Approach to shock in children

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Objectives

• Definition and pathophysiology of shock.
• Types, classifications and stages of shock.
• Systematic approach to shock in children.
• Using ABCDE +.... to recognize the pending shock.
• Initial management and stabilization.
• Specific treatment for each type of shock.
• Disposition.
Introduction

- **Shock** is Inadequate oxygen and tissue perfusion to meet metabolic demands.
- Oxygen delivery < Oxygen Consumption.
- Causing metabolic acidosis, organ dysfunction and death.
**TYPES OF SHOCK**

- **Hypovolemic shock**: Loss of blood or fluid.
- **Distributive shock**: Misdistribution of blood.
- **Obstructive shock**: Obstruction of blood flow.
- **Cardiogenic shock**: Primary heart problem.
- **Dissociative shock**: Hb is unable to give up O2 to tissues.
Pathophysiology of Shock

Contributing factors:

1. Preload  
2. CO  
3. Afterload  
4. SVR

Non Vital

Vital Organs

cytokines (TNF, IL)

IV

HR * SV
Why Hypotension?

BP = SVR × CO

Anaphylactic Shock
Neurogenic Shock
Septic Shock
Vasodilator Drug
Induced Shock

HR × SV

Tachycardia Extremes
Bradycardia Extremes

EDV − ESV

Hypovolemic Shock
Cardiogenic Shock

BP = blood pressure, SVR = systemic vascular resistance, HR = heart rate, SV = stroke volume, EDV = end diastolic volume (i.e. preload), ESV = end systolic volume (i.e. contractility)
Pathophysiology

Hypovolemic Shock

- Blood Pressure
  - Cardiac output
    - Heart Rate
    - Stroke Volume
      - Preload
      - Contractility
      - Afterload
  - Systemic Vascular Resistance
Pathophysiology

Cardiogenic Shock

Blood Pressure

Cardiac output

Systemic Vascular Resistance

Heart Rate

Stroke Volume

Preload

Contractility

Afterload
Pathophysiology

Obstructive Shock

Flowchart:
- Blood Pressure
  - Cardiac output
    - Heart Rate
    - Stroke Volume
      - Preload
      - Contractility
      - Afterload
  - Systemic Vascular Resistance
Pathophysiology

Distributive Shock

Blood Pressure

Cardiac output

Systemic Vascular Resistance

Heart Rate

Stroke Volume

Preload

Contractility

Afterload
Pathophysiology

Septic Shock (Warm Shock) Early, compensated, hyper dynamic state.

Blood Pressure

Cardiac output

Heart Rate

Stroke Volume

Preload

Contractility

Afterload

Systemic Vascular Resistance
Pathophysiology

Septic Shock (Cold Shock) Late, uncompensated stage.

Blood Pressure
- Cardiac output
  - Heart Rate
  - Stroke Volume
    - Preload
    - Contractility
    - Afterload
- Systemic Vascular Resistance
# Pathophysiology of Shock

To Summarize

<table>
<thead>
<tr>
<th>Type of Shock</th>
<th>Insult</th>
<th>Physiologic Effect</th>
<th>Compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiogenic</td>
<td>Heart fails to pump blood out</td>
<td>↓CO</td>
<td>BaroRc ↑SVR</td>
</tr>
<tr>
<td>Obstructive</td>
<td>Heart pumps well, but the outflow is obstructed</td>
<td>↓CO</td>
<td>BaroRc ↑SVR</td>
</tr>
<tr>
<td>Hemorrhagic</td>
<td>Heart pumps well, but not enough blood volume to pump</td>
<td>↓CO</td>
<td>BaroRc ↑SVR</td>
</tr>
<tr>
<td>Distributive</td>
<td>Heart pumps well, but there is peripheral vasodilation</td>
<td>↓SVR</td>
<td>↑CO</td>
</tr>
</tbody>
</table>
Stages of Shock

- **Compensated**
  - Vital organ function maintained, BP remains normal.

- **Uncompensated**

- **Irreversible**
Causes of Shock

Hypovolemic shock

• Haemorrhagic loss:
  Trauma, GI bleeding, coagulopathy

• Fluid and electrolytes loss:
  DKA, GE, mineralocorticoid deficiency

• Plasma /protein loss:
  Burns, peritonitis, necrosis, bowel obstruction
Causes of Shock

Distributive Shock

• Septic shock
  
  Gram negative bacteria, meningococcus.

• Anaphylactic shock

• Neurogenic shock

• Drugs:
  
  Antihypertensive, barbiturates
Causes of Shock

Obstructive Shock

• Pericardial tamponade.
• Aortic dissection.
• Tension pneumothorax.
• Pulmonary embolism.
Causes of Shock

Cardiogenic Shock

- Arrhythmia:
  - Bradycardia, SVT, VT

- Myocarditis.

- Congenital heart disease with heart failure.

- Hypoplastic left heart disease.
Causes of Shock

Dissociative shock
(tissue perfusion is adequate, but oxygen release to tissue is abnormal).

• Carbon Monoxide poisoning.
• Methemoglobinemia.
• Dyshemoglobinemias.
Causes of Shock in Neonate

• Congenital adrenal hyperplasia
• Inborn errors of metabolism
• Obstructive left sided cardiac lesions:
  – Aortic stenosis
  – Hypoplastic left heart syndrome
  – Coarctation of the aorta
  – Interrupted aortic arch
Systematic Approach to a sick child

Initial impression < 10 sec (appearance, work of breathing, circulation)

Is the child need Resuscitation (CPR)?

Yes

C A B

No

Evaluate

- Primary assessment (ABCDE approach)
- Secondary assessment (focused M&H)
- Diagnostic tests

Intervene

Identify
Primary survey

- A rapid hands-on **ABCDE** approach to evaluate respiratory, cardiac, and neurologic function of a sick child regardless of complaint.

- **Components of primary survey:**
  - Airway
  - Breathing
  - Circulation
  - Disability or neurological status
  - Exposure
ABCDE approach

Airway Assessment

- Patent
- Maintainable
Breathing

- RR
- Respiratory Mechanics
  - Retractions, Accessory Muscles use and Nasal Flaring
  - Head Bobbing
  - Grunting
  - Stridor
  - Wheezing

- Air Entry
  - Chest Expansion
  - Breath Sounds

- Color
  - Blue = Cyanosis
  - Pink = Normal
Circulation

- Heart rate
- BP
  - Vol/strength of central pulses
- Peripheral pulses
  - Present/absent
  - Volume/strength
- Skin perfusion
- Cap. refill time

- Color
  - Mottling, Pallor
- Temperature
- CNS perfusion
  - Responsiveness
  - Recognizes parents
  - Muscle tone
  - Pupil size
  - Posturing
Disability
(neurological status)

- Appearance
- Pupillary Response to Light
- Level of Consciousness: AVPU
  - A: Alert
  - V: Verbal
  - P: Pain
  - U: Unresponsive
- Glasgow Coma Scale
Exposure

Skin Findings:
- Petechiae, purpura
- Rashes, urticaria

Evidence of Trauma:
- Bruises, laceration
- Bleeding
- Raccoon eyes
- Battle's sign
- Ear bleeding
- Nasal discharge (CSF leak)
Secondary Survey

- **Focused medical history:** SAMPLE
  - **S**: Symptoms and Signs
  - **A**: Allergies
  - **M**: Medications
  - **P**: Past medical history
  - **L**: Last meal
  - **E**: Events leading to current illness

- **Focused Physical Examination:** Head to Toe
Signs of Shock

• **General:** sick, Signs of dehydration (dry mucous membranes, absent tears, decreased skin turgor).

• **Neurological:** disturbance in LOC.

• **Cardio-pulmonary:** tachypnea, tachycardia, hypotension.

• **Skin and extremities:** Cool, pallor, mottling, cyanosis, poor cap refill, weak pulses, poor muscle tone.

• **Renal:** reduced, concentrated urine.
Signs of Shock

Cardiogenic shock differs from other types of shock:

- Lack of history of fluid losses.
- History of heart disease.
- Hepatomegaly, rales, gallop rhythm, murmur cardiomegaly.

Failure to improve perfusion with adequate oxygenation, ventilation, heart rate, and volume expansion suggests: a cardiogenic or distributive shock.
Goal: increase oxygen delivery and decrease oxygen demand.

For all children:

- Oxygen
- Fluid
- Temperature control
- Correct metabolic abnormalities
• **Airway**
  – If not protected or unable to be maintained, intubate.

• **Breathing**
  – Always give 100% oxygen to start.
  – O2 Sat monitor.

• **Circulation**
  – Control bleeding with direct pressure.
  – Establish IV access rapidly.
  – CR monitor and frequent BP.
**GENERAL MANAGEMENT OF SHOCK**

- **Laboratory studies:**
  - ABG
  - Blood sugar
  - S. Electrolytes, renal Function, LFT
  - CBC
  - PT/PTT
  - Type and cross
  - Cultures
  - Urine A, X-Ray, ECG and Brain CT if indicated.
**SPECIFIC MANAGEMENT OF SHOCK**

**Hypovolemic shock:**

**Rapid volume replacement**

- 20ml/kg of NS up to 60ml/kg.
- Blood products as soon as available for hemorrhagic shock (Type and Cross with first blood draw).
- At 60ml/kg consider: ongoing losses, adrenal insufficiency, intestinal ischemia, obstructive shock. Get CXR. May need inotropes.
Septic shock:

Appropriate Antibiotics, Inotropes

- Cold Shock rapidly progresses to multiorgan failure or death if untreated.
- Multi-Organ Failure: Coma, ARDS, CHF, Renal Failure, Ileus or GI hemorrhage, DIC.
- More organ systems involved, worse the prognosis.
Cardiogenic Shock

– Improve cardiac output:
  • Correct dysrhythmias
  • Optimize preload
  • Improve contractility
  • Reduce afterload

– Minimize cardiac work:
  • Maintain normal temperature
  • Sedation
  • Intubation and mechanical ventilation
  • Correct anemia
Cardiogenic Shock

Minimal fluid support +

• If low BP+ Tachycardia:
  Inotropes (Dopamine, Dobutamine).

• If low BP+ Bradycardia or Normal HR:
  Chronotropes (Epinephrine or Isoproterenol).
Obstructive shock:

- Tension pneumothorax---needle decompression, chest tube
- Cardiac tamponade
  pericardiocentesis
- Pulmonary embolism
  Consider thrombolytic and anticoagulants
- LV outflow obstruction (ductal dependent lesions)
  Prostaglandin E
Anaphylactic shock:

- O2.
- IM epinephrine.
- Antihistamine.
- Hydrocortisone.
Shock is leading cause of cardiac arrest.

Early recognition and treatment of shock will reduce mortality rate.

Tachycardia is an early and hypotension is late signs.

Rabidly obtain IV access quickly, and if failed insert an IO line.

Fluid + reassess, then fluid + reassess for hypovolemic shock.

Correct electrolytes and glucose problems quickly.

If the Shocked patient is not responding to initial RX think about different types of shock.