



# Shock & Heamorrhage

Dr. Eman EL Eter

# Objectives

- By the end of this lecture the students are expected to:
- Define circulatory shock.
- List types and causes of shock.
- Understand the body compensatory mechanisms during the reversible phase of hemorrhagic shock.
- Understands the mechanisms responsible for the irreversible phase of hemorrhagic shock

# Definition

- Inadequate tissue perfusion with relatively or absolutely inadequate cardiac output.

# Types & causes:

- Hypovolemic shock:
- Distributive shock.
- Cardiogenic shock.
- Obstructive shock.

## Types & causes, continued...

- **Hypovolemic shock:**
  - Loss of blood volume due to:
    1. Hemorrhage.
    2. Trauma.
    3. Surgery.
  - Fluid loss due to:  
Severe vomiting or diarrhea.
  - Plasma loss;  
As in burns.

## Types & causes, continued

- **Distributive shock:**

(also called vasogenic, low resistance shock)

There is marked vasodilation caused by;

1. Anaphylaxis (due to antigen-antibody reaction, e.g drug –induced..)
2. Sepsis.
3. Neurogenic:  
vaspvgal, acute venous dilation,...

## Types & causes, cont.,.....

- **Cardiogenic shock:**
- Results from inadequate output caused by diseased heart:
  1. Myocardial infarction.
  2. Congestive heart failure.
  3. Arrhythmias.

## Types & causes, continued

- **Obstructive shock:**

Due to obstruction to the flow of the blood:

1. Tension pneumothorax.
2. Pulmonary embolism.



# Pathophysiology of hypovolemic shock

- **Characterized by:**
- Hypotension
- Rapid thready pulse.
- Cold, pale skin.
- Intense thirst.
- Rapid respiration.
- Restlessness.
- According to the cause hypovolemic shock is subdivided into; hemorrhagic, traumatic, surgical, burn shock.

## Pathophysiology of hypovolemic shock, cont.,.....

- **Stages of shock:**

- **Reversible stage.**

In which compensatory reactions & appropriate treatment help restoration of blood pressure & blood loss.

- **Irreversible stage.**

In which series of positive fed back mechanisms take place leading to further deterioration & tissue hypoxia. This depends on amount of blood lost. When blood loss is excess and not immediately replaced and proper treatment is delayed, this stage is reached and patient die. There is also failure of compensatory mechanisms.

# Reversible stage:

Characterized by compensatory reactions:

- A. Rapid compensatory reactions.  
(act within seconds-minutes).
- B. Responses Activated within hours
- C. Responses activated from hours-days

# Pathophysiology of hypovolemic shock, Reversible stage, cont.,...

## • A. Rapid compensatory reactions:

- **i. Vasoconstriction:** this increases TPR and hence ABP. It is produced by:
  - \* Baroreceptor reflexes.
  - \* Chemoreceptor reflex.
  - \* Vasopressin-vasoconstrictor mechanism.
  - \* Noreadrenaline-adrenaline vasoconstrictor mechanism (due to activation of adrenal medulla).

Vasoconstriction is marked in:

- Skin: cold, pale.
- kidneys: drop in GFR & urine volume.
- Viscera.

**Heart and brain are spared.**

Reversible stage in response to heamorrhage, cont,.....

## ii. Tachycardia:

Produced by:

- Baroreceptor reflex.
- Chemoreceptor reflex.
- Increased sympathetic activity.

## iii. Venoconstriction:

Caused by sympathetic activity. It is important to:

- Maintain filling pressure of the heart.
- Shift blood from reservoirs into the circulation.

## Reversible stage, continued.....

- **iv. Tachypnea:**

Caused by activation of chemoreceptor reflex and sympathetic over activity.

*Importance:*

Increase O<sub>2</sub> delivery.

Increase thoracic pump activity....help VR.

## Reversible stage, continued,.....

### V. Restlessness :

This increases sk. Ms. Pump activity.

### vi. Release of vasoconstrictor factors/hormones:

- Catecholamines by adrenal medulla.
- Vasopressin by posterior pituitary : besides vasoconstriction it restores fluid volume by reducing urine output.
- Renin-angiotensin-aldosterone. (preserve salt and water).

## Reversible stage, continued,.....

- **B. Responses Activated within hours:**
  1. Increased movement of interstitial fluid into capillaries (**capillary fluid shift**) (4 hrs needed).
  2. Increased secretion of glucocorticoids by adrenal cortex. (help to maintain blood sugar)
  3. Increased 2,3 DPG concentration in RBCs: important to help HB deliver more O<sub>2</sub> to the tissues (shift O<sub>2</sub> dissociation curve to the right)



## Reversible stage, continued,.....

- **C. Responses activated in hours-days:**
- Restoration of circulatory plasma volume. Takes 12-72 hrs after moderate hemorrhage.
- Restoration of plasma proteins: occur in 2 stages:
  - 1. Rapid entry of preformed albumin from extracellular stores.
  - 2. Hepatic synthesis of proteins over 3-4 days.
- Restoration of RBCs

## Reversible stage, continued,.....

- Restoration of RBCs:
  - 1. increase RBCs count in response to erythropoietin within 10 days.
  - 2. restoration of red cell mass within 4-8 weeks.

# Irreversible stage:

- **+ve feedback mechanisms lead to drop in CO:**
- **1. Cardiac depression.**

The drop in APB leads to drop in coronary  
flow → (-) heart → drop CO
- **2. Vasomotor failure.**

Results from depression of vasomotor center, the heart becomes depressed and CO drops.

# Irreversible stage:

- 3. Release of toxins by ischemic tissues.

e.g. histamine, tissue enzymes, potassium, ...

- 4. Endotoxin:
- Released from gram +ve bacteria when blood flow to intestine decreases → absorption of toxins → Cardiac depression.

# Irreversible stage:

- 5. Generalized cellular deterioration:
  - (-) of mitochondrial activity inside the cells lead to decrease in ATP.
  - (-) of cellular metabolism, especially glucose.
  - Rupture of many lysosomes.
  - Drop in active transport of  $\text{Na}^+$  and  $\text{K}^+$  across the cell  
→  $\text{Na}^+$  accumulate inside the cell.

# Summary of compensatory mechanisms of hypovolemic shock

