Shock

Semmelweis University
Dept. of Anesthesiology and Intensive Therapy
Fritúz Gábor

Objectives

- Definition of shock
- Classification of shock
  - Presentation, early diagnostics
  - Pathophysiological background
  - Early treatment
- Detailed
  - hypovolaemic
  - cardiogenic
  - anaphylactic

Definition of shock

- Acut haemodynamic (micro- and macrocirculatory) disorder, which leads to insufficient O₂-supply of the (vital) organs and tissue hypoxia.
- Initially reversible
- Afterwards irreversible structural damage of each organs.

Classification of shock

M

Obstructive
Distributive

Cardiogenic
Hypovolaemic

Right: volume
Left: inotrops
Volume +/- blood
Volume +/− vasopressors
Lysis / Take out

Emergency Approach

Rapid assessment (A-B-C-D-E)
Stabilization of vital parameters
Group diagnostics
Recognition of further hazard
Obligatory and sufficient therapy
Oxygen – Monitor – Vein (OMV)
Transport
A-B-C-D-E approach
Rapid assessment
Checklist for the critically ill

A... Airway
B... Breathing
C... Circulation
D... Neurologic disability
E... Exposure
    Environment
    Event

O - M - V
• Oxygen
• Monitor
• Vein

Circulatory centralisation
organ specific

Effective blood volume ↓
SY-activity ↑

Bowel ischaemia
Renal ischaemia

Immuno-
    depression

Mucosal damage

RAAS ↑

Metabolic acidosis

Vasoactive toxins in the circulation

Progressive tissue ischaemia

Shock-syndrome

• Damage of capillary endothel
• Fluid loss from vascular compartment
• Intravascular coagulation
• Metabolic disorders
• Worsening organ functions
  – Cardiac, respiratory, renal, cerebral, etc.
Effective blood volume ↓
SY-activity ↑
Bowel ischaemia
Renal ischaemia
Lung
Skin ischaemia
Muscle ischaemia
Shock-syndrome

α
No α-effect:
- Brain (70mmHg)
- Coronaries (RRdiast)
- Adrenals

Shock-specific vasomotion

Capillary leakage

States of shock
- Compensated shock
  - Perfusion of vital organs is (still) sufficient
  - Tissue hypoxia, microcirculatory disorder
  - A-B-C-D-E (Early rapid recognition)
    - Respiratory rate, pattern
    - RR Diast!!! MAP, RR syst, CRT, skin
    - ECG-monitor and 12-lead
    - Passage, diuresis
    - Alertness: inadequate behaviour, confusion
- Decompensated shock
  - Manifest organ dysfunctions
### States of shock

**Early state**
- Pale skin
- Cool acre

**Shock syndrome**
- Diaphoresis
- Cyanosis

**Terminal**
- Cyanotic, cool skin, hypotonia, tachycardia, bradycardia, petechia, bleeding, DIC, anuria, unconsciousness, convulsions, apnoe

### Hypovolaemic shock

1. **Evaluation of amount of fluid loss?**
   - **Classification of haemorrhagic shock**
     - Acute blood loss (%):
       - Mild: 20-25%
       - Moderate: 30-35%
       - Severe: 35-40%
       - Vital: 50%

2. **Causes of volume loss?**
   - External – internal loss

### Targeted substitution in blood loss

<table>
<thead>
<tr>
<th>Volume loss (%)</th>
<th>Crystalloid + Colloid</th>
<th>+ RBC</th>
<th>+ FFP</th>
<th>+ PLT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30%</td>
<td>70</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>60%</td>
<td>40</td>
<td>60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>90%</td>
<td>10</td>
<td>90</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Gastrointestinal bleeding

- Rupture of varicose veins in the esophagus
- Ulcer bleeding
  - Stress ulcer
    - Polytrauma, operation, ARDS
  - Cushing-, Curling-ulcer
  - Forrest classification (acute endoscopic)
    - Va: atrial severe
    - Ib: mild bleeding
    - II: coagulum can be seen
    - III: can not identify source
- Small intestine - rare
  - Schönlein-Henoch, M. Crohn
- Colon
  - M. Crohn, colitis ulcerosa
Intensive therapeutic approach to GI-bleeding

- **Anti-shock therapy**
  - Volume, blood
- **Identify the source of bleeding**
- **Stop bleeding**
  - tamponade

- **Definitive therapy**
  - Sclerotization, operation
- **Removal of blood from the gut**
- **Intraintestinal antibiotic treatment**
- **Treat the underlying disease**

---

Rupture of Varicose Veins in the Esophagus

- **Stop bleeding**
  - Sengstaken-Blakemore-tube
    - Two-ballon:
      - 1. gastric: 120ml water, 40-60 Hgmm
      - 2. esophageal: 40-90ml water, 25-40Hgmm
    - Linton-tube
      - One-ballon, pear-shape

---

Bleeding from the Small Intestine identification and therapy

- **No gastro- or colonoscopy result**
  - Enteroscopy
  - Selective small intestine angiography
    - intraoperative vital indicator

---

Functionally heart means 2 organs

Right heart | Left heart
---|---
Preload-dependency | Cardiogenic Right
Volume | Fluid challenge

CO₂, SVR:
Cardiogenic Left
CO₂ inotropic ±vasopressor
SVR: vasodilator

Acute ischaemic cardiogenic shock
- Congestion? - Auscultate the lung.

If no signs of acute left heart failure, right heart insufficiency, give 300-500ml crystalloid = fluid challenge in preload-dependency

---

Cardiogenic shock

- Treatment is determined by cause
- AMI – left ventricle (40%)
- AMI – right ventricle
- Arrhythmias

- Cause and consequence?
Supportive therapy in acute ischaemic left ventricle cardiogenic shock

**Instrumental**
- Positive pressure ventilation (PEEP) CPAP
- Intra-aortic ballonpump IABP

**Drug therapy**
- $RR_{sys} > 90$ Hgmm
  - dobutamin (2-20 µg/kg/min)
- $RR_{sys} : 80 - 90$ Hgmm
  - dopamin (5-15 µg/kg/min)
  - dobutamin (2-20 µg/kg/min)
- $RR_{sys} < 80$ Hgmm
  - norepinephrin (0.05-0.2 µg/kg/min)

---

**Therapy in acute ischaemic cardiogenic shock**

**TREAT THE CAUSE**

**Revascularisation !!!**

---

**REVASCULARISATION**

Open up the Infarct-related-artery — reduces mortality

Percutaneous Coronary Intervention (PCI)

If there is no possibility for PCI
Consider fibrinolysis
Potential for treating side effects
Monitoring!

---

**Classification and Presentation of Acute Left Ventricle Decompensation**

<table>
<thead>
<tr>
<th>Systolic dysfunction</th>
<th>Diastolic dysfunction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilated left ventricle</td>
<td>Non-dilated left ventricle</td>
</tr>
<tr>
<td>↓ contractility</td>
<td>↓ contractility</td>
</tr>
<tr>
<td>Cardiac output ↓</td>
<td>Cardiac output ↓</td>
</tr>
<tr>
<td>CI &lt; 2 L/min PCWP &gt; 20 Hgmm</td>
<td></td>
</tr>
</tbody>
</table>

**Pulmonary congestion**
- Cardiac asthma, pulmonary edema
- dyspnoe, tachypnoe, orthopnoe

**Organ perfusion dysfunctions**
- weakness, collapsus
- oliguria = 20 ml/h
- confusion, agitation, somnolentia

**Signs of compensatory sympathicotonia:**
Tachycardia, diaphoresis, ↓ pulse amplitude

---

**Therapy of Acute Left Ventricle Decompensation in case of stable haemodynamics**

- Treat the cause
  - E. g. in case of hypertension ACE-inhibitor (sublingual)
- Reduce oxygen demand
  - Vasodilatator
    - Nitrate (0.3 – 3 mg/h iv.)
  - Diuretics
  - Furosemid (20-60 mg iv)
  - Morphine (2-5 mg iv)
  - béta-blocker
  - Metoprolol
- Improve oxygen supply
  - Oxygen (10-15 l/min)

---

**Pathophysiology of Acute Left Ventricle Decompensation**

Cardiac Output ↓

- Congestion
- $PCWP$ ↑
- $PVR$ ↑
- $P_{preload}$ ↑
- $O_2$-demand ↑
- $CBF$ ↓
- $AFTERLOAD$ ↑
- Pulmonary edema
- hypoxia
- myocardial ischaemia
- dyspnoe → Work of → $O_2$ Breathing ↑ → demand ↑

$PCWP$: Pulmonary Capillary Wedge Pressure
$PVR$: Pulmonary Vascular Resistance
$CVP$: Central Venous Pressure
$SVR$: Systemic Vascular Resistance
$CBF$: Coronary Blood Flow
In case of drug resistancy

- CPAP
  - Haemodynamic effect
  - Improves oxygenisation
  - Bridge-therapy (till drug effect)
- Tourniquette
  - Reducing venous reflow
- Catecholamin therapy
  - Just in case of unstable haemodynamics
  - Elevates oxygen demand (!)

Periarrest arrhythmias

ALWAYS! Supportive
  - Oxygen – monitor – vein ☺
UNSTABLE haemodynamics
  - Electric therapy
    - bradycardia → pacemaker
    - tachycardia → cardioversio
STABLE haemodynamics
  - Drug therapy
    - Antiarrhythmic agents

Electrical therapy

- In arrhythmias that causes unstable haemodynamics
  - Fast effect
  - Side effects - consider risk-benefit
  - Cardioversion requires deep sedation!
  - External pacemaker may require sedation

Antiarrhythmic drugs

- Just in stable state
  - Slower effect
  - Difficult to predict
- Negative inotropic
  - generally
- Proarrhythmic
  - Polypragmasia! ☺

ANAPHYLAXIS

- Angio-oedema – laryngeal oedema
- Bronchial constriction
- Hypotension
  - vasodilatation & ↑ vascular permeability
- Danger of early return
  - continuation of absorbtion of trigger

RESUSCITATION

- Remove allergen
- High-flow oxygen
- Epinephrin
  - shock, stridor, etc - 0,5 ml 1:1000 i.m.
  - severe shock - 1:10 000 i.v.
- Volume – crystalloid (colloids can cause allergic reactions)
- Antihistamin - H₁-receptor blockers
- Szteroid and inhalative β₂ –agonista
- Consider early intubation (stridor)

Summary

- Definition of shock
- Classification of shock
  - Presentation, early diagnostics
  - Pathophysiologiacal background
  - Early treatment
  - Detailed
    - hypovolaemic
    - cardiogenic
    - anaphylactic