Emergency Medicine Update

A Case-Based Review of Recent Impactful Literature

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Disclosures

- None

Learning Objectives

1. Consider the YEARS algorithm to make imaging decisions in cases of potential pulmonary embolism in pregnancy.
2. Provide anticipatory guidance on the use of adult tourniquets in pediatric patients.
3. Appraise the utility of qSOFA score in predicting sepsis.
4. Outline the role of tranexamic acid in acute traumatic brain injury.
5. Discuss treatment options in spontaneous pneumothorax.

Case #1

A 30-year-old female with no significant PMH presents to the emergency department with dyspnea x 3 hours. She noticed her right calf has been swollen since yesterday, though not red or painful. The patient is G1P0 and is currently 15 weeks pregnant. No fever, cough, or hemoptysis. PE assumed most likely diagnosis.

No smoking history, no FH of CAD or PE

Takes prenatal vitamins

Vital signs: HR 110, RR 22, SpO_2 95% on RA, BP & temp normal

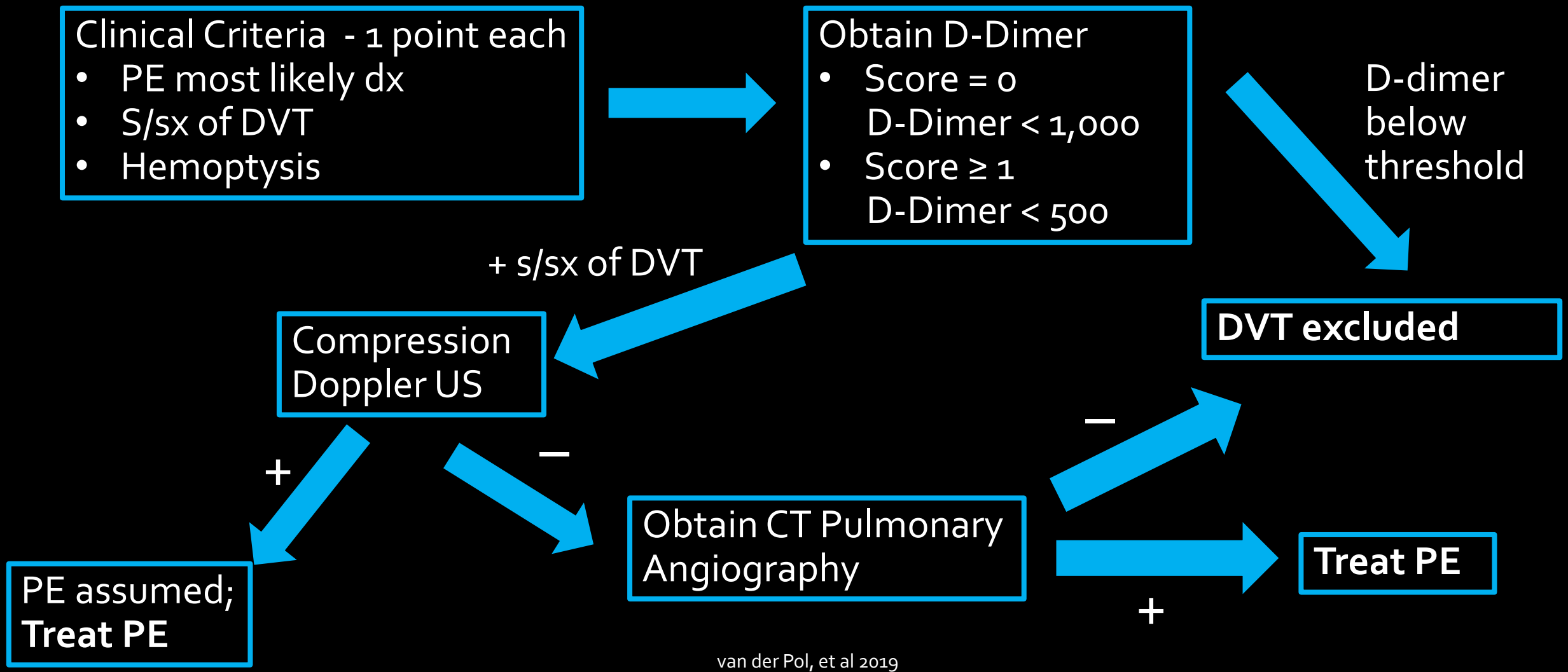
The YEARS Algorithm

- Clinical prediction rule to exclude pulmonary embolism (PE), use in pregnancy originally studied in Artemis trial
- Until recently, Wells Score & Geneva Criteria not validated in pregnancy
- Uses 3 most common clinical symptoms in combination with D-Dimer
- Adapted to include venous Doppler US if signs/symptoms of DVT present

YEARS Criteria
Hemoptysis
Signs/symptoms of DVT
PE is most likely diagnosis
D-Dimer

van der Pol, et al 2019

YEARS Algorithm for PE in Pregnancy



van der Pol, et al 2019

YEARS Algorithm Validation

- Retrospective, ad-hoc analysis of 371 outpatient pregnant females at 11 centers
- 6.5% had PE; YEARS algorithm missed 0 PE (95% CI 0-3.9)
- 21% of participants would have *avoided* radiation if YEARS algorithm applied
- Results consistent with Artemis trial

Langlois E, et al 2019

Case #1 Takeaways

- Our patient had a score of 2
  - Signs & symptoms of DVT (+1)
  - PE most likely diagnosis (+1)
- Underwent Doppler venous US, which was +
- Treated for suspected PE

Consider YEARS algorithm to reduce radiation exposure in pregnant women with possible PE

van der Pol, et al 2019
Langlois E, et al 2019

Case #2

A 10-year-old female presents to the emergency department with a gunshot to the right thigh by private vehicle. She being carried by an adult, and there is a clear arterial bleed from her right femoral artery. The patient is alert and hysterical. She is immediately brought back to the trauma bay. Airway and breathing is unaffected.

BP is 80/ 50, HR is 125

Combat Application Tourniquet (CAT)

- Used & carried by U.S. Military
- Success in limb hemorrhage control in adults well established
- Distributed as part of the Stop the Bleed civilian hemorrhage control training programs & in emergency bleeding response kits

Harcke et al, 2019
Kelly et al, 2020
Image: https://commons.wikimedia.org/wiki/File:Tourniquet.jpeg

Adult Tourniquet for Use in School Age & Young Children: 2 Prospective Studies

60 children, age 6-16 years

- CAT applied to mid-upper arm & mid thigh; no more than 3 windlass turns
- Pulse monitored by Doppler
- Occlusion achieved in 100% of upper extremities, 93% of lower extremities (56 of 60)
- Patients with insufficient tourniquet were older and had a BMI >30; 3 windlass turns likely insufficient

13 children, age 2-7 years

- CAT applied to most proximal part of limb while under general anesthesia for outpatient orthopedic surgery
- Pulse monitored by Doppler until absent or until CAT as tight as would allow
- 11 arms and 13 legs tested
- Arterial occlusion achieved in 100% of limbs (95% CI, 85.8-100%)

Harcke et al, 2019
Kelly et al, 2020

CAT Application Strategies in Children

- Correct initial placement should be tight enough to not allow fingers underneath the tourniquet before tightening
- Flexing the base plate into a concave configuration at application may facilitate snug fit in small circumferences
- Direct placement on skin is preferable, but still effective over light clothing
- More than 3 windlass turns may be required in a true emergency to stop hemorrhage

Harcke et al, 2019

Case #2 Takeaways

- CAT successfully applied during ER resuscitation with good control of hemorrhage; patient survived injuries
- Pre-hospital personnel, first responders, ED clinicians & pediatricians can all benefit from CAT application knowledge

The adult CAT can be used for limb hemorrhage control in children

Case #3

A 75-year-old male with a PMH of type II diabetes presents to the emergency room with general weakness x 2 days. He is alert but confused. He denies fever.

HR of 110, BP of 140/90, RR of 20, temp 99.0 F, and SpO2 99% RA. Extensive physical exam is without focal abnormalities, aside from confusion & GCS of 14. Alert to person and place but not time or situation. Head CT returns negative. UA & CXR are negative. WBC of 13,000 (4,500-11,000) , lactic acid is 1.3 (<2 mg/dL), & CRP is 18 (<10 mg/L). Blood cultures are pending.

He is admitted for altered mental status. The next day he becomes hypotensive and tachycardic, and the following day blood cultures return positive for gram+ cocci.

Potential Sepsis Screening Options

SIRS Criteria (2 or more is positive)
Temperature >38.0°C *or* <36.0°C
Pulse >90 beats/minute
Respirations >20 breaths/minute
WBC >12,000 *or* WBC <4,000

Quick Sequential Organ Failure Assessment (qSOFA) (2 or more is positive)
Systolic blood pressure ≤ 100
Respirations ≥ 22 breaths/minute
Glasgow Coma Scale < 15

Bone et al, 1992
Seymour et al, 2016
Anand et al, 2019

qSOFA Criteria in Undifferentiated Patients & Association With Suspected Infection & Sepsis

- Retrospective analysis of 1,004, 347 hospitalized patients, age ≥ 20 at 85 US hospitals with ≥ 2 qSOFA criteria within 1 day of admission
- 27% qSOFA positive at admission
- Sensitivities of qSOFA :
  - Suspected infection 41.3% (95% CI, 41.1%-41.5%)
  - Sepsis 62.8% (95% CI, 62.4%-63.1%)
- Conclusion: 1 in 3 patients who are qSOFA positive on admission has suspected infection; 1 in 6 has sepsis. Low sensitivity for identifying suspected infection & sepsis.

Anand et al, 2019

Case #3 Takeaways

- Our patient would have been missed by qSOFA
- Sepsis-3 shows qSOFA has improved prognostic value over SIRS for sepsis screening with known infection
- qSOFA has poor sensitivity in detecting suspected infection and sepsis in undifferentiated patients; it is a general marker of severe illness & impending deterioration

qSOFA is not be reliable to screen for suspected infection or sepsis in undifferentiated patients

Seymour et al, 2016
Anand et al, 2019

Case #4

A 50-year-old male presents to the ED unconscious after a large chunk of ice slid off the roof and hit him in the head 1 hour ago.

He has a GCS of 11 (Eye 3, Verbal 4, Motor 4); pupils are equal and bilaterally reactive to light. ATLS protocol is initiated, and he is stabilized.

CT reveals a 3 mm subdural hematoma without midline shift.

Background on Tranexamic Acid (TXA) in Trauma

- TXA reduces bleeding by inhibiting the breakdown of fibrin blood clots
- CRASH-2 trial (2010) showed TXA administered within 3 hours in patients with major extracranial bleeding significantly reduced mortality
- TXA subsequently included in guidelines for pre-hospital trauma, but isolated traumatic brain injury (TBI) excluded

Shakur et al, 2010
CRASH-3 Trial Collaborators, 2019

Effects of TXA in Patients with Acute Traumatic Brain Injury (CRASH-3)

- Randomized, placebo-controlled trial of 12,737 patients with TBI
- Primary outcome was head injury-related death in hospital within 28 days in patients treated within 3 hours of injury
- Mortality rates
  - All patients: 18.5% TXA vs. 19.8% placebo (RR 0.94)
  - Excluding GCS 3 or nonreactive pupils: 12.5% TXA vs. 14.0% placebo (RR 0.89)
  - TXA reduced mortality in mild-moderate head injury (RR 0.78) but not severe head injury (RR 0.99)
- Early treatment more effective than later treatment in mild-moderate injury (p=0.005)
- Conclusion: TXA is safe in TBI and treatment within 3 hours reduces head injury-related mortality.

CRASH-3 Trial Collaborators, 2019

Case #4 Takeaways

- Our patient received TXA as it was able to be administered within 3 hours of trauma
- He was admitted to the neuro ICU and subsequently discharged home, with a GCS of 15, two weeks later

TXA should be given within 3 hours, and as soon as possible, to trauma patients with a TBI or known intracranial hemorrhage

CRASH-3 Trial Collaborators, 2019

Case #5

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.

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

Brown et al, 2020

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

Brown et al, 2020

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)

Brown et al, 2020

Case #5 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 #6

A 23-year-old male is brought by EMS to the ED in cardiac arrest with asystole following possible illicit drug use. Bystander CPR was started immediately after the patient collapsed.

In the emergency department, return of systemic circulation (ROSC) was achieved using ALS protocol, however the patient remains comatose (GCS of 5). He is pending ICU admission.

Therapeutic Hypothermia (TH)

- 2015 International Liaison Committee on Resuscitation (ILCOR) guidelines advises TH at 32 ^{0} F – 36 ^{0} F for 24 hours in all patients with coma post-resuscitation from cardiac arrest
- Prior trials with inconclusive results in patients with cardiac arrest with a non-shockable rhythm, leading to decreased use of TH
- Nonshockable rhythms predominate among patients with cardiac arrest & are associated with poor neurologic outcome

Lascarrou et al, 2019

Targeted Temperature Management for Cardiac Arrest with Nonshockable Rhythm

- Open-label, RCT of 581 patients at 25 hospital ICUs
- Experimental group had TH of 33⁰ F for 24 hours before rewarming; control group had targeted normothermia of 37 ⁰ F for 48 hours
- Primary outcome: survival with a favorable neurologic outcome at day 90
  - Cerebral Performance Category (CPC) scale of 1 (no or mild disability) or 2 (moderate disability)
- Results (% alive with a CPC score of 1 or 2)
  - TH: 10.2%
  - Normothermia: 5.7%
  - P=0.04
- Adverse events & mortality did not differ significantly between groups

Lascarrou et al, 2019

Case #6 Takeaways

- Our patient underwent TH at 33^{0}C for 24 hours wand was rewarmed over the next 24 hours
- At 90 days, he was alive with moderate disability
- During his hospitalization, it was arranged for him to see addiction specialist upon discharge from skilled nursing facility

Initiate moderate therapeutic hypothermia (33^{0}C) for 24 hours in patients resuscitated from cardiac arrest with a non-shockable rhythm

Lascarrou et al, 2019

A few other interesting emergency medicine studies…

Standard (S-CPR) vs. Compression Only (CO-CPR) CPR in Out of Hospital Cardiac Arrest

- Swedish study of 3 time periods following ILCOR guideline changes
- CO-CPR deemed acceptable option in 2010

	2000 – 2005	2006 – 2010	2011 – 2017
Patients receiving S-CPR	35.4%	44.8%	38.1%
Patients receiving CO-CPR	5.4%	14%	30.1%
Patients receiving CPR	40.8%	58.8%	68.2%

Riva et al, 2019

Standard (S-CPR) vs. Compression Only (CO-CPR) CPR in Out of Hospital Cardiac Arrest

	2000 – 2005	2006 – 2010	2011 – 2017	Adjusted Odds Ratio
30 day survival: S-CPR	9.4%	12.5%	16.2%	2.6
30-day survival: CO-CPR	8.0%	11.5%	14.3%	2.0
30-day survival: no CPR	3.9%	6.0%	7.1%	

- Conclusions:
  - Higher rate of CPR before EMS arrival over time
  - Any type of CPR better than no CPR

CO-CPR is acceptable in out-of-hospital cardiac arrest

Riva et al, 2019

Artificial Intelligence (AI) to Detect Papilledema from Ocular Fundus Photographs

- 14,341 retrospectively analyzed dilated ocular fundus photographs from 6,779 patients in 11 countries
- AI had sensitivity of 96.4% (95% CI, 93.9 to 98.3) & specificity of 84.7% (95% CI, 82.3 to 87.1)

AI can discriminate among normal optic discs, discs with papilledema, & discs with other abnormalities

Milea et al, 2020

Key Points

- Consider YEARS algorithm for suspected PE in pregnancy
- Adult Combat Application Tourniquets can be used in pediatric patients with life-threatening limb hemorrhage
- qSOFA is not a reliable screening tool for suspected infection or sepsis in undifferentiated patients
- Therapeutic hypothermia should be initiated in resuscitated patients with nonshockable rhythms
- CPR, both standard and compression-only, is better for survival than no CPR

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