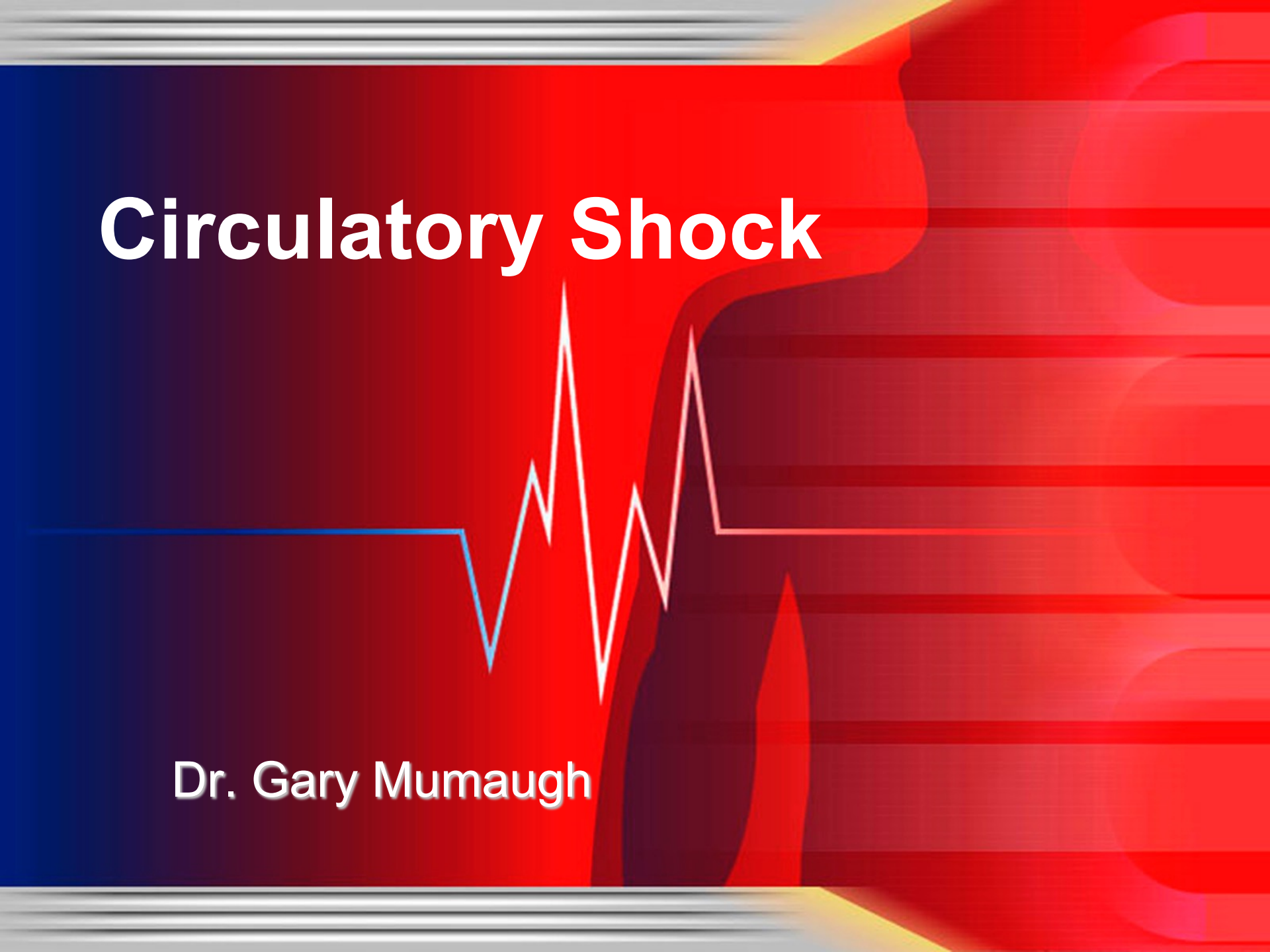
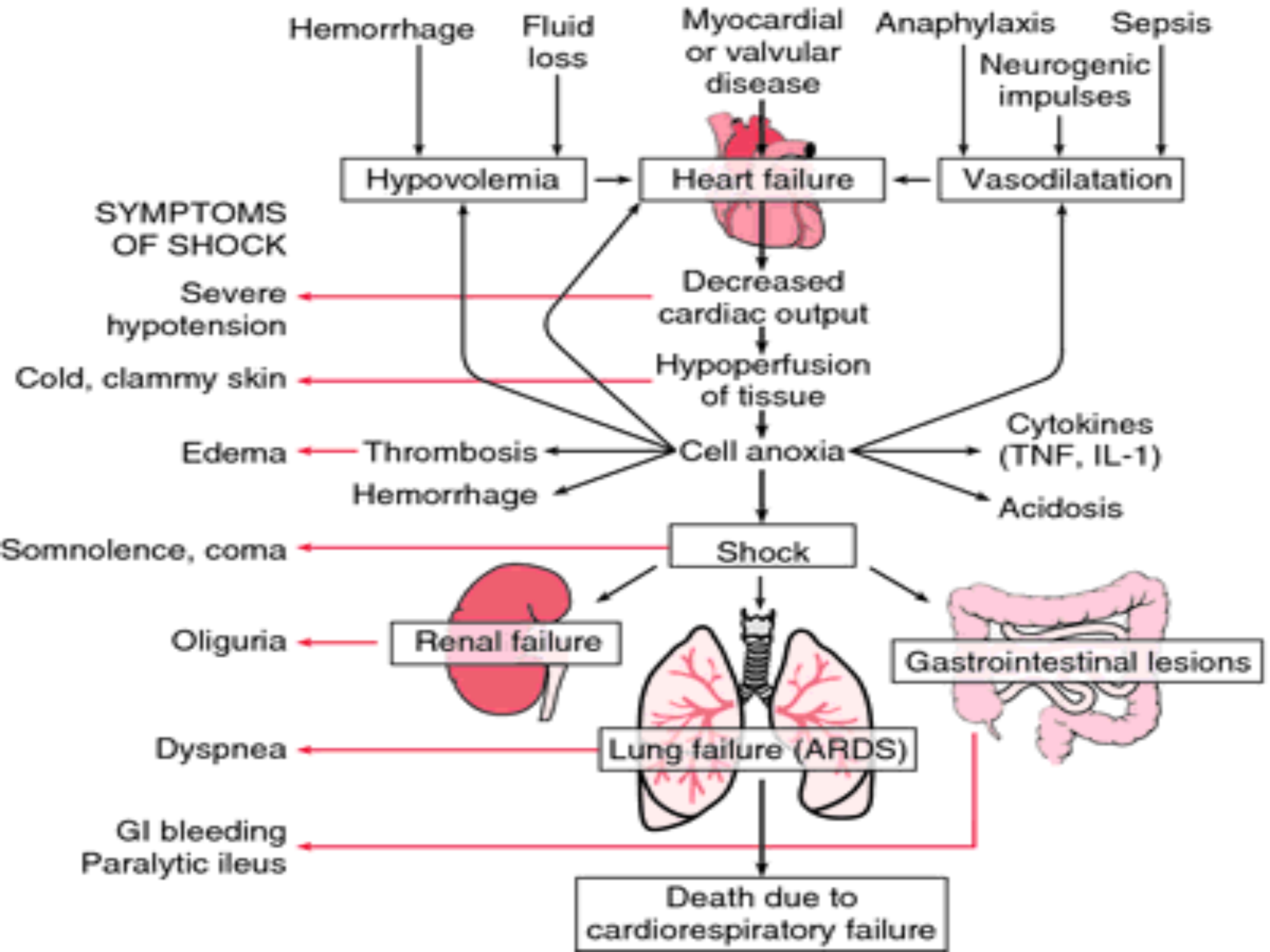
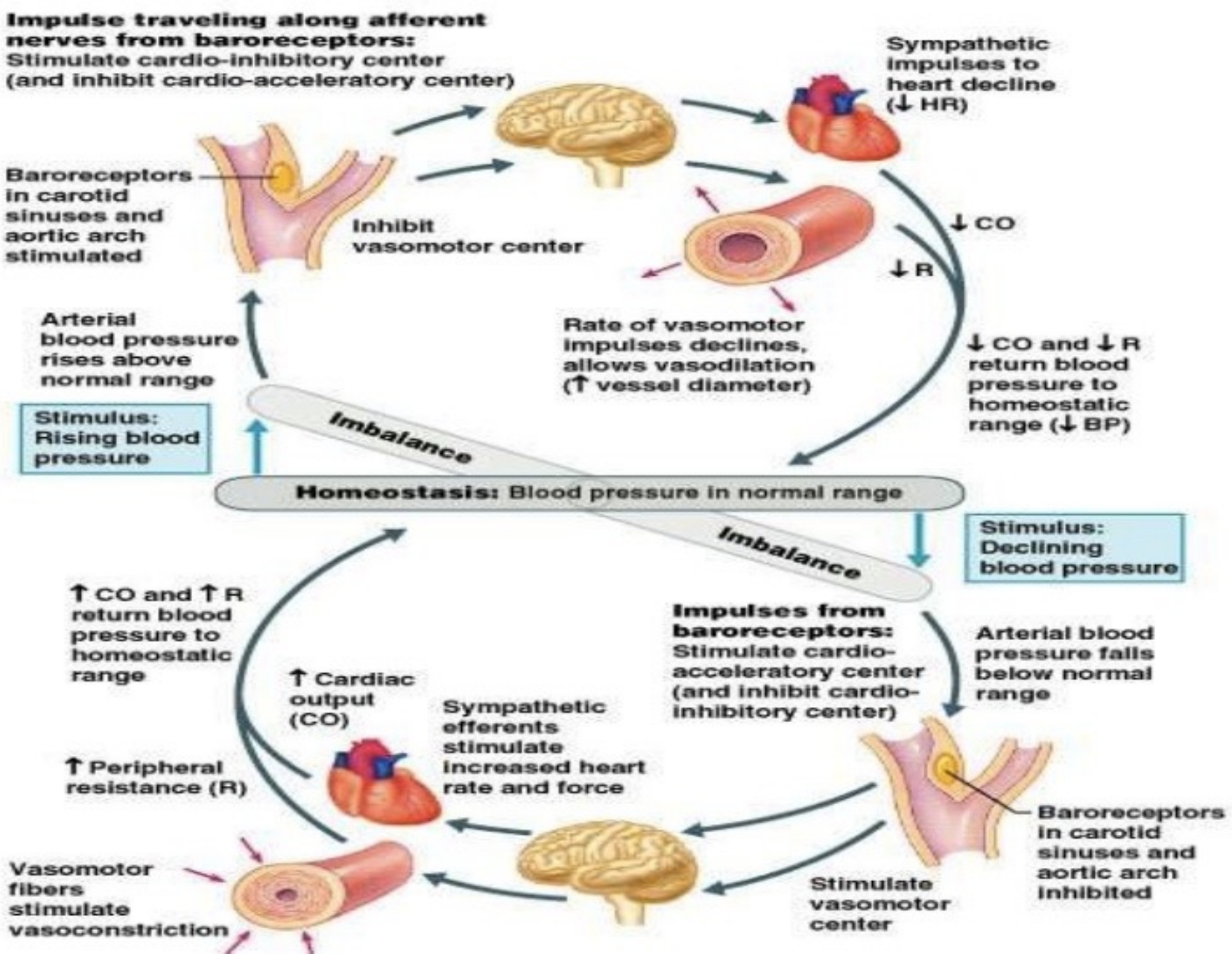
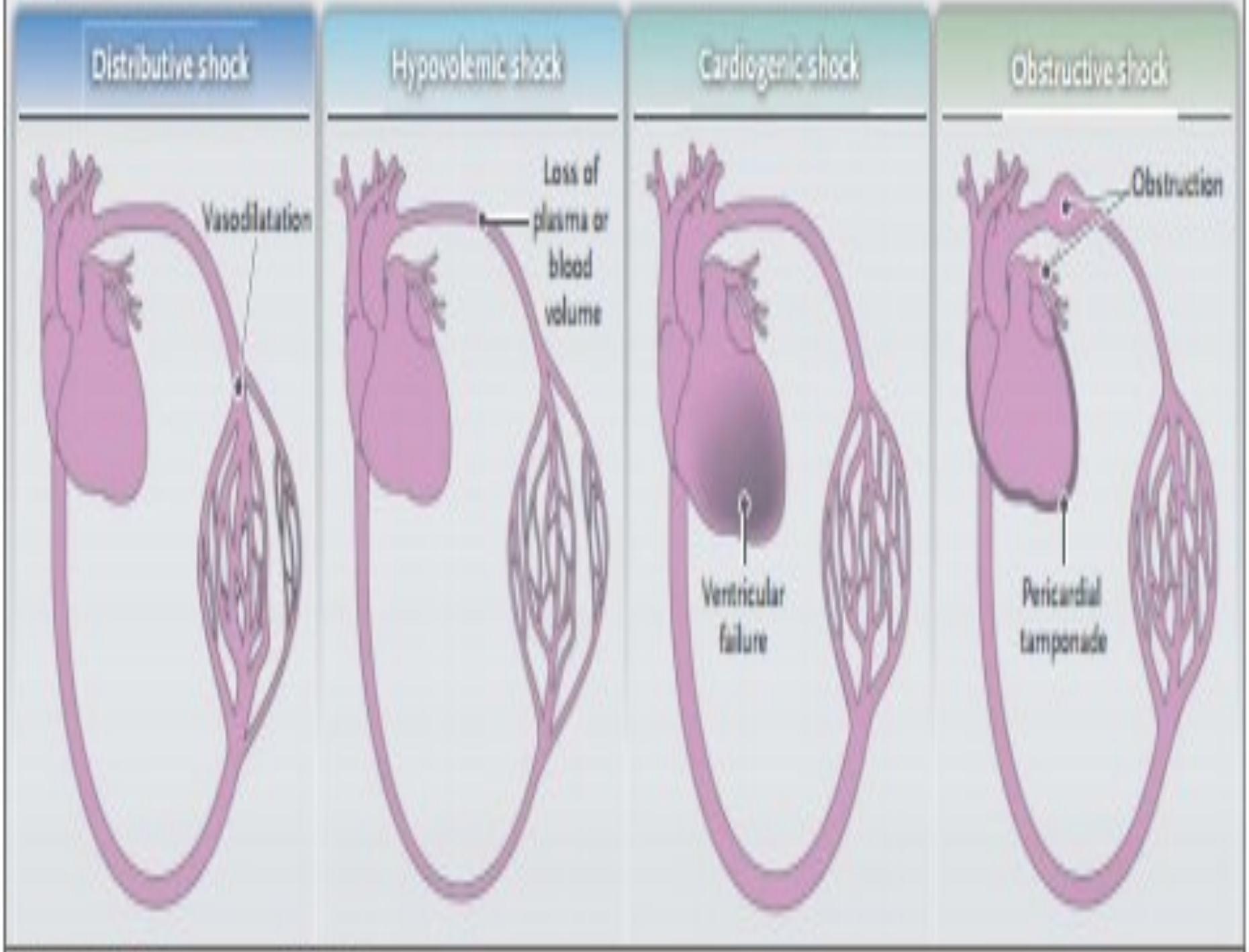
# Circulatory Shock



Dr. Gary Mumaugh


Hemorrhage
Fluid loss
Myocardial or valvular disease
Anaphylaxis
Sepsis
Neurogenic impulses
Hypovolemia
Heart failure
Vasodilatation
SYMPTOMS OF SHOCK
Severe hypotension
Decreased cardiac output
Cold, clammy skin
Hypoperfusion of tissue
Edema
Thrombosis
Cell anoxia
Cytokines (TNF, IL-1)
Hemorrhage
Acidosis
Somnolence, coma
Shock
Oliguria
Renal failure
Gastrointestinal lesions
Dyspnea
Lung failure (ARDS)
GI bleeding
Paralytic ileus
Death due to cardiorespiratory failure


Impulse traveling along afferent nerves from baroreceptors:
Stimulate cardio-inhibitory center
(and inhibit cardio-acceleratory center)
Sympathetic impulses to heart decline (↓ HR)
Baroreceptors in carotid sinuses and aortic arch stimulated
Inhibit vasomotor center
↓ CO
↓ R
Rate of vasomotor impulses declines, allows vasodilation (↑ vessel diameter)
↓ CO and ↓ R return blood pressure to homeostatic range (↓ BP)
Arterial blood pressure rises above normal range
Stimulus: Rising blood pressure
Imbalance
Homeostasis: Blood pressure in normal range
Imbalance
Stimulus: Declining blood pressure
↑ CO and ↑ R return blood pressure to homeostatic range
Impulses from baroreceptors:
Stimulate cardio-acceleratory center
(and inhibit cardio-inhibitory center)
Arterial blood pressure falls below normal range
↑ Cardiac output (CO)
Sympathetic efferents stimulate increased heart rate and force
↑ Peripheral resistance (R)
Baroreceptors in carotid sinuses and aortic arch inhibited
Vasomotor fibers stimulate vasoconstriction
Stimulate vasomotor center


Distributive shock
Vasodilatation
Hypovolemic shock
Loss of plasma or blood volume
Cardiogenic shock
Ventricular failure
Obstructive shock
Obstruction
Pericardial tamponade

# Circulatory Shock

- Tissues depend on adequate blood flow reaching the **microcirculation** (network of capillaries)
  - Adequate blood flow depends on **arterial blood pressure**
- Normal BP is determined by:
  - Cardiac output
  - Plasma volume
  - Proper arteriolar constriction

**Circulatory Shock -** An acute, system-wide loss in blood pressure that reduces blood flow to tissues

# Types of Shock

## Primary (Neurogenic) Shock

- Rapid drop in blood pressure reduces blood flow to the brain (**syncope**- fainting)
- Vasodilation **+** drop in cardiac output **=** ↓ BP
- Often in response to an emotional stimulus, brain damage, or CNS depression
- Immediate onset→ passes quickly→ rapid recovery
  - Results in altered nervous system output to vessels and heart

# Types of Shock

**Cardiogenic Shock-** Malfunction in heart's pumping activity

**Hypovolemic Shock-** Rapid loss of blood from circulatory system

**Vascular Shock-** Widespread dilation of systemic arterioles

- **Splanchnic circulation-** vessels of abdominal viscera are especially significant in vascular shock

# Cardiogenic Shock

- Heart malfunction decreased cardiac output
- Most common cause- L. Ventricle failure from myocardial infarction
  - Shock results when >40% of the myocardium is lost due to MI
- Other causes
  - Thrombosis within heart or pulmonary circulation
  - Cardiac tamponade
  - Tension pneumothorax
  - Cardiac dysrhythmia

# Hypovolemic Shock

- **Hypovolemia** - Inadequate circulating blood volume
- Usually the result of massive blood loss (**hemorrhagic shock**)
- Many causes
  - Massive burns (3rd degree)
  - Massive skin punctures
  - Internal rupture of major vessels
  - Dehydration

# Vascular Shock

- Rapid, usually systemic vasodilation = BP, venous return, cardiac output ↓
- **Septic Shock** (most common)- Caused by circulating vasodilators (often bacterial exotoxins)
- **Toxic Shock**- Circulating toxins are NOT bacterial in origin
- **Anaphylactic Shock**- Caused by the widespread release of endogenous vasodilators by the immune system (e.g. histamine)

# Compensation in Shock

## Baroreceptors

- Receptors that sense changes in pressure
- Found predominantly in the aorta/common carotid artery
- Send information to the **cardiovascular center** in the medulla oblongata

**Cardiovascular reflexes** adjust to normal BP

# Compensation in Shock

**In extreme cases**:

- **CNS Ischemic Response** → sympathetic stimuli rapidly raises BP

**Kidney**

- Signals body (via renin, angiotensin II) to retain water
- Kidneys are VERY sensitive to shock- high $O_2$ demand, maintain water balance

# Therapy Helps Treat Shock

- **Primary concern-** Restoring blood flow to sensitive tissues
  - Transfusion- Compensate for loss in blood (hypovolemic shock)
  - Vasoconstriction Drugs- Increase blood flow (vascular shock)
  - Isoproterenol- increases cardiac output (cardiogenic shock)

# Therapy Helps Treat Shock

- If possible, eliminate cause of shock (e.g. administering antibiotics for septic shock, surgery)
- Cope with secondary effects

# Systemic Effects of Shock

- Generalized muscular weakness
- Drop in body temperature
  - Metabolism slows→ lack of nutrients
- Restlessness and confusion
- **Lung Shock-** highly permeable alveoli results in build up of fluid in lungs

# Systemic Effects of Shock

- Anoxic damage to kidneys→ acute renal failure
- **Metabolic Acidosis-** tissues switch to anaerobic respiration due to hypoxia
- GI track mucosae vulnerable to necrosis
- Heart and liver damage

# Progression of Shock: 3 Stages

- **Non-Progressive Shock**- Therapy (internal or external) will usually correct the problem
- **Progressive Shock**
  - Tissue/organ damage will usually result
  - Positive feedback cycles cause progression of shock
  - Major cause- decline in functional capacity of circulatory system
  - May result in **metabolic acidosis**

- **Irreversible Shock**- Shock is acute and severe→ death will likely result even if normal BP is restored