



EM CASES SUMMARY

Episode 50 – Pediatric Sepsis

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Pediatric Sepsis

Sepsis in children is a relatively rare emergency department presentation. Although only about 0.35% of pediatric emergency department visits are for sepsis, the mortality rate is as high as 2 to 10% (1,2). Having a sepsis guidelines protocol in the emergency department can decrease mortality from 5% to as low as 1% (2)

Red Flags for Pediatric Sepsis:

1. Age: <1yr and early adolescence (10-14yr). (Bimodal distribution)
 - a. Of the children <1yr, most will be <1month old (high risk)
2. Unexplained tachycardia (after correcting for fever – see below)
3. Clinical signs:
 - a. Poor perfusion (long cap refill, lethargy, irritability)

4. Conditions that predispose to sepsis: neuromuscular disease, immunocompromised, respiratory conditions, cardiac disease
5. Recent surgery

Temperature Corrected Heart Rate and Respiratory Rate:

***Recall from podcast 48, rule of thumb - Heart Rate increases by approximately 10 beats/min and Respiratory Rate by 5 breaths/min for every Celsius degree (1.8 degree of Fahrenheit) of fever >38°C*

Normal Pediatric Vital Signs

Age	Heart Rate (beats/min)	Blood Pressure (mm Hg)	Respiratory Rate (breaths/min)
Premie	120-170	55-75/35-45	40-70
0-3 mo	100-150	65-85/45-55	35-55
3-6 mo	90-120	70-90/50-65	30-45
6-12 mo	80-120	80-100/55-65	25-40
1-3 yr	70-110	90-105/55-70	20-30
3-6 yr	65-110	95-110/60-75	20-25
6-12 yr	60-95	100-120/60/75	14/22
12 \geq yr	55-85	110-135/65/85	12-18

Hypotension is a Late Sign of Pediatric Septic Shock

- Be very cautious in setting of tachycardia and **DO NOT WAIT for hypotension** to make diagnosis of septic shock.
- A pediatric patient with hypotension and sepsis is a pre-arrest patient.

Investigations in Sepsis

Blood work should include CBC, electrolytes, glucose, kidney function, blood gas, blood cultures, LFTs, and lactate. Urine cultures are commonly done to identify a possible source. Clinical history guides imaging such as chest x-ray.

ABC - DEFG = ABC, DON'T EVER FORGET GLUCOSE.

Up to 25% of children with septic shock will have adrenal insufficiency, so always check glucose in septic children. Extremes in blood glucose in sepsis are associated with higher mortality in children (2). Arterial lactate 2 times upper limit of normal indicates organ dysfunction.

Acute Management of Pediatric Sepsis

Fluid Resuscitation Goals in Pediatric Sepsis:

Circulation is of paramount importance in this patient and COMES BEFORE AIRWAY and all other concerns. Thus the approach should be CAB:

1) Circulation, 2) Airway, 3) Breathing.

Establishing IV access in a septic child can be very difficult, especially in the setting of hypotension. If, after **1 MINUTE** of trying, you cannot establish IV access, move to IO (ideally x2).

Initial fluid goal: **60cc/kg of NS in first hour (3) (2)**

- a. <2 years of age: Syringes pushed BY HAND as quickly as possible
- b. Older children: level 1 infuser

Blood pressure should not be a deciding factor in giving fluids. All septic patients should receive the initial boluses.

Initial Antibiotic Choice: Ceftriaxone 100mg/kg IV push (2)

Intraosseous Access:

IO access can be used in all ages, even in awake patients. Studies show that the pain from the IO comes more from the actual infusion than the insertion (5). In order to decrease pain, consider infiltrating lidocaine into the bone prior to infusion of fluids. The possibility of pain should not cause hesitation in establishing IO access. (2)

Sites (in this order of preference):

1. Proximal tibia
2. Distal femur
3. Proximal humerus

You can administer the same agents through an IO as an IV (fluids, antibiotics, vasopressors etc.) (2)

When to intubate?

Consider early intubation in fluid refractory septic shock (after 3 boluses of 20ml/kg IV NS) or in any compromised airway.

Infants or neonates with severe sepsis may require early intubation. Intubation and mechanical ventilation increases intrathoracic pressure which reduce venous return and lead to worsening shock. Therefore, fluid resuscitation must be done first.

Choice of medications in intubation

There is no strong data supporting any particular induction agents or paralytic agents in the intubation of a septic child.

Ketamine	<u>Drug of choice</u> as it is relatively safe in hypotension and tachycardia. However, catecholamine depletion can cause refractory hypotension and result in worsening shock.
Propofol	Should not be used for long-term sedation in children younger than 3 years old because of an association with fatal metabolic acidosis.
Etomidate	Should be discouraged or used carefully in septic shock as it inhibits the adrenal axis and sympathetic nervous system affecting hemodynamic stability. Etomidate is associated with increased mortality in children with meningococcal sepsis because of adrenal suppression effect.

Succinylcholine 1 mg/kg (or 2mg/kg in infants) IV or Rocuronium 0.45-0.6 mg/kg IV are both reasonable choices for paralytic agents.

Fluid Refractory Shock

If there are no signs of improvement within 1 hour of aggressive fluid resuscitation (remember goal of 60cc/kg), the initiation of inotropes is indicated. Consider which agent you will use early (during second bolus of 20cc/kg) so that it can be ready to administer at 60min mark without delay if necessary. (2)

Cold vs. Warm shock:

Most children have COLD shock, which is characterized by high SVR and low cardiac output (this differs from adults who usually have low SVR and present with warm shock). Thus, children are poorly perfused, have delayed cap refill with cold extremities and have a temperature differential between their core and their extremities. (5)

Inotropic Choices:

While there is no good evidence to support specific pressor selection in pediatric sepsis, dopamine 10mcg/kg/min is considered the first line choice.

First line: **Dopamine 10mcg/kg/min**, THEN IF:

1. Cold Shock: **Epinephrine 0.05-0.3 mcg/kg/min** and titrate to effect
2. Warm Shock: **Norepinephrine .05-0.3 mcg/kg/min** and titrate to effect.

You can safely start these inotropes through a peripheral IV or IO. ***The lack of a central line should not delay the initiation of inotropes at the 60min mark.*** (2) (5)

Adjunct Treatments:

Glucose: Remember to check the **glucose** in all children and treat as necessary. Both hypo and hyperglycemia are associated with worse outcomes. For glucose <6mmol, start **D10W 5cc/kg** (avoid higher concentration). (2)

Corticosteroids: The use of hydrocortisone in pediatric septic shock is currently being investigated and its role is unclear. Consider using hydrocortisone 2mg/kg in any child that has fluid and inotropic resistant septic shock or proven adrenal insufficiency (1).

Goals of Resuscitation in Pediatric Septic Shock

Normalization of vital signs is a main goal. Aim for a normal blood pressure, pulse (without differences between central and peripheral pulses).

Clinically, the child should have a normal capillary refill, warm extremities and urine output >1ml/kg/hour indicating improved perfusion. Lactate and mental status should be normalized as well.

Cognitive Decision Aids:

ESTABLISHED PROTOCOLS for pediatric sepsis have been shown to **DECREASE MORTALITY**. (5) (2) It is helpful to have your room equipped with PALS algorithms (6), broslow tapes, GCS and normal

vital sign tables to facilitate timely and accurate decisions. See below for The Children's Hospital of Eastern Ontario pediatric sepsis algorithm.

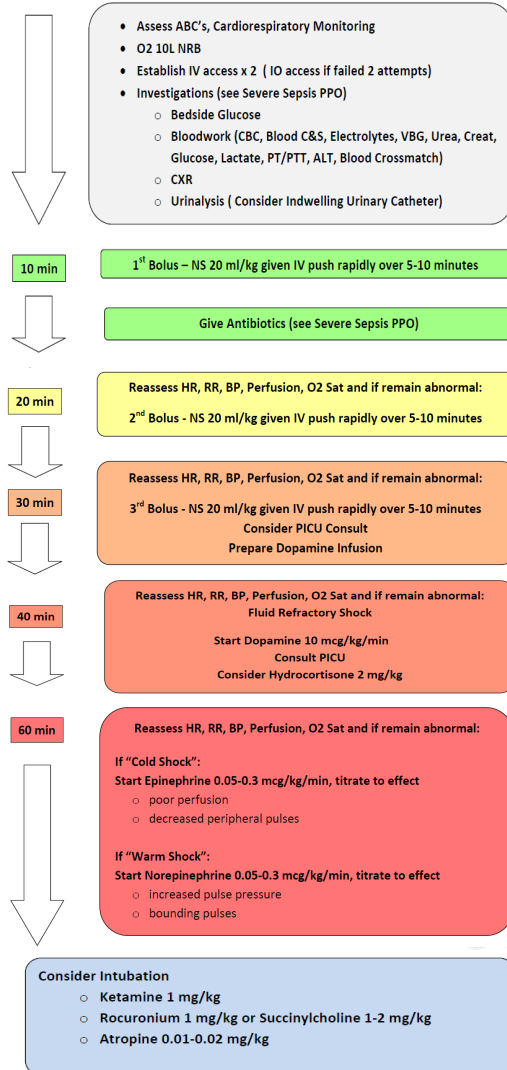
Extra-Corporal Membrane Oxygenation

If all else fails, **ECMO** can be used in the child who is in cardio-respiratory failure and refractory to all treatment. (2) However, in Canada, this treatment is almost exclusive to the ICU setting given all the resources involved.

Key Clinical Points:

1. **Hypotension is a late sign** - do not wait for it to diagnose and aggressively treat pediatric sepsis.
2. **CAB, not ABCs** – fluid 20ml/kg is the first priority even if normal BP. Aim for three boluses over the first hour. Don't delay using an IO!
3. **Early goal directed therapy** – early antibiotics! (ceftriaxone 20mg/kg IV)
4. **Don't forget glucose** – a large proportion of septic children have adrenal insufficiency, which is associated with increased mortality.

CHEO Algorithm for Pediatric Sepsis



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