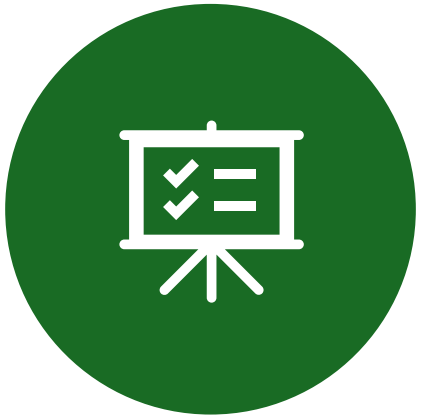
Welcome Everyone

Program Agenda: December 12th 2024

1:00pm – 2:00pm EST (US & Canada)

SPEAKER INTRODUCTION



SPEAKER PRESENTATION

Q&A WITH SPEAKER

Key Learning Objectives:

Content Reviewed: Advanced

Provide an overview of POCT in the transport environment

Demonstrate the importance and clinical utility of POCT in the transport environment

Identify pediatric-specific clinical scenarios in which POCT makes an impact in clinical decision-making

Develop a pragmatic mindset when approaching and performing POCT in dynamic, resource-poor environments

Meet Today's Speaker...

- **Tim McLaughlin** is a registered nurse at Metro Life Flight in Northeast Ohio as part of the MetroHealth System. With over a decade of work in critical care transport, he has extensive experience with neonatal, pediatric, and adult populations. He received his BSN from Kent State University and has board certifications as a CFRN and CEN. Tim has also served as a critical care transport consultant for several foreign governments, including the Kingdom of Saudi Arabia and the State of Israel. Tim is a proud husband and father of two.

- Registered Nurse
- Bachelor of Science Nursing
- Certified Emergency Nurse
- Certified Flight Nurse
- Continuing education instructor
- Emergency Medical Technician
- Flight Nurse Specialist, RN, BSN, CEN, CFRN, CE-I, EMT

Disclosures

The content of my presentation is based on my professional experiences and personal viewpoints. Siemens Healthineers is the sponsor for this webinar; however, the opinions and insights I share are my own and do not necessarily represent those of Siemens Healthineers without any commercially biased data. Any references to technologies are intended for educational purposes and not as endorsements. Webinar attendees are encouraged to evaluate the information critically and independently in the context of their clinical practices.

What do all these areas have in common?

Kids don’t often get sick or hurt next to a quaternary pediatric facility

43% of U.S. children live within an hour of a pediatric trauma center[1]

Transporting a child to a pediatric center can extend time to definitive care[2]

1. Glass NE, Salvi A, Wei R, et al. Association of Transport Time, Proximity, and Emergency Department Pediatric Readiness With Pediatric Survival at US Trauma Centers. JAMA Surg. 2023;158(10):1078–1087. doi:10.1001/jamasurg.2023.3344
2. 2. Brantley MD, Lu H, Barfield WD, Holt JB, Williams A. Mapping US Pediatric Hospitals and Subspecialty Critical Care for Public Health Preparedness and Disaster Response, 2008. Disaster Medicine and Public Health Preparedness. 2012;6(2):117-125. doi:10.1001/dmp.2012.28

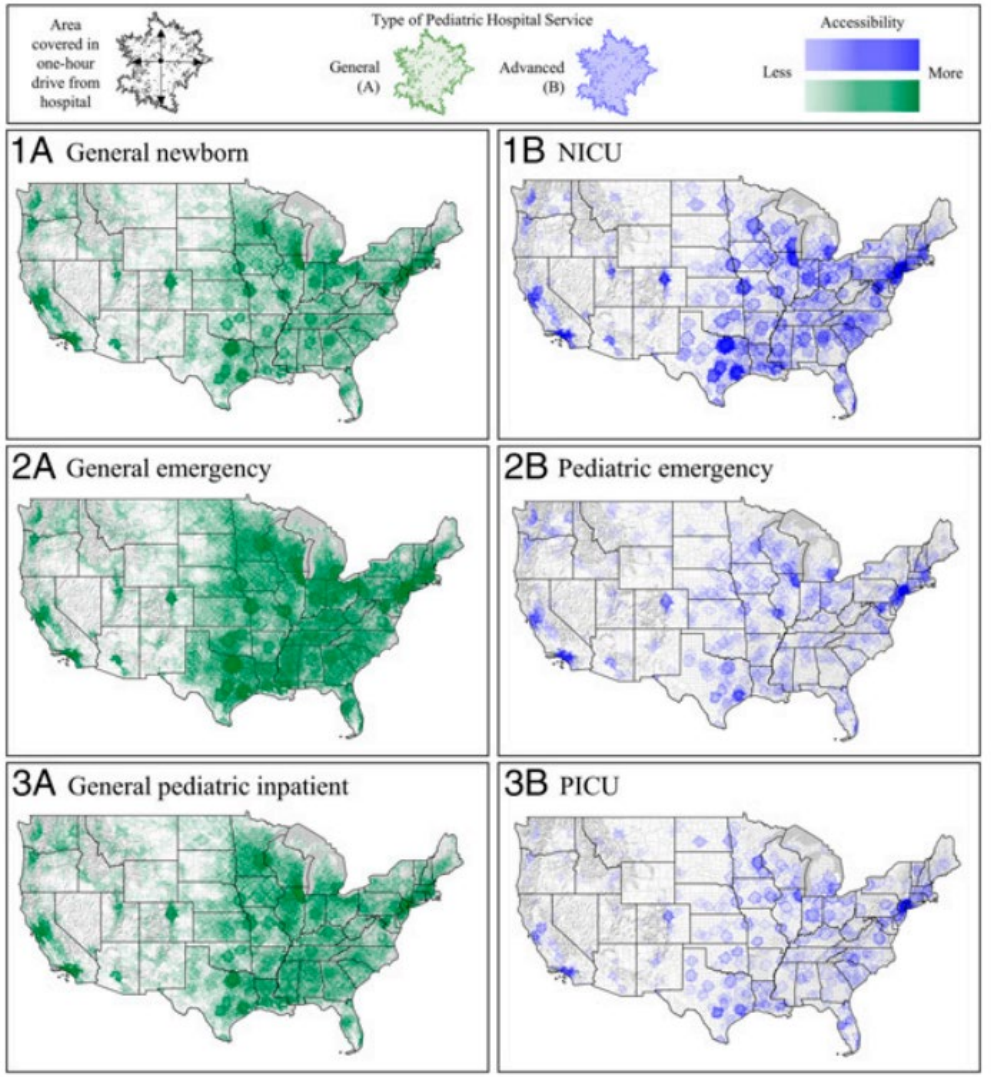
39.6% of U.S. counties are within a one-hour drive of a pediatric emergency department[1]

36.1% are within a one-hour drive of a PICU[1]

1. Brantley MD, Lu H, Barfield WD, Holt JB, Williams A. Mapping US Pediatric Hospitals and Subspecialty Critical Care for Public Health Preparedness and Disaster Response, 2008. Disaster Medicine and Public Health Preparedness. 2012;6(2):117-125. doi:10.1001/dmp.2012.28

Where are the hospitals?

- Pediatric medical resources are not evenly distributed and can be overwhelmed quickly[1]
- Often pediatric patients enter through a general acute care facility that generally doesn't have PICU/NICU services[1]
- Rural counties have on average 1 bed per 100,000 pediatric-aged population that can be used for general peds inpatient and/or PICU[1]
- Thus, the number decreases to 0.4 beds per 100,000 pediatric-aged population for pediatric hospital PICU bed[1]



1. Brantley MD, Lu H, Barfield WD, Holt JB, Williams A. Mapping US Pediatric Hospitals and Subspecialty Critical Care for Public Health Preparedness and Disaster Response, 2008. Disaster Medicine and Public Health Preparedness. 2012;6(2):117-125. doi:10.1001/dmp.2012.28

Where are the kids?

Rural children often have more complex and chronic medical problems and live in areas with limited pediatric health care resources[1]

Often come from low-income families[1]

Have frequent admissions and higher cost of hospital stay[1]

1. Peltz A, Wu CL, White ML, Wilson KM, Lorch SA, Thurm C, Hall M, Berry JG. Characteristics of Rural Children Admitted to Pediatric Hospitals. Pediatrics. 2016 May;137(5):e20153156. doi: 10.1542/peds.2015-3156. Epub 2016 Apr 11. PMID: 27244794; PMCID: PMC4845869.

How do we get children to the definitive care they need?

Critical care transport teams

- Often consist of critical care RNs, critical care Paramedics, respiratory therapists
- Modes of transport: ground (ambulance), helicopter, fixed-wing
- Maintain highly specialized skillsets

CCT capabilities

- Endotracheal intubation
- Chest tube insertion
- Mechanical ventilation
- Medication administration
- Mechanical cardiovascular support
- Administration of blood products

CCT limitations

- Space-vehicle
- Space-equipment
- Resource-personnel
- Resource-equipment
- Environment-dynamic

Why Point of Care Testing?

We need to make decisions

Additional information is sometimes needed to make appropriate decisions

Pediatric patients often can't or won't communicate information

POCT may provide additional insight to correlate with clinical assessment to help guide decision making

Common Use Cases

DKA

Sepsis

Respiratory Disorders

Electrolyte Disturbances

Ingestions

Trauma

Today, you’re a critical care transport crew member...

Case 1: Too sweet

Case 1

- 8-year-old, 20kg female presents to a rural ED complaining of abdominal pain, increased urination, and nausea/vomiting worsening over past two days
- She is lethargic but alert and oriented x 4
- Mother says she has had poor appetite for several days and multiple episodes of emesis today
- Urine output has been increased over past 24 hours
- Vitals:
  - HR 131, RR 34, SpO2 96%, BP 105/67, T 36.7

Time to go!

You arrive

Patient is more lethargic, GCS[1] 13 (E3V4M6)

She was complaining of headache prior to onset of confusion

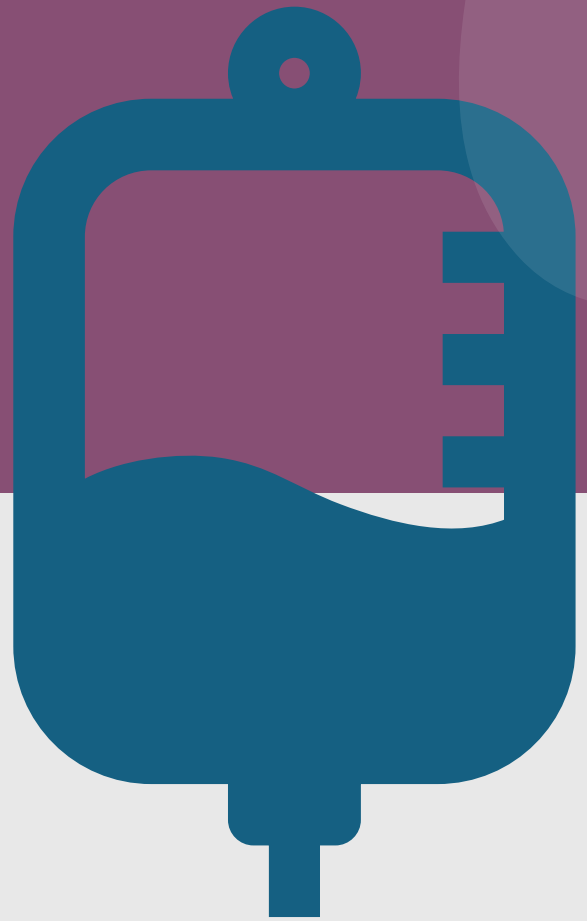
Mother states she is “worried something bad is going to happen to my daughter”

Vitals: HR 91, RR 24, SpO2 95%, BP 140/86, T 36.7° C

Reference 1: https://www.mdcalc.com/calc/3702/pediatric-glasgow-coma-scale-pgcs

PTA interventions*

- NS bolus 60 mL/kg (patient initially hypotensive)
- Insulin bolus 0.1 unit/kg
- Insulin infusion 0.1 unit/kg/hr
- NS at 100 mL/hr



* Treatment algorithms outlined are examples for use and are not suggested preferred treatment algorithms.

Rural Hospital laboratories

Drawn 2 hours ago

Chemistry

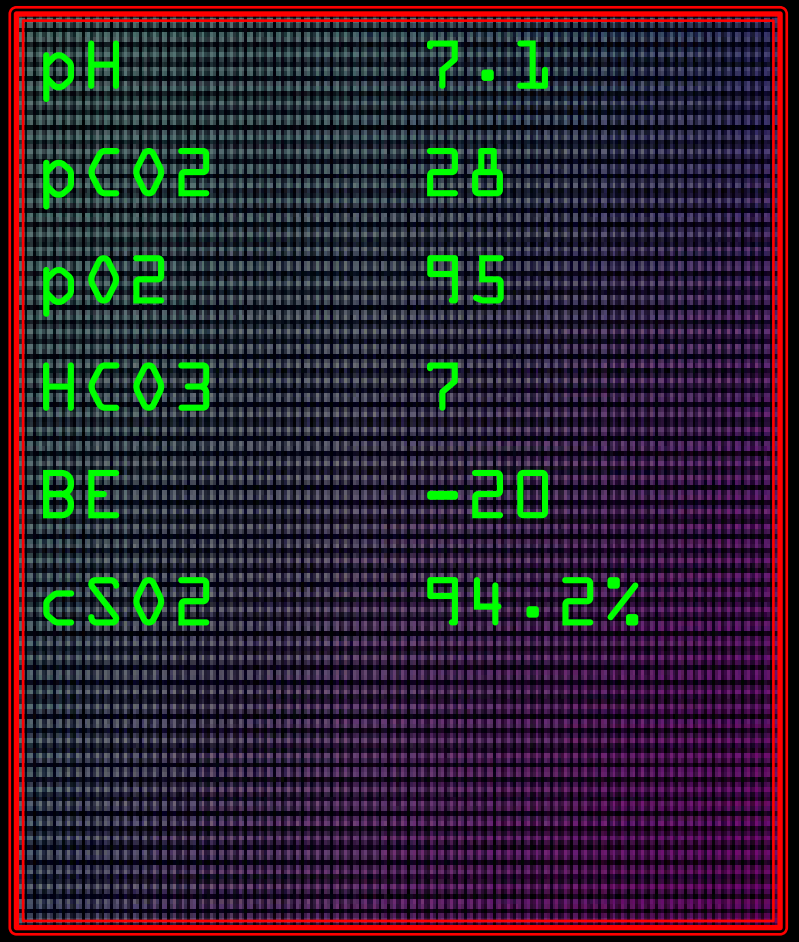
Sodium	122
Potassium	5.6
Chloride	87
Carbon dioxide	7
BUN	50
Creatinine	0.9
Calcium	8.9
Glucose	694

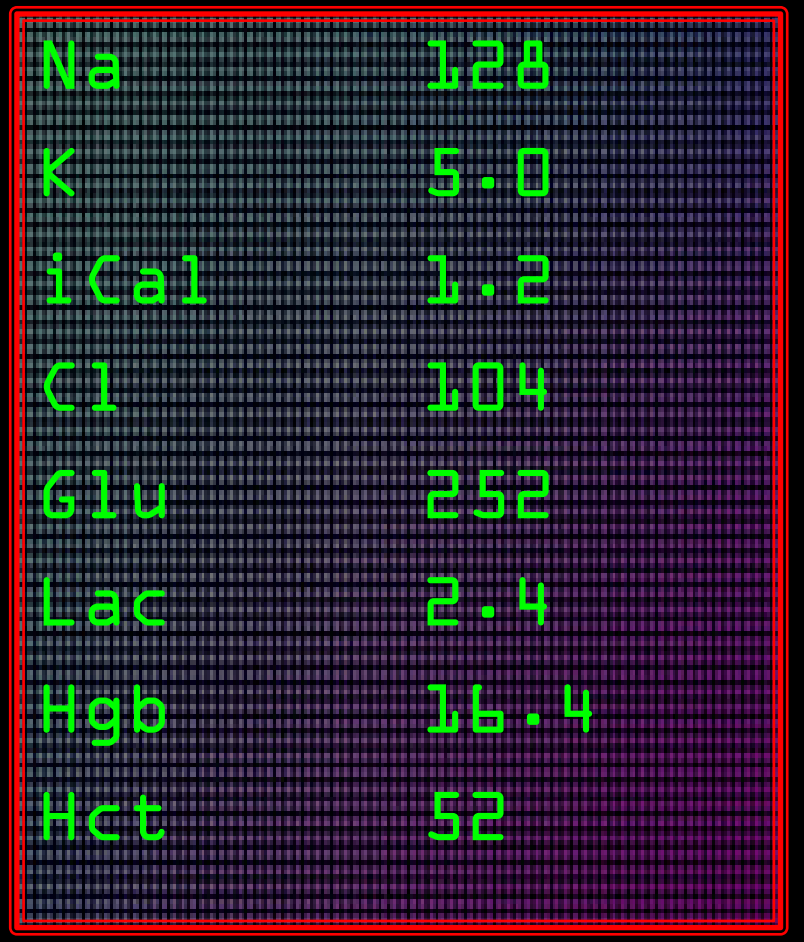
Blood gas

pH	7.05
pCO2	25
paO2	94
HCO3	6
BE	-18
sO2 %	95.4

Lactate 2.6

POC Analyzer





Concerns

Glucose drop of almost 450 mg/dL in two hours	Fluid/osmotic shifts
Potassium	Relative hypokalemia due to insulin resistance
Sodium	Must be corrected (1.6 mEq/L for every 100 mg/dL glucose over 100[1])
BE not decreasing	Possible hyperchloremia Strong ion difference/Strong ion gap

1. E. Lars Penne, Stephan Thijssen, Jochen G. Raimann, Nathan W. Levin, Peter Kotanko; Correction of Serum Sodium for Glucose Concentration in Hemodialysis Patients With Poor Glucose Control. Diabetes Care 1 July 2010; 33 (7): e91. https://doi.org/10.2337/dc10-0557

What is your plan of care?*

Two bag system initiated

D10NS c 40 mEq KCl

NS c 40 mEq KCl

Maintenance: 1.5x normal maintenance rate

- 4:2:1 rule—20kg = 60mL/hr * 1.5 = 90mL/hr

3% NaCl administration

3-5 mL/kg over 10 min

Recheck glucose in 30 min, repeat POC panel in 60 min

* Treatment algorithms outlined are examples for use and are not suggested preferred treatment algorithms.

Outcomes

- Patient mental status improved slightly in PICU
- Her DKA resolved over two days
- She received diabetes education for new onset type I diabetes
- She was discharged home with care management plan

Learning Points

DKA patients may have a relative hypokalemia even if serum measurements are normal or elevated[1]

Sodium measurements must be corrected according to degree of hypoglycemia[1]

Rapid decreases in serum glucose can cause fluid shifts resulting in cerebral edema[2]

POCT aided the crew in this case to intervene before the patient deteriorated further and potentially avoided a catastrophic scenario

1. EL-Mohandes N, Yee G, Bhutta BS, et al. Pediatric Diabetic Ketoacidosis. [Updated 2023 Aug 21]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470282/
2. Namatame K, Igarashi Y, Nakae R, Suzuki G, Shiota K, Miyake N, et al. Cerebral edema associated with diabetic ketoacidosis: Two case reports. *Acute Med Surg*. 2023; 10:e860. https://doi.org/10.1002/ams2.860

Case 2: Jack Fell Down...

Case 2

- 10-year-old 60kg male was riding his dirt bike and fell over the handlebars. He was unhelmeted and had no loss of consciousness. He presented to the community hospital ED with chest and abdominal pain, left arm deformity, occipital scalp laceration, and abrasions/bruising to the left arm, left leg, and left hip
- CT imaging of the brain, c-spine, and abdomen was negative for acute injury. Left arm x-ray showed displaced left radius and ulna fracture
- He is being transferred to the Level I pediatric trauma center for further evaluation
- Vital signs: HR 115, RR 24, SpO2 95% RA, BP 132/84, T 36.5° C


METRO
LIFE FLIGHT
Metro Life Flight

You arrive...

The patient is alert and oriented complaining of abdominal and chest/left arm and shoulder pain.

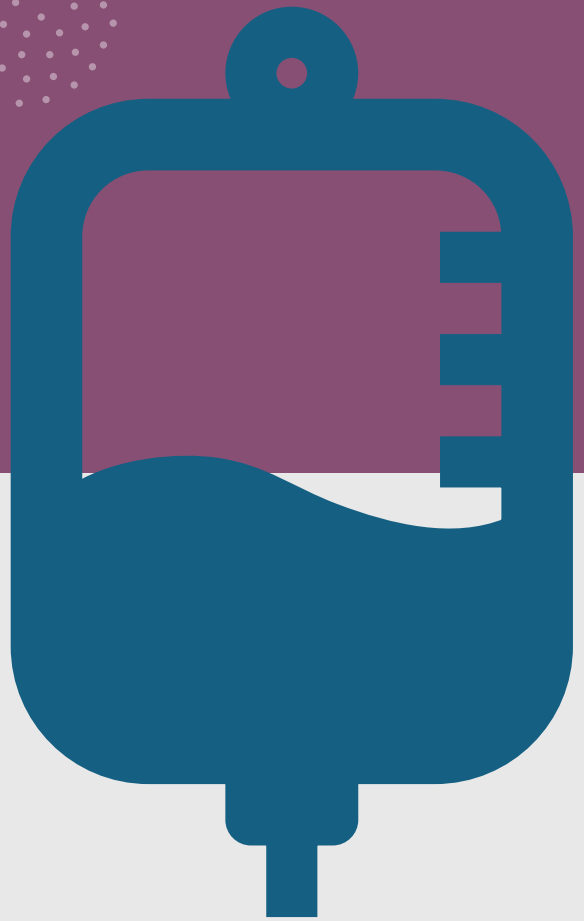
His left arm is splinted

He is talkative but states his pain is getting worse

Vital signs: HR 121, RR 28, SpO2 94%, BP 110/54, T 37.9° C

PTA interventions[1]

- Morphine 4 mg IVP
- 20 mL/kg NS bolus



Reference 1: https://www.med.unc.edu/pediatrics/cccp/wp-content/uploads/sites/1156/gravity_forms/1-188e5632d99d8f770a150fd48b72fb22/2021/02/Pediatric-Medication-Dosing-Guildelines.pdf

What's your plan of care?

- **Remains tachycardic—treat pain and monitor for shock**
- **Transport patient to the trauma center**

En route…

While en route, the patient begins to feel more nauseated and notes worsening pain

HR 133, BP 101/60, SpO2 94%, cap refill 5 seconds

His mother who is riding with you notes he “looks worse”

Prior to arrival labs
(2 hr ago)

POC analyzer (VBG)

Concerns

Increasing HR	Patient’s tachycardia hasn’t resolved after analgesia
Decrease in Hgb	Suggests hemorrhage
Lactic acidosis	Indicates possible tissue hypoxia secondary to hemorrhage
Hypocalcemia	Possibly from developing hemorrhage

What’s your plan of care?

- The patient had unresolved tachycardia after multiple doses of analgesia
- The crew discussed clinical presentation and mechanism of injury with corresponding drop in hemoglobin
- Age-adjusted shock index = 1.32
- Decision to administer blood product due to concern for hemorrhagic shock
- LP transfusion 10mL/kg
- Administration of TXA 15mg/kg

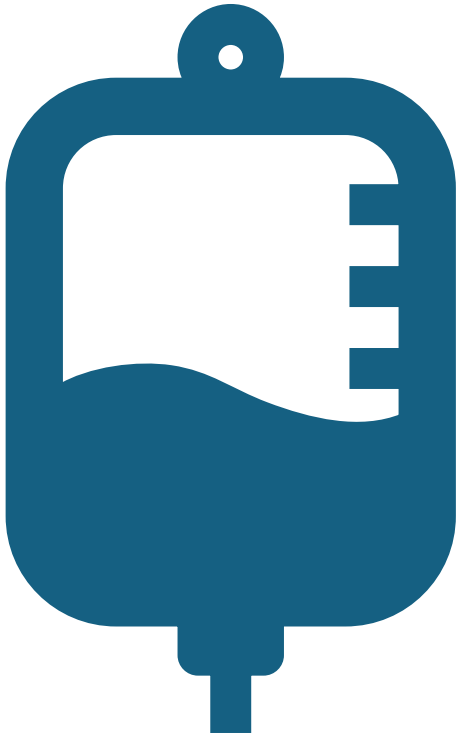
Outcomes

The patient arrived to a pediatric trauma center with continued tachycardia and developing hypotension

He was given additional blood product in ED with improvement in vital signs

Patient had repeat CT scan showing encapsulated grade 4 splenic laceration

The patient had non-operative care management for splenic laceration. He was taken to the OR once stable for orthopedic repair of the left humerus. Discharged home following an inpatient stay.



Discussion

- Pediatric shock can be challenging to identify
- Children may lose 20% of circulating volume before clinical signs of shock appear[1]
- Pediatric age-adjusted shock (SIPA) index may be helpful[2]
- Administration of blood products is not without risk but must be considered in the setting of traumatic hemorrhage
- Hemoglobin drop may have clinical significance when correlated with vital signs[3]

1. Thyagarajan, Sujatha*,; Edmonds, Naomi J**. Hemorrhagic Shock in Pediatric Trauma. Journal of Pediatric Critical Care 4(1):p 30-36, Jan–Mar 2017. | DOI: 10.21304/2017.0401.00159
2. Zachary T. Sheff, Meesam M. Zaheer, Melanie C. Sinclair, Brett W. Engbrecht. Predicting severe outcomes in pediatric trauma patients: Shock index pediatric age-adjusted vs. age-adjusted tachycardia. The American Journal of Emergency Medicine, Volume 83, 2024, Pages 59-63. ISSN 0735-6757, https://doi.org/10.1016/j.ajem.2024.06.041. (https://www.sciencedirect.com/science/article/pii/S0735675724003061)
3. Bruns, Brandon MD; Lindsey, Mark MD; Rowe, Kinsey BS; Brown, Sandra RN; Minei, Joseph P. MD; Gentilello, Larry M. MD; Shafi, Shahid MD, MPH. Hemoglobin Drops Within Minutes of Injuries and Predicts Need for an Intervention to Stop Hemorrhage. The Journal of Trauma: Injury, Infection, and Critical Care 63(2):p 312-315, August 2007. | DOI: 10.1097/TA.0b013e31812389d6

Learning Points

Negative radiological imaging does not necessarily preclude internal injury/hemorrhage

Identification of shock in pediatric patients can be challenging but must always be a differential in trauma

The value of parental input (both truthful and untruthful) should not be underestimated

POCT confirmed the crew's suspicion of hemorrhage in the absence of radiological confirmation leading to appropriate treatment

Case 3: Baby + aspirin

Case 3

22-month-old, 11.5 kg female presents to regional ED via EMS after being found lethargic on the floor by grandmother who was babysitting patient

Numerous pill bottles (grandmother's) were found open with pills on floor

The patient is tachypneic but lethargic

Vitals: HR 185, RR 56, SpO2 90%, BP 94/46, T 39.0º C

You arrive…

The patient awakens to voice but is still lethargic

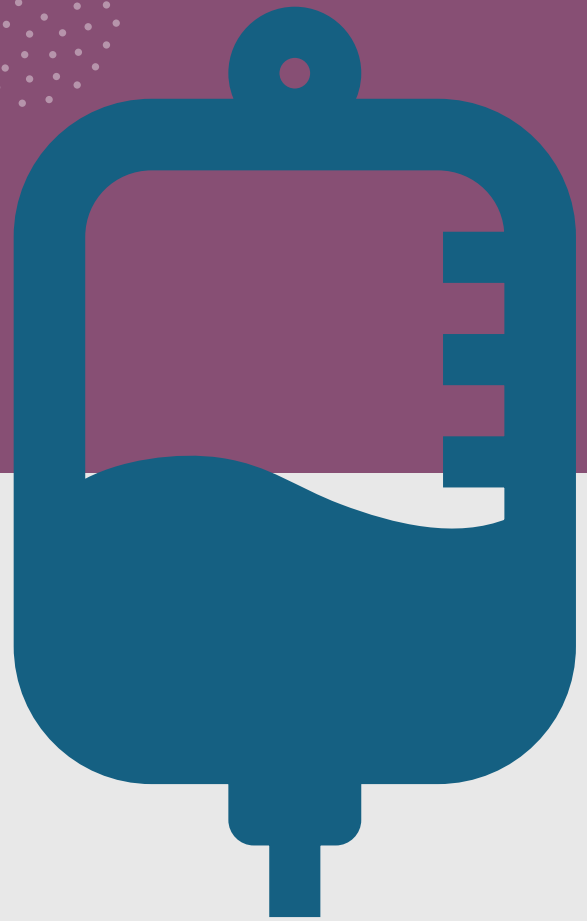
The ED physician notes the grandmother noticed pills missing from her aspirin and clonidine bottles

The IV site appears reddened and swollen. The RN noted the patient improved a little after naloxone

Vital signs: HR 140, RR 50, SpO2 96%, BP 92/54, T 39.2° C

PTA interventions*

- Narcan 0.1mg/kg
- NS bolus 20mL/kg
- 4.2% Sodium bicarb bolus 0.5 mEq/kg



* Treatment algorithms outlined are examples for use and are not suggested preferred treatment algorithms.

pH 7.34

pCO_2 21

HCO_3^- 12

pO_2 65

BE -8

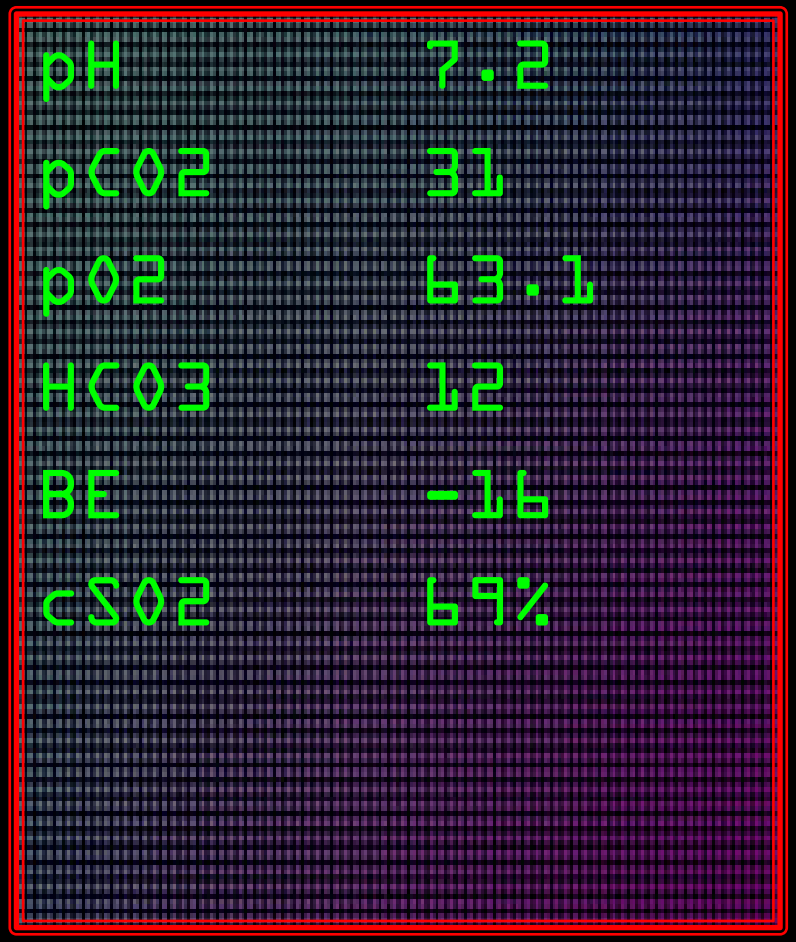
SaO_2 71%

135	98	17	71
4.7	17	0.8	

AG = 20

Salicylate level 48 mg/dL

POC analyzer



Concerns

Mental Status	Patient is lethargic with eye opening to voice
Respiratory status	Maintaining compensatory tachypnea but coingested a sedatory agent. Rising pCO2 is concerning.
Elevated Anion Gap	Developing metabolic acidosis secondary to salicylate poisoning
Hypoglycemia	Secondary to disease process from salicylate poisoning

1. https://www.merckmanuals.com/professional/injuries-poisoning/poisoning/aspirin-and-other-salicylate-poisoning
2. https://www.chop.edu/centers-programs/poison-control-center/aspirin-poisoning-quick-treatment-tips

What’s your plan of care?

THE CREW DISCUSSED THE DANGEROUS COMBINATION OF THE INGESTION OF A SEDATIVE AND SALICYLATE POISONING

AFTER REESTABLISHING IV ACCESS, THE CREW ELECTED TO GIVE AN ADDITIONAL DOSE OF NALOXONE

THE PATIENT’S MENTAL STATUS IMPROVED, AND SHE BECAME MORE ALERT

BICARB DRIP CONTINUED

THE CREW ELECTED NOT TO INTUBATE DUE TO POSITIVE RESPONSE TO NALOXONE

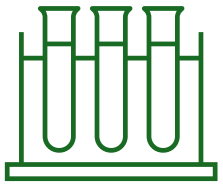
Winter’s formula

Winter’s formula: (1.5 x HCO_3) + 8 +/- 2 = expected pCO_2.

- **(12 x 1.5) + 8 +/-2= expected pCO_2 range 24-28**

Learning Points

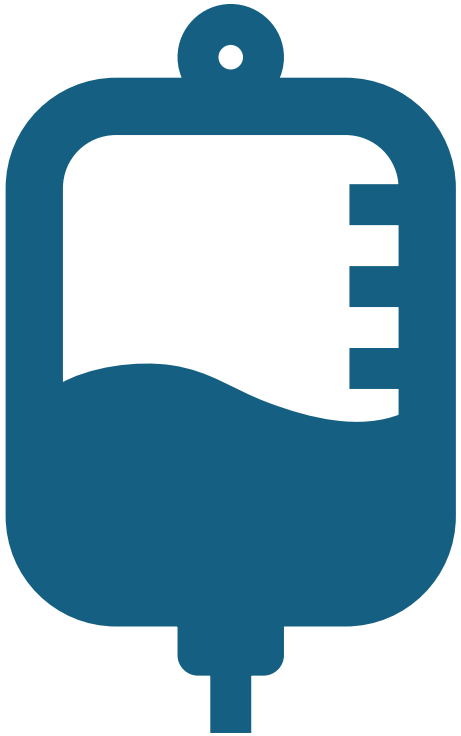
Patient arrived to PICU with improvement in mental status, remained tachypneic



Blood panels were repeated q2h with gradual decrease in salicylate and resolution of acidosis within 12 hours

Patient was admitted to PICU for 2 days then discharged on day 3 from medical floor

Child protective services investigation ensued showing no suspected child endangerment

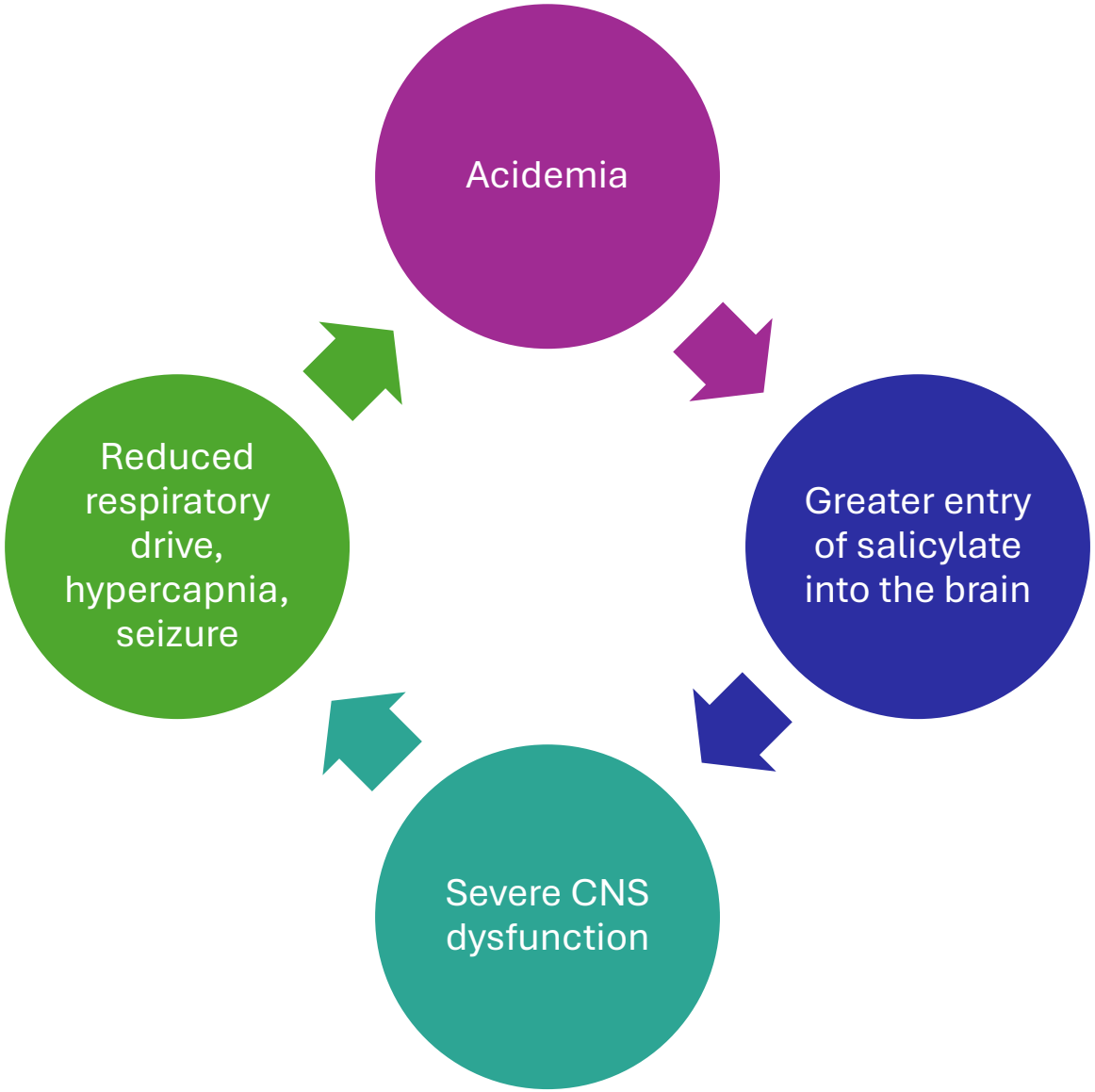


Discussion

- Salicylate ingestion in the presence of a coingestion of a sedative or respiratory suppressant results in a very dangerous scenario
- Salicylate toxicity creates a host of additional metabolic disruptions that exacerbate the acidosis (Runde, 2023)
- Every attempt must be made to preserve respiratory compensation
- Circumstances of ingestion may be accidental but also may be intentional

Runde TJ, Nappe TM. Salicylates Toxicity. [Updated 2023 Jul 10]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK499879

“Death Spiral”



Adapted from IBCC "Salicylate intoxication“
Farkas, Josh. “Salicylate intoxication.” Internet book of Critica Care (blog). Accessed October 10, 2024. http://emcrit.org/ibcc/salicylates

Learning points

Ingestions in young children may necessitate investigative efforts

Keep open differential with acid-base disturbances

Remember the possibility of suspected child abuse and neglect

The information obtained from POCT allowed this crew to monitor the patient's acid-base disorder and avoid high-risk intervention

Application

- Environments similar to critical care transport
  - Wilderness medicine
  - Austere environments
  - Zones of conflict
- Acute care settings
  - Emergency departments
  - Critical access hospitals
  - Rural clinics

Thank you!

References

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Picture references

Slide 1:

https://50skyshades.com/images/l/tyrol-air-ambulance-and-pediatric-air-ambulance-announce-cooperation-to-provide-childrens-intensive-care-transport-12482-TdjCWOlHUARLlb1mu7bPGewNQ.jpg

Slide 4:

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https://www.hopkinsmedicine.org/-/media/gynecology-obstetrics/images/birthing-services-images/labor-and-delivery.jpg

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Slide 6:

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