SHOCK
DEFINITION OF SHOCK

- A condition where tissue perfusion is unable to meet demand.
- Not defined by blood pressure.
- Hypovolemic shock is the commonest type.
HOW COMMON IS SEPTIC SHOCK?
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• With advent of PICU, mortality reduced from 97% to 9%.

• But Overall mortality much lower than that in adults.
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:
  – 1. Core temperature of >38.5°C or <36°C.
  – 2. Tachycardia or, for children <1 yr old: bradycardia
  – 3. Mean respiratory rate >2 SD above normal for age
  – 4 Leukocyte count elevated or depressed for age
SEPSIS

• Sepsis is defined as the presence (probable or documented) of infection together with systemic manifestations of infection
SEPTIC SHOCK

• Sepsis and cardiovascular dysfunction
WHAT ARE THE COMMON TYPES OF SHOCK?

1. Hypovolemic shock
2. Cardiogenic shock
3. Septic shock
4. Distributive shock
HYPOVOLEMIC

• Caused by a reduction in volume of blood.

• Vomiting, diarrhea, trauma, burns, blood loss.

• Preload is decreased

• Afterload is increased
CARDIOGENIC

• Resulting from a decline in cardiac output secondary to serious heart disease.

• Myocarditis, cardiomyopathy, dysrhythmia, CHD

• Preload is increased

• Afterload is increased

• Myocardial contractility is decreased
SEPTIC SHOCK

• Commonly seen in septicemia
• Usually by Gram negative & positive bacteria & rarely in fungal sepsis.
• Early septic shock:
  – preload decreased
  – afterload decreased
  – myocardial contractility increased
• Late septic shock:
  – preload & afterload increased
  – myocardial contractility decreased
DISTRIBUTIVE SHOCK

- Profound decrease in systemic vascular tone.

- Anaphylaxis & Dengue shock
  - Preload & afterload decreased
  - Myocardial contractility increased
<table>
<thead>
<tr>
<th>Type</th>
<th>Preload</th>
<th>Afterload</th>
<th>Contractility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiogenic</td>
<td>↑</td>
<td>↑</td>
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</tr>
<tr>
<td>Hypovolemic</td>
<td>↓</td>
<td>↑</td>
<td>No change</td>
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<tr>
<td>Distributive</td>
<td>↓</td>
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<tr>
<td>Septic</td>
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<td>early</td>
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<td>late</td>
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STAGES OF SHOCK

Compensated
Vital organ function maintained, BP remains normal.

Uncompensated
Microvascular perfusion becomes marginal.
Organ and cellular function deteriorate.
Hypotension develops.

Irreversible
HEMODYNAMIC RESPONSE TO SHOCK

- Vascular resistance
- Cardiac output
- Blood pressure

Percent of control

Compensated shock

Decompensated shock
Hypovolemic Shock

Hypovolemic
- Dehydration
- Hemorrhage
- Burns

Cardiogenic
- CHD
- RHD
- Myocarditis

Distributive
- Sepsis
- DHF/DSS
- Severe Hemolysis
- Heat Stroke
- Adrenalin Insufficiency

Others

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CAUSES OF SHOCK BY AGE

- Neonate
  - Sepsis
  - Dehydration
  - CHD
  - Metabolic

- Infant
  - Sepsis
  - Dehydration
  - SVT
  - Myocarditis
  - Trauma
  - Toxin

- Child
  - Sepsis
  - Trauma
  - CCF

- Adolescent
  - Trauma
  - Toxin
  - Sepsis
CLINICAL FEATURES - EARLY SIGNS

- Decreased peripheral perfusion
- Cool hands and feet with warm arms and legs
- Delayed capillary refill
- Decreased peripheral pulses
- Cool skin with core hyperthermia
• Prolonged capillary refill (10 seconds) in a 3-month-old with cardiogenic shock
COMPENSATORY MECHANISMS

• Increased heart rate
• Increased respiratory rate or altered respiratory pattern
• Concentration of urine
WARM SEPTIC SHOCK

- Hyper or hypothermia
- Flush, warm, dry skin
- Widening pulse pressure
- Tachycardia
- Tachypnoea
- Change in mental status
COLD SEPTIC SHOCK

- Hypotension
- Cold clammy skin
- Narrow pulse pressure
- Tachycardia with thready pulse
- Rapid shallow breaths
- Oliguria
- Cyanosis
- Metabolic acidosis
INITIAL EVALUATION: PHYSICAL EXAMINATION

- Neurological: Fluctuating mental status

- Skin and extremities: pallor, mottling, cyanosis, poor cap refill, weak pulses, poor muscle tone, sunken fontanel.

- Cardio-pulmonary: Hyperpnea, tachycardia.

- Renal: Scant, concentrated urine
BASIC MANAGEMENT

• Structured approach
• Investigations
• Fluids
• Anticipate problems
• Shift to PICU immediately.
EARLY MANAGEMENT

- Circulation
- Airway
- Breathing
CIRCULATION

• Establish IV access rapidly/Intra-Osseous

• CVP monitor
AIRWAY & BREATHING

• Secure the airway.

• High flow oxygen system (100%)

• Maintain arterial O2 saturation

• Endotracheal intubation
  • Minimizes work of breathing
  • Reduces oxygen consumption
  • Improves oxygenation
INVESTIGATIONS

- Complete blood count
- C reactive protein and procalcitonin
- Serum electrolytes
- Liver function tests
- Renal function tests
- Blood culture and sensitivity (drawn prior to starting antibiotics)
- Chest X-ray and ECHO
FLUID MANAGEMENT

• Fluid -NS/RL 20ml/kg bolus

• If no improvement a second bolus of 20ml/kg.

• Hypovolumic shock may require 40-60ml/kg.

• Septic shock may require 60-80ml/kg.
FLUID MANAGEMENT

• Hypovolemic shock:
  • If no improvement with 60ml/kg of crystalloids
  • Consider colloid transfusion.

• Colloids:
  • Hydroxyethyl starch, FFP, Albumin & blood.

• Crystalloids and colloids are equally good but crystalloids are preferred due to the cost.
FLUID RESPONSIVENESS

At time of admission

After 12 hours of admission
INOTROPES

• Dopamine
  • 10 μg/kg/min
  • increases contractility, HR and SVR

• Dobutamine
  • 10 μg/kg/min
  • improves contractility
  • reduces afterload
• Epinephrine
  • 0.05-1.5 \( \mu g/\text{kg/min} \)
  • increase HR, SVR, and contractility
  • End point: adequate BP; acceptable tachycardia

• Norepinephrine
  • 0.05-1.0 \( \mu g/\text{kg/min} \)
  • Increase SVR
  • End point: adequate BP
SUPPORTIVE CARE

• START OXYGEN FOR EVERY CHILD IN SHOCK.

• Monitor saturation.

• Glucose homeostasis
  – Uninterrupted infusion at least 4-6 mg/kg/min.
  – Maintain blood glucose below 180 mg/dl
SUPPORTIVE CARE

• Thermoregulation
  • Adequate heat source and prevention of heat loss
  • Monitor core temperature

• Nutrition
  • 100-110 Cal/kg/day,
  • Protein 2-4 gm/kg/day
FEATURES OF CARDIOGENIC SHOCK

• Increased respiratory effort- grunting, nasal flaring, retractions
• Tachypnea, tachycardia
• Cold and mottled skin
• Weak or absent pulses
• Delayed capillary refill
• Cyanosis
• Signs of congestive heart failure
TREATMENT

• Give 5-10ml/kg isotonic crystalloid bolus slowly over 10 to 20 minutes. Use fluids with caution

• Administer supplementary oxygen

• Dobutamine is the drug of choice

• Treat the underlying cause
FEATURES OF ANAPHYLACTIC SHOCK

• Anxiety and agitation
• Nausea and vomiting
• Urticaria
• Swelling of the face, lips and tongue - anaphylactic shock
• Hypotension
• Tachycardia
• Respiratory distress with stridor or wheeze
TREATMENT

• IM Epinephrine (1:1000) is the drug of choice.

• Salbutamol helps to relieve the bronchospasm.

• Antihistamines

• Corticosteroids like methylprednisolone can be given

• For refractory hypotension Epinephrine infusion (1:10000) can be used and titrated as needed.
CONCLUSIONS: SHOCK MANAGEMENT PRIORITIES

Rapid assessment of patient and stabilisation

- CAB
- Intravenous access
  - Fluid bolus of 20 mL/kg normal saline
  - Reassess after each bolus
- Inotropic agent only after adequate fluid resuscitation

Expedite laboratory workup

Empiric antibiotics fast

Specific management depending on the cause of shock
Thank You