

# Shock

宋明璋

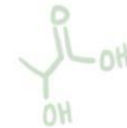
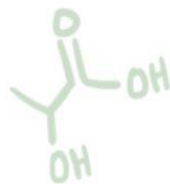
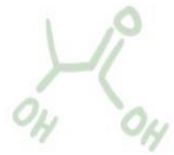


# Definition

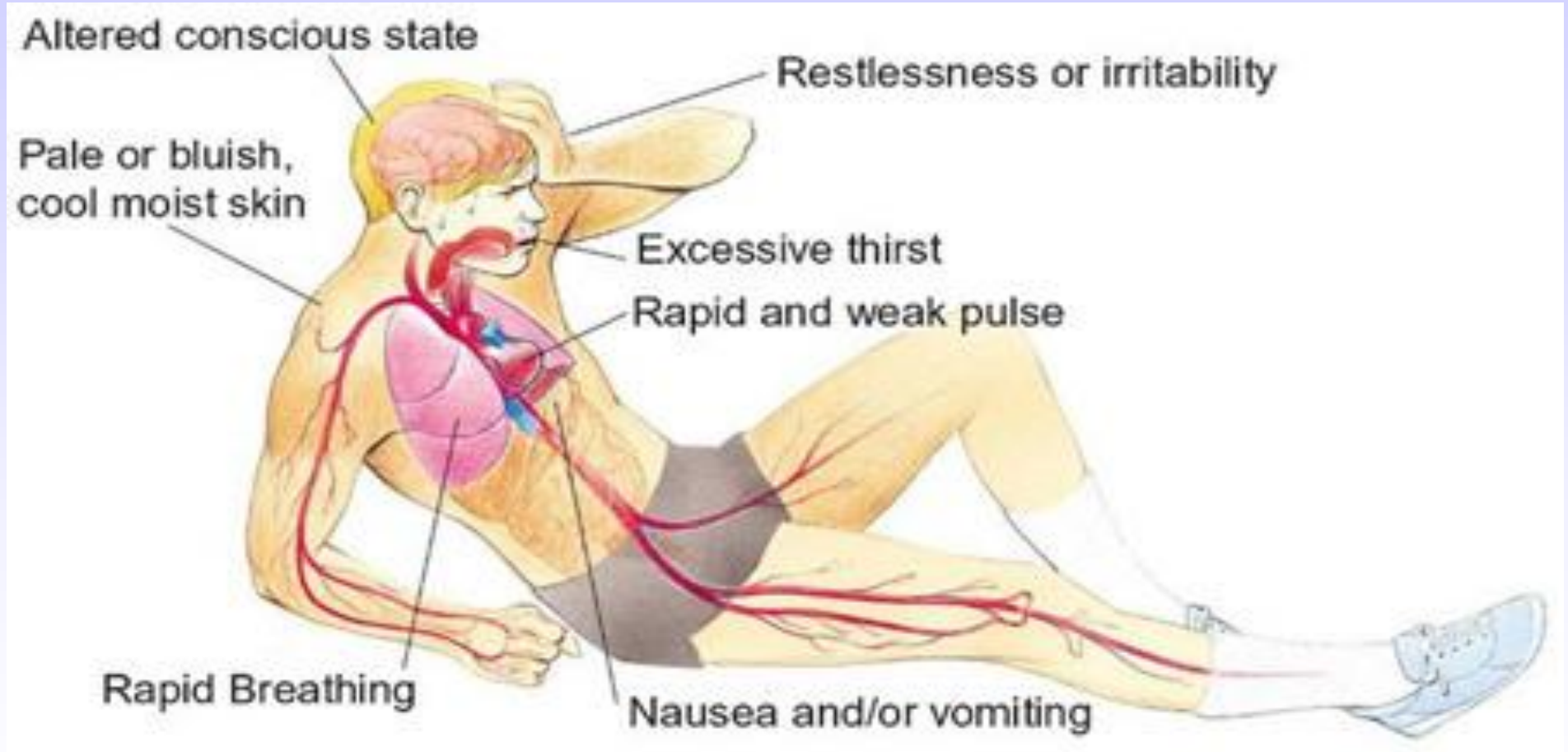
**A state of cellular and tissue hypoxia**

- Reduced oxygen delivery
- Increased oxygen consumption
- Inadequate oxygen utilization

# HYPOXIA

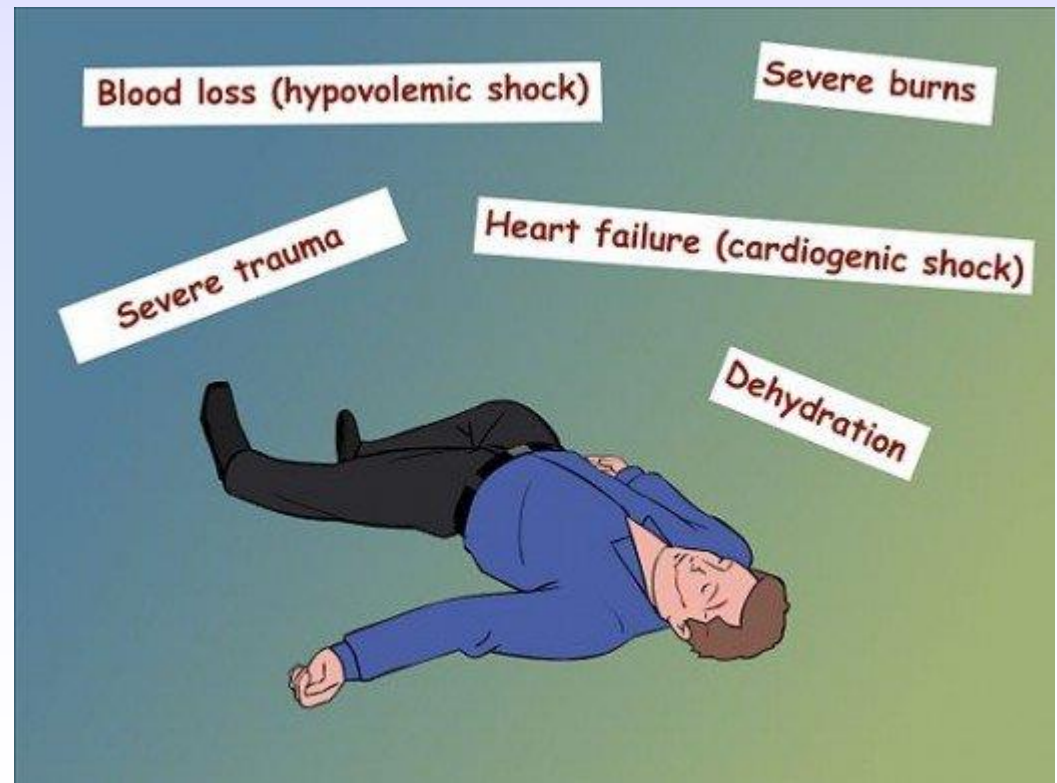


# Signs of shock



# Classification of shock

- Four types of shock:
  - Distributive
  - Cardiogenic
  - Hypovolemic
  - Obstructive



# Distributive shock

- Severe peripheral vasodilatation (vasodilatory shock):
  - ★ Septic shock
  - ★ Systemic inflammatory response syndrome (SIRS)
    - ◆ Neurogenic shock
    - ◆ Anaphylactic shock
    - ◆ Drug and toxin-induced shock
    - ◆ Endocrine shock

Current Guidelines and Terminology	Sepsis	Septic Shock
1991 and 2001 consensus terminology <sup>9,10</sup>	Severe sepsis Sepsis-induced hypoperfusion	Septic shock <sup>13</sup>
2015 Definition	Sepsis is life-threatening organ dysfunction caused by a dysregulated host response to infection	Septic shock is a subset of sepsis in which underlying circulatory and cellular/metabolic abnormalities are profound enough to substantially increase mortality
2015 Clinical criteria	Suspected or documented infection and an acute increase of $\geq 2$ SOFA points (a proxy for organ dysfunction)	Sepsis <sup>a</sup> and vasopressor therapy needed to elevate MAP $\geq 65$ mm Hg and lactate $> 2$ mmol/L (18 mg/dL) despite adequate fluid resuscitation <sup>13</sup>

# Sequential Organ Failure Assessment (SOFA)

System	Score				
	0	1	2	3	4
<b>Respiration</b>					
PaO <sub>2</sub> /FIO <sub>2</sub> , mm Hg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
<b>Coagulation</b>					
Platelets, ×10 <sup>3</sup> /μL	≥150	<150	<100	<50	<20
<b>Liver</b>					
Bilirubin, mg/dL (μmol/L)	<1.2 (20)	1.2-1.9 (20-32)	2.0-5.9 (33-101)	6.0-11.9 (102-204)	>12.0 (204)
<b>Cardiovascular</b>					
	MAP ≥70 mm Hg	MAP <70 mm Hg	Dopamine <5 or dobutamine (any dose) <sup>b</sup>	Dopamine 5.1-15 or epinephrine ≤0.1 or norepinephrine ≤0.1 <sup>b</sup>	Dopamine >15 or epinephrine >0.1 or norepinephrine >0.1 <sup>b</sup>
<b>Central nervous system</b>					
Glasgow Coma Scale score <sup>c</sup>	15	13-14	10-12	6-9	<6
<b>Renal</b>					
Creatinine, mg/dL (μmol/L)	<1.2 (110)	1.2-1.9 (110-170)	2.0-3.4 (171-299)	3.5-4.9 (300-440)	>5.0 (440)
Urine output, mL/d				<500	<200

Abbreviations: FIO<sub>2</sub>, fraction of inspired oxygen; MAP, mean arterial pressure; PaO<sub>2</sub>, partial pressure of oxygen.

<sup>a</sup> Adapted from Vincent et al.<sup>27</sup>

<sup>b</sup> Catecholamine doses are given as μg/kg/min for at least 1 hour.

<sup>c</sup> Glasgow Coma Scale scores range from 3-15; higher score indicates better neurological function.

# qSOFA (Quick SOFA) Criteria

Respiratory rate  $\geq 22$ /min

Altered mentation

Systolic blood pressure  $\leq 100$  mm Hg



# Systemic Inflammatory Response Syndrome (SIRS)

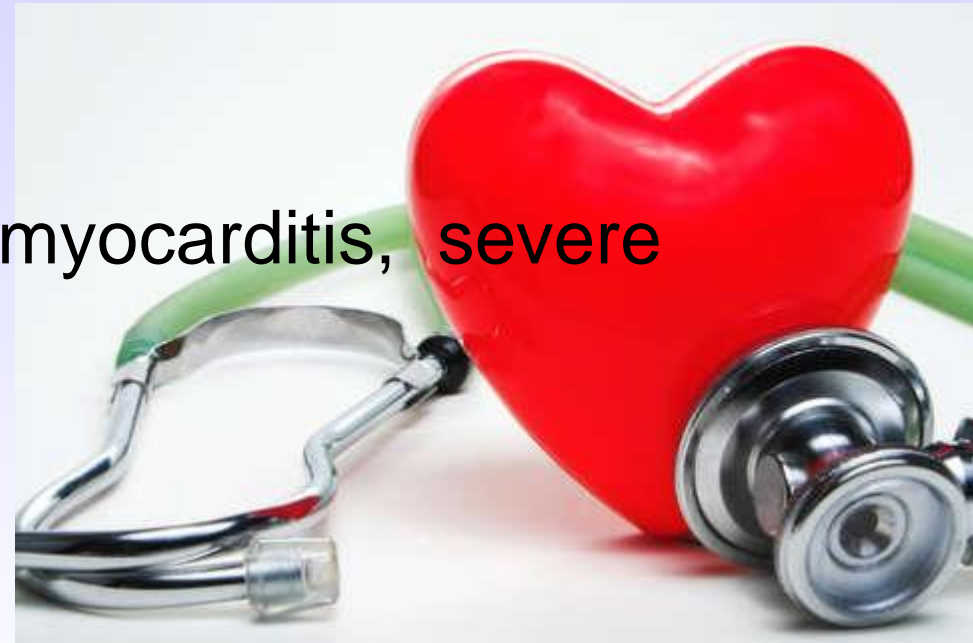
Two or more of:

- Temperature  $>38^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$
- Heart rate  $>90/\text{min}$
- Respiratory rate  $>20/\text{min}$  or  $\text{Paco}_2 <32 \text{ mm Hg}$  (4.3 kPa)
- White blood cell count  $>12\,000/\text{mm}^3$  or  $<4000/\text{mm}^3$  or  $>10\%$  immature bands

From Bone et al.

# Cardiogenic shock

- Cardiac pump failure results in reduced cardiac output
- ★ Cardiomyopathic
  - ◆ Ex: myocardial infarction, myocarditis, severe dilated cardiomyopathy
- ★ Arrhythmic
- ★ Mechanical
  - ◆ Ex: severe aortic or mitral valve insufficiency, mitral valve defect, severe ventricular septal defects or acute rupture of the intraventricular septum



# Hypovolemic shock

- Reduced intravascular volume
- ★ Hemorrhagic
- ★ Nonhemorrhagic
  - ◆ Gastrointestinal losses (eg, diarrhea, vomiting)
  - ◆ Skin losses (eg, burns)
  - ◆ Renal losses (eg, osmotic diuresis)
  - ◆ Third space losses into the extravascular space or body cavities (eg, postoperative and trauma, intestinal obstruction, pancreatitis, cirrhosis)

# Obstructive shock

- Extracardiac causes of cardiac pump failure (poor right ventricle output)
  - ★ Pulmonary vascular
    - ◆ Pulmonary embolism
    - ◆ Pulmonary hypertension
  - ★ Mechanical
    - ◆ Tension pneumothorax
    - ◆ Pericardial tamponade
    - ◆ Constrictive pericarditis
    - ◆ Restrictive cardiomyopathy

# Stages of shock

- ★ Pre-shock (compensated shock, or cryptic shock)
  - ◆ Tachycardia, a modest change in systemic blood pressure, mild to moderate hyperlactatemia.
- ★ Shock
  - ◆ Tachycardia, dyspnea, restlessness, diaphoresis, metabolic acidosis, hypotension, oliguria, and cool, clammy skin.
- ★ End-organ dysfunction
  - ◆ Anuria, acidemia, recalcitrant hypotension, worse hyperlactatemia, obtundation and coma.

# Reference

- David FG, Mark EM. Definition, classification, etiology, and pathophysiology of shock in adults. UpToDate. last updated: May 25, 2016. from <http://www.uptodate.com/contents/definition-classification-etiology-and-pathophysiology-of-shock-in-adults>
- Mervyn Se, Clifford SD, Christopher WS, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*. 2016;315(8):801-810.