

Hypovolemic Shock

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Definition

- **Shock, or acute circulatory failure**
a state in which the delivery of oxygen and nutrients to the tissue is insufficient to meet basal metabolic needs, leading to tissue hypoxia, and, if persistent, to MOF and death.



Clinical findings

- **Hypotension**

- SBP <90mm Hg or
- MAP <65mm Hg or
- requirement for vasopressor agents to maintain blood pressure above these levels.

- **Signs of perfusion alteration to the organs**

- Alteration in mental state: confusion, agitation, sometimes coma.
- Oliguria: urine output <0.5ml/kg/h. Requires at least 1h to be diagnosed, and sometimes longer when the bladder is not catheterized.
- Skin vasoconstriction (clammy skin)

Biological signs

- **Metabolic acidosis**

excess of hydrogen ions due to ATP hydrolysis occurring during anaerobic metabolism.

- **Hyperlactataemia**

in response to hypoxia

pyruvate cannot enter the Krebs cycle

lactate is produced in large amounts.

Normal values are close to 1mEq/l

values >2.0 suggest tissue hypoxia

values >4.0 are associated with a mortality rate >50%.

Signs of organ dysfunction

- Decreased PaO₂
- Increased creatinine levels
- Hyperbilirubinaemia.

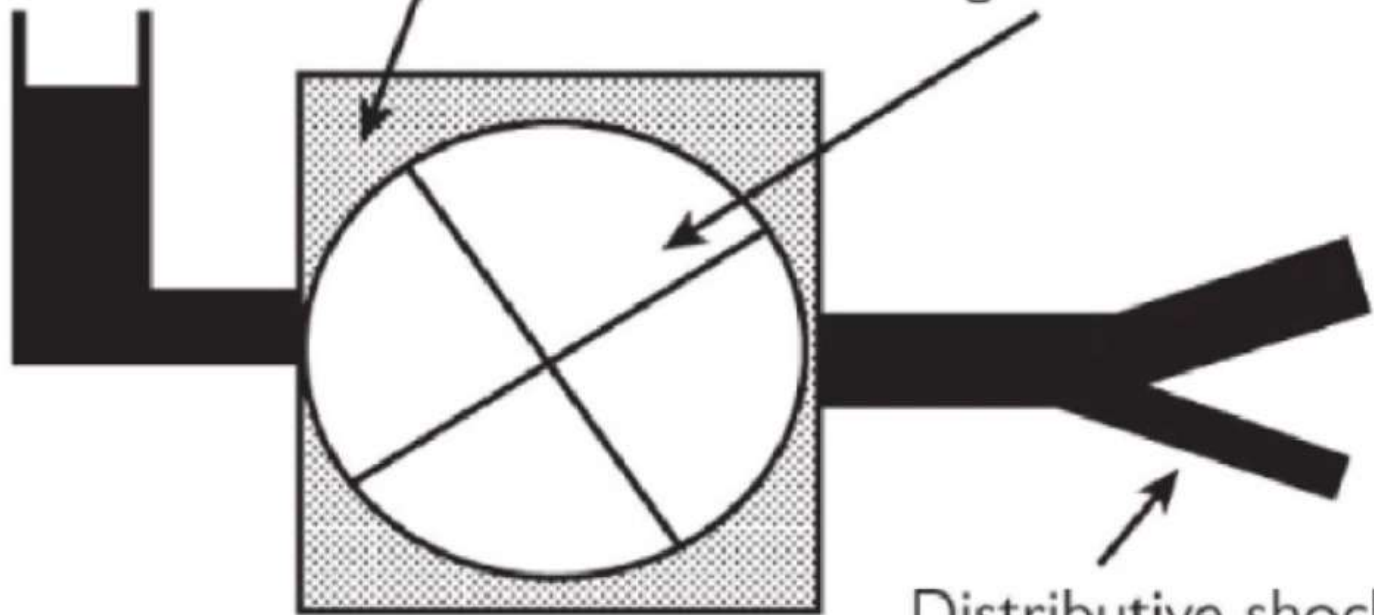
Classification of shock

- **Hypovolaemic**
- **Cardiogenic**
- **Obstructive**
- **Distributive**
- In this categorization of shock, the circulation is divided into its four essential components
 - the vascular reservoir (hypovolaemic shock)
 - the pump (cardiogenic shock)
 - the conduits (obstructive shock)
 - distribution of blood flow among and within the organs (distributive shock).

Hypovolemic shock

Obstructive shock

Cardiogenic shock

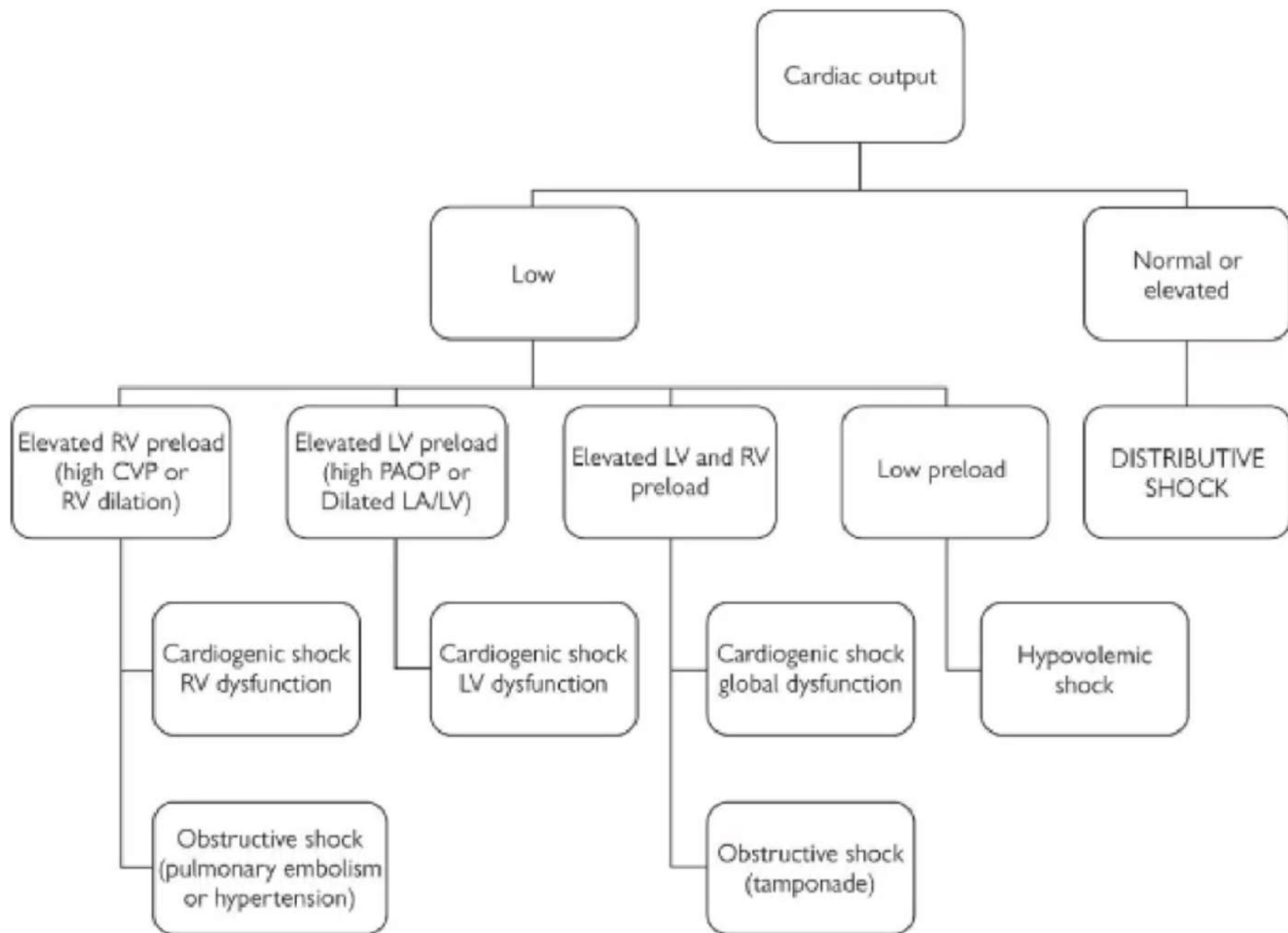


Distributive shock

- Identifying the type of shock is thus important as it helps to indicate what should be the target of the primary intervention.
- There may be some overlap between these presentations, as a patient with distributive shock may also present hypovolaemia and myocardial depression.

How to diagnose the type of shock

- Differentiation between the four categories of shock can be made using several haemodynamic monitoring tools, including a pulmonary artery catheter, cardiac echocardiography and pulse contour analysis.
- Whatever the technique used, classification of shock relies on the determination of cardiac output and evaluation of intravascular pressures or volumes



Hypovolaemic shock

- Hypovolaemic shock is characterized by a profound reduction in blood volume.
- It is the most common source of shock
- Can easily be reversed, if detected early and provided its cause can be corrected.

Causes

- **Bleeding**
 - Trauma
 - Digestive haemorrhage
- **Decreased plasma volume**
 - diarrhoea
 - vomiting

Pathophysiology

- **Decreased intravascular volume** →
- Decreased venous return →
- Decreased ventricular filling →
- Decreased stroke volume →
- Decreased CO →
- (Compensatory mechanisms)
- **Inadequate tissue perfusion**

Compensatory mechanisms

- **Adrenal Response - Neurohormonal response Stimulated by baroreceptors**
 - Increased heart rate
 - Increased contractility
 - Vasoconstriction (SVR-Afterload)
 - Increased Preload

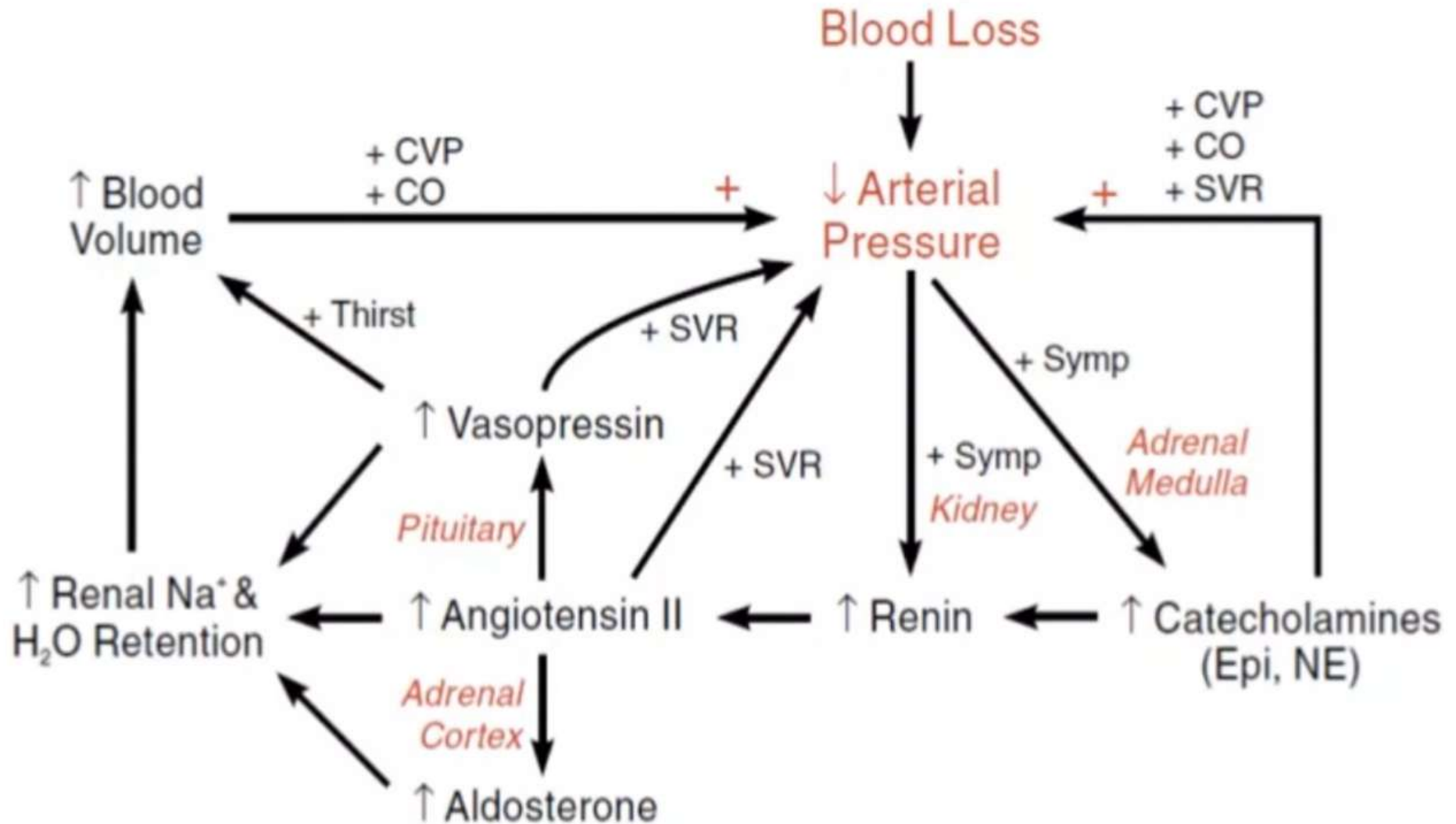
Compensatory mechanisms

- **Hormonal: Renin-angiotension system**
- Decrease renal perfusion
- Releases renin → angiotension I →
- angiotension II → potent vasoconstriction
- releases aldosterone adrenal cortex
- sodium & water retention

Compensatory mechanisms

- **Hormonal: Antidiuretic Hormone**
- Osmoreceptors in hypothalamus stimulated
- ADH released by Posterior pituitary gland
 - Vasopressor effect to increase BP
 - Acts on renal tubules to retain water

Pathophysiology

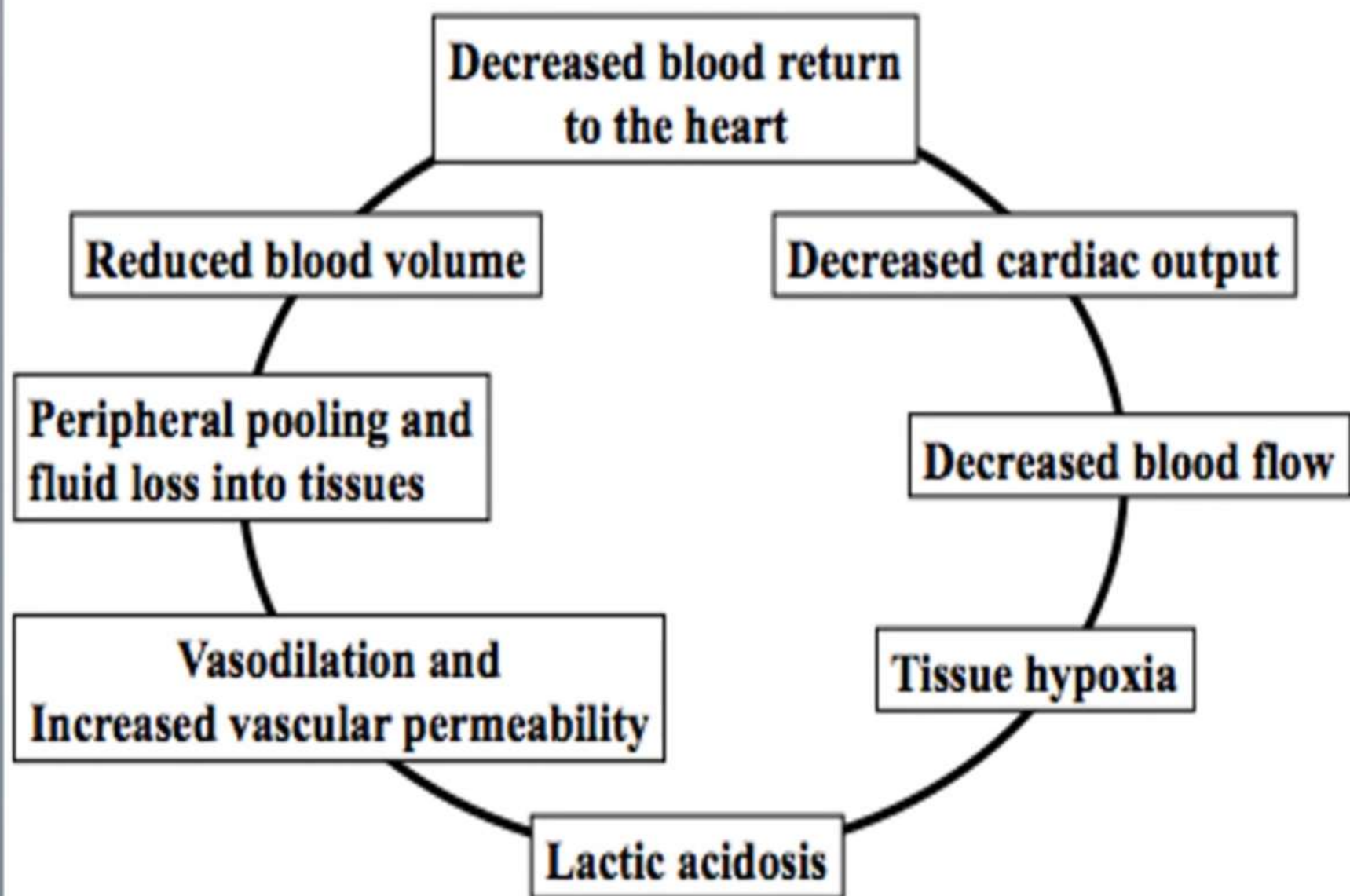


Stages of Shock

- **Initial stage** - tissues are under perfused, decreased CO, increased anaerobic metabolism, lactic acid is building
- **Compensatory stage** - Reversible. SNS activated by low CO, attempting to compensate for the decrease tissue perfusion.
- **Progressive stage** - Failing compensatory mechanisms: profound vasoconstriction from the SNS → ISCHEMIA
Lactic acid production is high → metabolic acidosis
- **Irreversible or refractory stage** - Cellular necrosis and Multiple Organ Dysfunction Syndrome may occur

- **Net results of cellular shock:**
 - systemic lactic acidosis
 - decreased myocardial contractility
 - decreased vascular tone
 - decrease blood pressure, preload, and cardiac output

The Vicious Circle of Shock



Clinical Presentation

	<u>Class I</u>	<u>Class II</u>	<u>Class III</u>	<u>Class IV</u>
Blood Loss	< 750	750-1500	1500-2000	> 2000
% Blood Vol.	< 15%	15 – 30%	30 – 40%	> 40%
Pulse	< 100	> 100	> 120	> 140
Blood Pressure	Normal	Normal	Decreased	Decreased
Pulse Pressure	Normal	Decreased	Decreased	Decreased
Resp. Rate	14 – 20	20 – 30	30 – 40	> 40
UOP	> 30	20 – 30	5 – 15	negligible
Mental Status	sl. Anxious	mildly anx	confused	lethargic