



P.A.L.S

Pediatric Advanced Life Support

SHOCK

Definition of shock

Shock is an acute, complex state of circulatory dysfunction result in failure to deliver sufficient amount of oxygen and other nutrients to meet tissue metabolic demand.

Classification of the cause of shock

Hypovolemic

- Haemorrhage
- Gastroenteritis
- Intussusception

Distributive

- Septicemia
- Anaphylaxis

Cardiogenic

- Arrhythmias
- Cardiomyopathy
- Valvular disease

Obstructive

- Tension pneumothorax
- Cardiac tamponade

Stages of shock

- **Compensated shock** :presence of normal blood pressure by compensatory mechanism (Hypoperfusion state)
- **Decompensate shock**: fail of compensatory mechanism. Hypotension and organ dysfunction
- **Irreversible shock** :progression of organ dysfunction

Hypotension definition

- Neonate (0-28 days): < 60 mmHg
- Infant (1-12 months): < 70 mmHg
- Children (1-10 years): $70 + [2 \times \text{age (y)}]$ mmHg
- >10 years: <90 mmHg

Hypovolemia following Gastroenteritis is the most common cause of shock in children.

Septicemia is the second most common cause of shock in children.

Definition of systemic inflammatory response syndrome

Systemic inflammatory response syndrome

The presence of at least two of the following four criteria, one of which must be abnormal temperature or leukocyte count:

- Core temperature of $> 38.5^{\circ} \text{C}$ or $< 36^{\circ} \text{C}$
- Tachycardia
- High respiratory rate
- leukocyte count elevated or depressed for age

Definition of Sepsis, severe sepsis, and septic shock

- **Sepsis**

Systemic inflammatory response syndrome in the presence of or as a result of suspected or proven infection

- **Severe sepsis**

Sepsis plus one of the following : cardiovascular organ dysfunction OR acute respiratory distress syndrome OR two or more other organ dysfunctions.

- **Septic shock**

Sepsis and cardiovascular organ dysfunction

Children with sever sepsis can present

- Low cardiac output and high systemic vascular resistant (cold shock, more common scenario)
- High cardiac output and low systemic vascular resistant
- Low cardiac output and low systemic vascular resistant

Recognize decreased mental status and perfusion.
Begin high flow O₂, Establish IV/IO access

Initial resuscitation:

Push boluses of 20 cc/kg isotonic saline or colloid up to & over 60 cc/kg until perfusion improves or unless rales or hepatomegaly develop.

Correct hypoglycemia & hypocalcemia.

Begin antibiotics

Shock not reversed?



Fluid refractory shock:

Begin Dopamin or Dobutamin

dose range:

Dopamine up to 10 µ/kg/min,

Epinephrine 0.05 to 0.3 µ/kg/min

Shock not reversed?



Catecholamine resistant shock:

Begin hydrocortisone if at risk for absolute adrenal insufficiency

Transfer to PICU



Monitor CVP in PICU, attain normal MAP-CVP & ScvO₂ > 70%

5 min

15 min

60 min

- Recognize decreased mental status and **perfusion**

Begin high flow O₂, Establish IV/IO access

Sign of shock(perfusion)

- Fever
- Tachycardia
- Tachypnea
- Mottled or cool extremities
- Mental status change
- Decreased urine output
- Capillary filling > 3 sec
- Decreased peripheral (dorsalis pedis or radial)pulses compared to central pulses
- Increase in central to peripheral temperature gradient(gap>3 c)

Initial resuscitation

1. Boluses of 20 cc/kg isotonic saline or colloid up to & over 60 cc/kg until perfusion improves or unless rales or hepatomegaly develop.
2. Correct hypoglycemia & hypocalcemia.
3. Start antibiotics

Shock not reversed?



- In hypotensive patient ,fluid should be given as rapidly as possible in aliquots of 20ml/kg using a syringe and a 3-way stopcock and rapid pull-push or pressure bag system to achieve therapeutic goal
- With vasodilation and ongoing capillary leak most patient require continuing aggressive fluid resuscitation during the first 24h. of management.

Antibiotics

Early antibiotic therapy is vital

- After cultures provided this does not significantly delay antibiotic administration (2 or more B/C)
- Within 1 hour of recognition of sepsis
- Broad spectrum
- Cover likely organism
- High infected tissues penetration
- Hospital acquired: know local resistance pattern

Shock not reversed

Begin Dopamine or Dobutamine

dosage range:

Dopamine up to 10 $\mu\text{g/kg/min}$,
Epinephrine 0.05 to 0.3 $\mu\text{g/kg/min}$

Shock not reversed?



- Pediatric patients mostly have myocardial dysfunction with intense compensatory vasoconstriction.

Therefore, selected agents should act primarily by providing **myocardial support** (increasing stroke volume) without adding much to the already existing vasoconstriction.

- Since hypotension is a sign of late shock with severe myocardial dysfunction often preceding imminent arrest, early intubation and **inotrope infusion** should be planned.

Vasoactive pharmacologic agents commonly used in the management of pediatric shock

Agent	Dose range	Comments
Dopamine	3-5 $\mu\text{g}/\text{kg}/\text{min}$	Renal-dose dopamine (primarily dopaminergic agonist activity); increases renal and mesenteric blood flow, increases natriuresis and urine output
	5-10 $\mu\text{g}/\text{kg}/\text{min}$	Inotropic (β_1 -agonist) effects predominate; increases cardiac contractility, heart rate, and blood pressure
	10-20 $\mu\text{g}/\text{kg}/\text{min}$	Vasopressor (α_1 -agonist) effects predominate; increases peripheral vascular resistance and blood pressure

Vasoactive pharmacologic agents commonly used in the management of pediatric shock

Agent	Dose range	Comments
Dobutamine	5-10 $\mu\text{g/kg/min}$	Inotropic effects (β_1 -agonist) predominate; increases contractility and reduces afterload
Epinephrine	0.03-0.1 $\mu\text{g/kg/min}$	Inotropic effects (β_1 - and β_2 -agonist) predominate, increases contractility and heart rate; may reduce afterload to a slight extent via β_2 -effects
	0.1-1 $\mu\text{g/kg/min}$	Vasopressor effects (α_1 -agonist) predominate; increases peripheral vascular resistance and blood pressure

Catecholamine resistant shock:

Begin hydrocortisone if at risk for absolute adrenal insufficiency

Transfer to PICU



Hydrocortisone?

- Septic shock with Purpura fulminant
- Congenital adrenal hyperplasia
- Prior recent steroid exposure
- Hypothalamic / pituitary abnormalities

It is recommended in catecholamine resistant shock.

Recommended dose is a wide range from 2mg/kg /day for stress coverage to 50 mg/kg /day titrated to reversal of shock

When intubate?

Early sepsis:

Respiratory alkalosis from central mediated hyperventilation

Late sepsis:

Hypoxemia

Metabolic acidosis

The decision to intubate and ventilate is based on clinical assessment of:

- Increased work of breathing
- Hypoventilation
- Decreased level of consciousness

Patient in fluid refractory shock should be intubated and ventilated without delay

Blood transfusion?

Transfusion with packed RBC if

$$\text{Hb} \leq 10 \text{ g/dl}$$

$$\text{CaO}_2 = \text{Hb} \times 1.34 \times \text{So}_2$$

Therapeutic goal in emergency room:

- Capillary refill ≤ 2 secs,
- Normal pulses with no differential between the quality of peripheral and central pulses,
- Warm extremities,
- Urine output >1 mL/kg/h
- Normal mental status
- Normal blood pressure for age
- Normal glucose concentration
- Normal ionized calcium concentration.

Transfer to PICU