=0.62

Similar adverse events between groups

Restrictive fluid strategy did not result in significantly lower or higher mortality than liberal fluid strategy

Baseline Patient Characteristics & Intervention Data		
	Restrictive (N=782)	Liberal (N=781)
Age	59.1 (±16.0)	59.9 (±15.9)
SOFA Score	3.4±2.8	3.5±2.7
Systolic BP mm Hg	93.2±12.0	93.8±12.2
Median volume of IVF given before randomization	2050 (1500-2457)	2050 (1371-2442)
% of patients receiving vasopressors before randomization	21%	18%
Median IVF given during 1 st 6 hours post-randomization	500 mL	2300 mL
Cumulative median IVF given in 24 hours post-randomization	1267 mL	3400 mL
% of patients receiving vasopressors after randomization	59%	27%

Utility of Serum Lactate on Differential Diagnosis of Seizure-like Activity: a Systematic Review & Meta-analysis

Transient loss of consciousness (TLOC) presents frequently to the ED; etiology is often unclear

Primary outcome: serum lactate level difference between a patient with generalized tonic-clonic seizures (GTCS) vs. other forms of TLOC

Eight studies, 1,348 total patients

Serum lactate levels in GTCS significantly higher than TLOC from any other cause ($p=0.004$)

Serum lactate level ≥ 2.4 mmol/L (normal 0.5-2.2 mmol/L) allowed differentiation between GTCS and non-GTCS & can be a valuable differentiating tool but not used for definitive diagnosis

Serum lactate likely to remain elevated for 2 hours post-GTCS

Key Points

- Current IDSA guidelines include doxycycline as a reasonable treatment for pediatric patients
- VTE should be in the differential diagnosis for splinted ankle-fracture patients returning with leg redness or pain
- Short duration, low intensity aerobic exercise may hasten sports concussion recovery in adolescents
- Conservative management of moderate-to-large primary spontaneous pneumothorax may be non-inferior to interventional management
- The PECARN algorithm is a helpful clinical decision tool in pediatric blunt head trauma with a GCS of 14-15
- In facial burns, shortness of breath & high TBSA are significant predictors of inhalation injury
- Ultrasonography is a valuable adjunct to identifying soft tissue foreign bodies

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