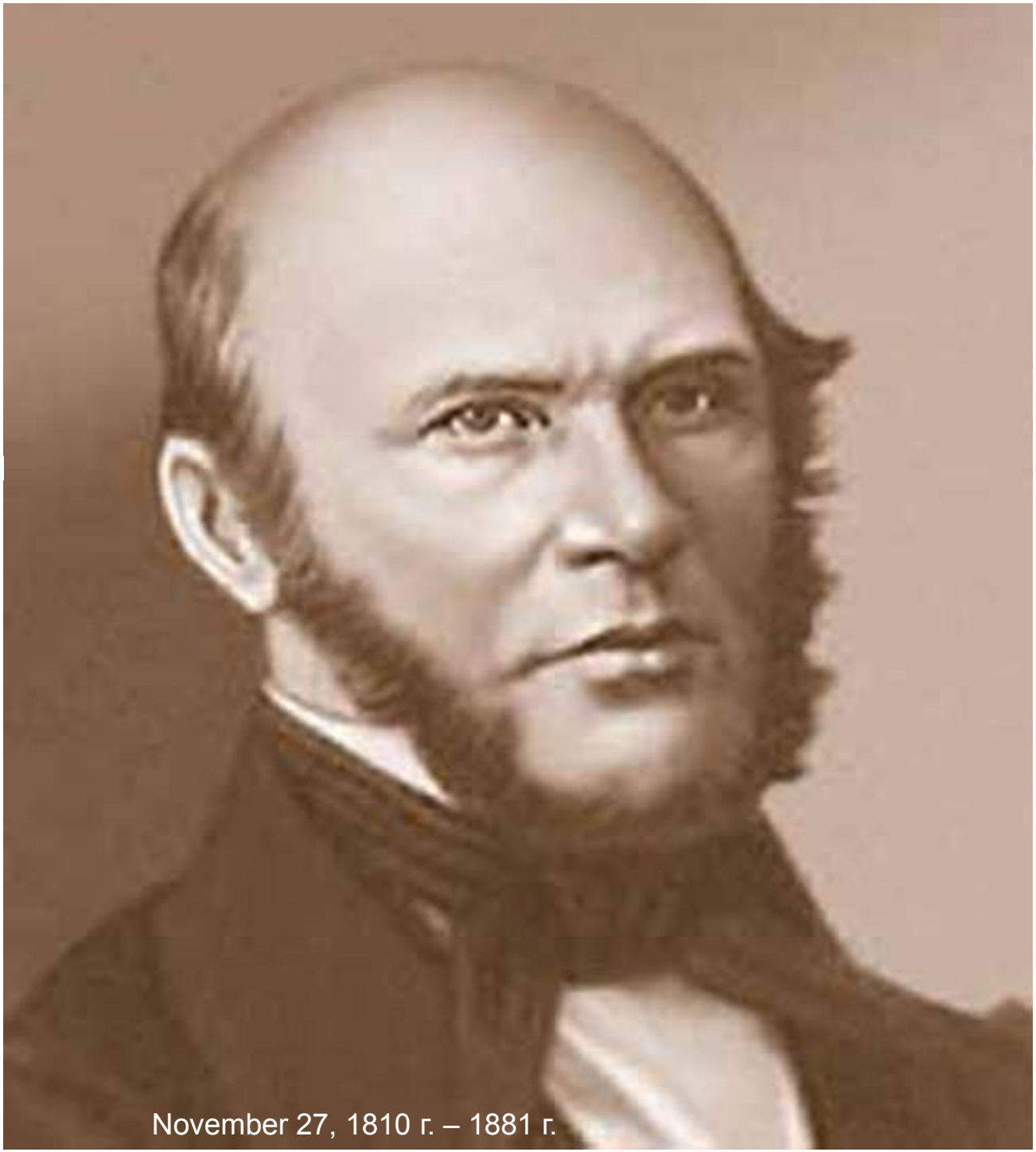
S H O C K



November 27, 1810 г. – 1881 г.

SHOCK –
a general non-specific passively defensive reaction of an organism to aggression formed during the evolution

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It is characterized by minimization of vital activity and inhibition of specific resistance mechanisms in combination with stimulation of systems that provide non-specific resistance of the organism.

In mammals and humans, in connection with the development of the nervous system and the increase in the protective role of actively adaptive, including behavioral, reactions, shock acquires relative adaptability and may have a negative biological significance.

(*Litvitsky P.F.*, 2002.)

Shock definition

- Shock is a descriptive term by which clinicians call a syndrome characterized by prolonged prostration and hypothermia. This condition is manifested by pallor, cold, moist skin, a decrease in superficial veins, a change in mental status and a decrease in diuresis. (M.H. Weil, 1967).

- Shock is a nonspecific circulatory-metabolic syndrome in which microcirculation disorders and associated metabolic disorders are the leading component that determines the further course of the process, regardless of the trigger. (R.N. Lebedeva, 1978)

- Shock is an acute failure of blood circulation with a critical disorder of tissue perfusion, which leads to oxygen deficiency in tissues, cell damage and organ dysfunction. (V.D. Malyshev, 2002);

- Shock is a condition of insufficient tissue perfusion in which the delivery of oxygen to the tissues does not meet their needs for aerobic metabolism. (E.V. Nedashkovsky, 2003).

THE MAIN START-UP PATHOGENETIC FACTORS DEFINING SHOCK DEVELOPMENT ARE:

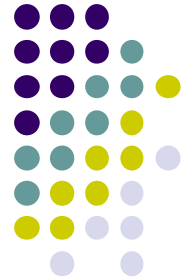
1. Decreased circulating blood volume;
2. Increasing the capacity of the vascular bed (vasodilation), redistribution of blood;
3. Violation of the productive function of the heart.

SHOCK PRESENTS A DYNAMIC PROCESS, AT WHICH THE STAGE OF CIRCULATORY DISTURBANCES CORRELATES WITH A DEGREE OF SHOCK TROUBLE AND MAKES DEFINED PREDICTIVE CORRECTIVE

«There are as many types of shock as opportunities to die».

F.D. Moor

Shock classification - hemodynamic

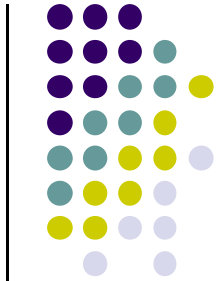


1. Hypovolemic (hemorrhagic, burn, dehydration)

2. Distributive (redistribution shocks - anaphylactic, septic)

3. Cardiogenic (contraction reduction, arrhythmogenic)

4. Obstructive (pulmonary embolism, intense pneumothorax, cardiac tamponade)

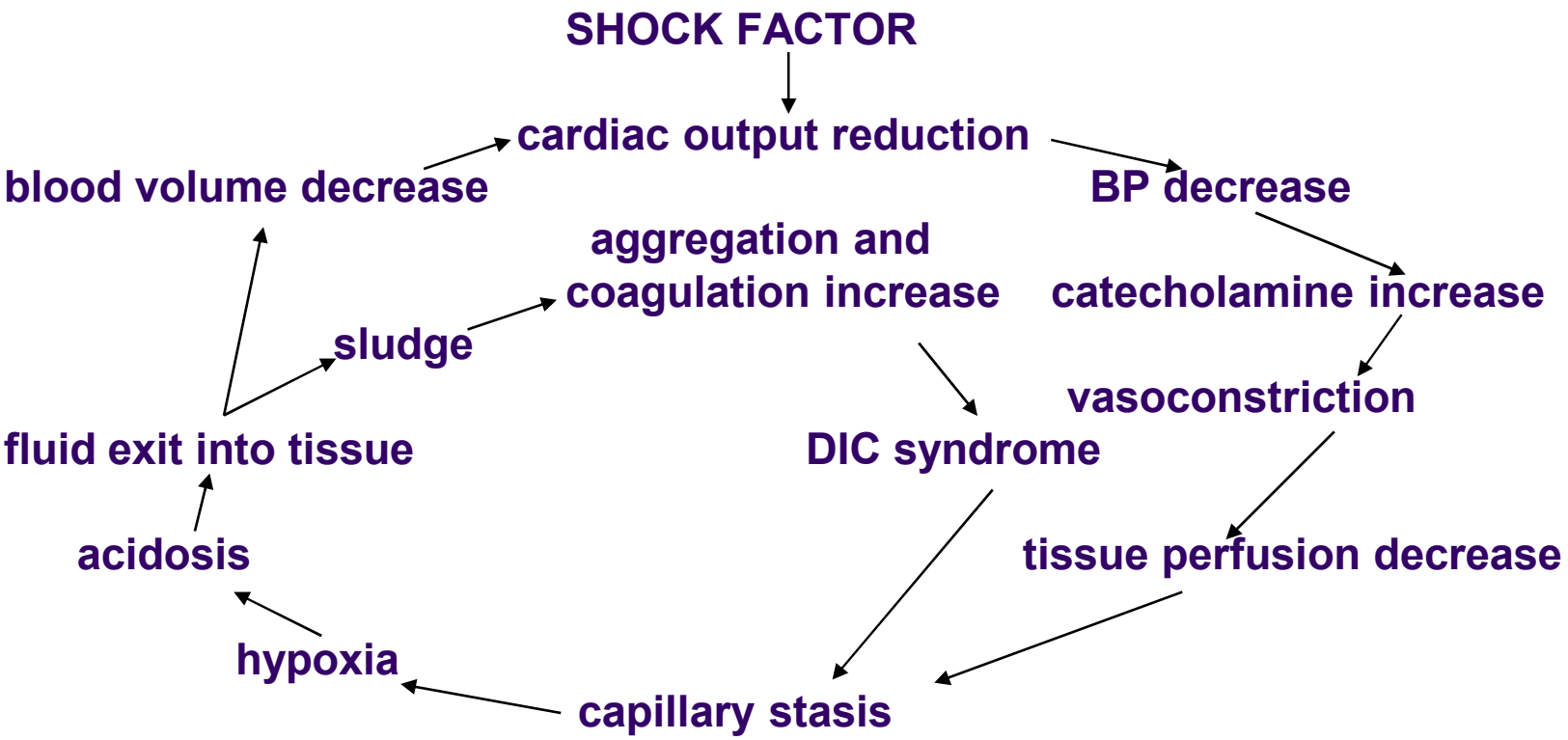


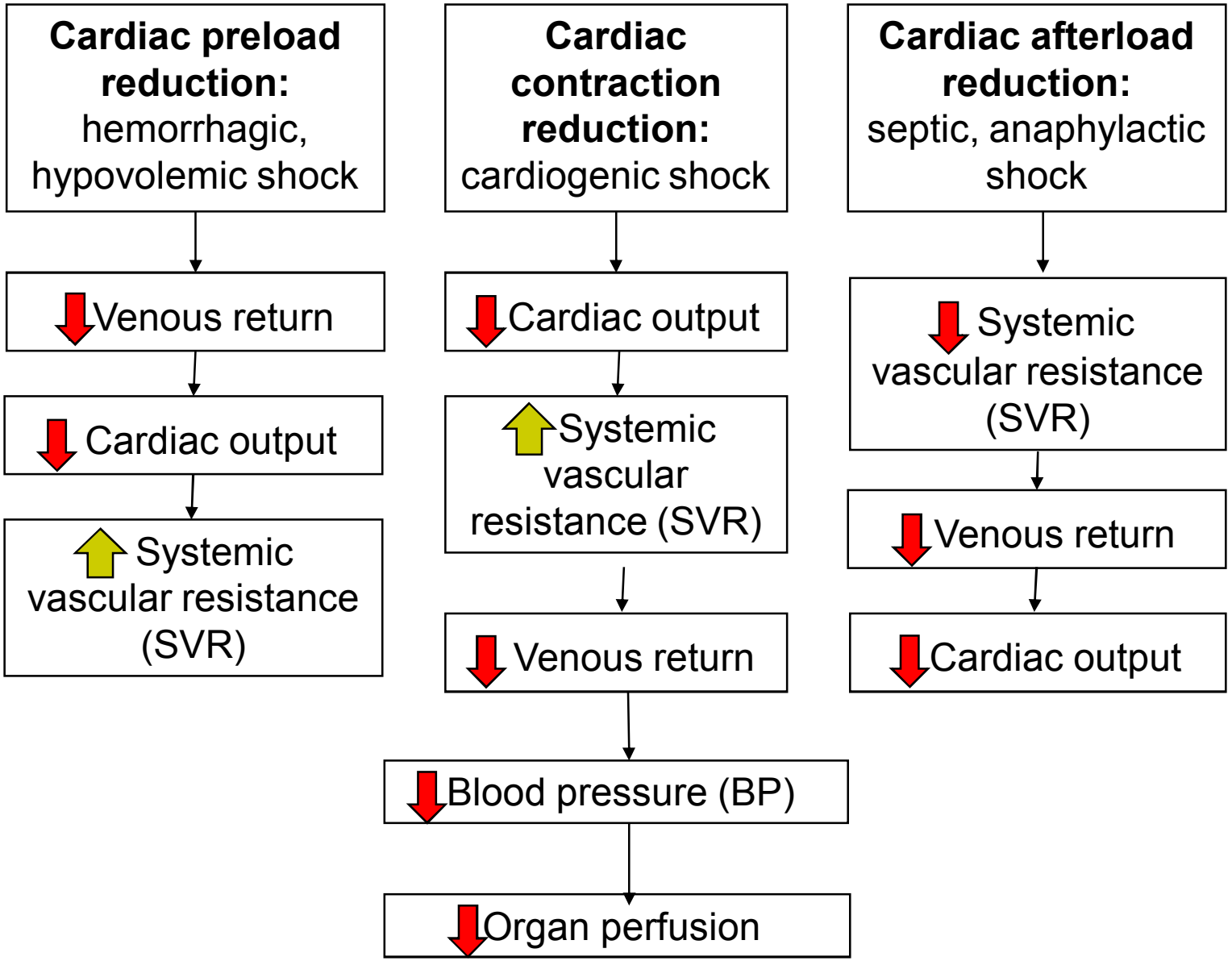
Shock is a nonspecific phase-course progressive clinical syndrome.

It is characterized by:

- **a decrease vital activity;**
- **insufficient blood circulation;**
- **hypoxia;**
- **deterioration of the exchange;**
- **excessive tension of regulatory mechanisms;**
- **gradual violation of the function and structure of organs and tissues due to serious disorders of microcirculation.**

Pathogenesis of shock
(R.N. Lebedeva et al., 1978)




Cardiac preload reduction: hemorrhagic, hypovolemic shock
Venous return
Cardiac output
Systemic vascular resistance (SVR)
Cardiac contraction reduction: cardiogenic shock
Cardiac output
Systemic vascular resistance (SVR)
Venous return
Blood pressure (BP)
Organ perfusion
Cardiac afterload reduction: septic, anaphylactic shock
Systemic vascular resistance (SVR)
Venous return
Cardiac output

Shock clinic (common features)

Stages of shock	Consciousness	RR	Pulse	BP	Daily diuresis	Other
I	Slightly inhibited	<25	90-100	>100/60	>500 ml	Pallor of the skin, decreased tendon reflexes
II	Braking lethargy	25-30	100-130	**>80/60**	<500 ml	Temperature reduction
III	Pronounced inhibition	>30	>130	>60/30	<50 ml	
IV	Absant	-//-	Filiform	<60/30	Anuria	Disappearance of reflexes, agony

Standart monitoring for shock:

•Pulse on the carotid and radial arteries, heart rate (HR), blood pressure (BP), central venous pressure (CVP);

•Respiratory rate (RR);

•Diuresis per hour;

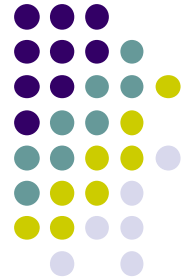
•Temperature;

•oximetry,

•hemoglobin, red blood cells, hematocrit;

•indicators of acid-base balance (pH, actual bicarbonate, standard bicarbonate, the amount of buffer systems, the deficit or excess of bases).

Clinical evaluation of peripheral hemodynamics

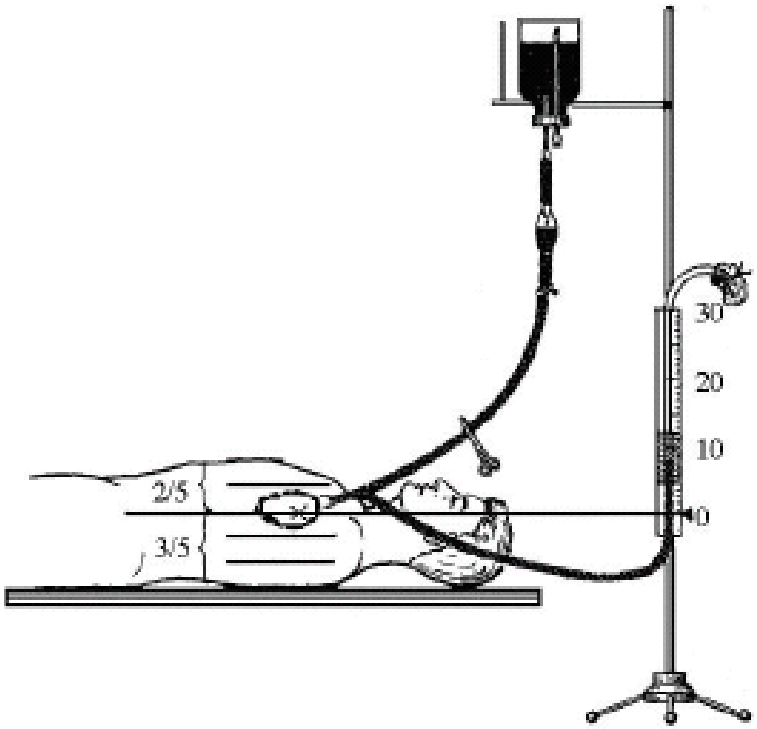


- Acrocyanosis on the background of pallor of the skin
- Skin temperature
- Nail bed reperfusion / white spot symptom
- Minute / hour diuresis

Clinical evaluation of central hemodynamics

- Pulse
- Blood pressure (systolic, diastolic, pulse, mean)
- Central venous pressure
- Minute Blood Circulation Volume / Cardiac Index
- Systemic Vascular Resistance

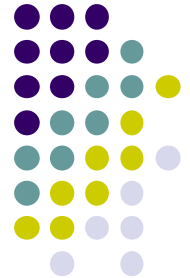
Central venous pressure



Measurement of CVD with Waldman phlebotonometer

- The main reason for the reduction of CVP is hypovolemia (absolute and relative)
- The main reason for the increase in CVP is a decrease in myocardial contractility
- CVP may be normal with a combination of factors that increase and decrease it.

Minute Volume of Blood Circulation

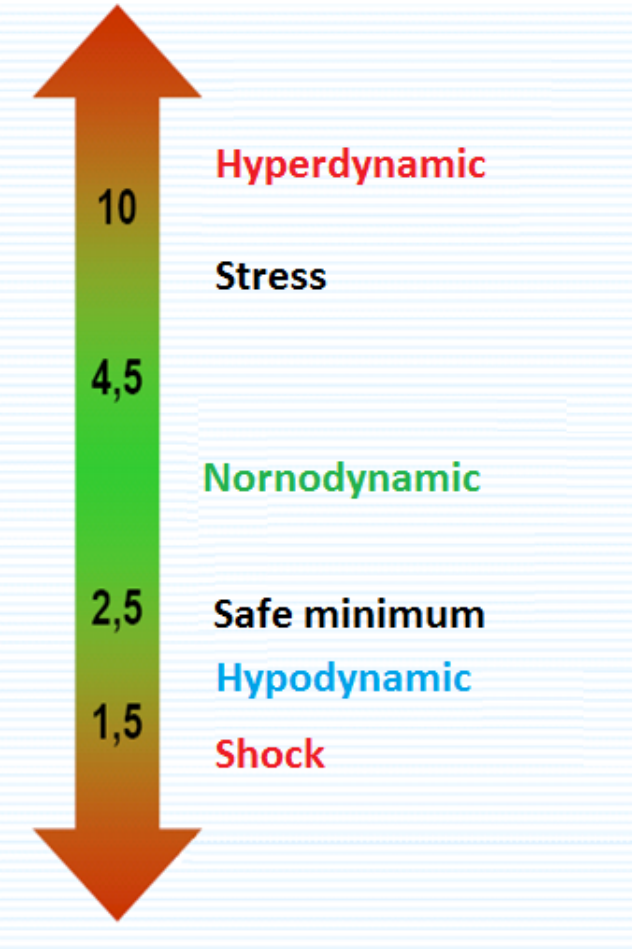


MVBC = cardiac output (CO) × heart rate (HR) (l/min)

Cardiac index (CI) = MVBC / body surface area (BSA) (l/(min*m^2)).

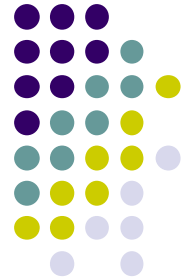
Normal CI = 3-4,5 l/(min*m^2) – normal hemodynamic

Clinical value of the cardiac index



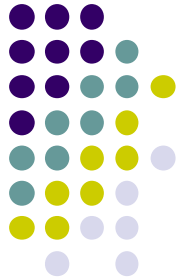
- Normal CI does not indicate normal tissue perfusion
- Reduced CI is always associated with poor tissue perfusion.
- CI - flow rate, but not pressure, BP correlates poorly with CI

Systemic Vascular Resistance (SVR)



- The calculated value determines the ratio of the minute volume of blood circulation and mean arterial pressure (MAP)
- SCR = Systolic BP / MVBC
- SCR in healthy people is from 1200 to 2500 Dyne / sec * cm3
- In order to compare different people, calculate the specific peripheral vascular resistance (SPVR)
- SPVR = Systolic BP / CI
- The normal value of the SPVR depends on gender and age

Differential diagnosis of shock in terms of central hemodynamic parameters (hemodynamic profiles of shock)



Hypovolemic (hemorrhagic)

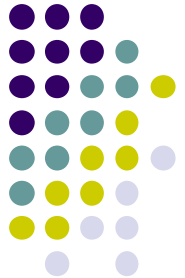
low PAWP* / low CI / high SVR

Distributive (septic)

low PAWP* / high CI / low SVR

*PAWP – pulmonary artery wedge pressure

Shock Diagnosis - Outcome

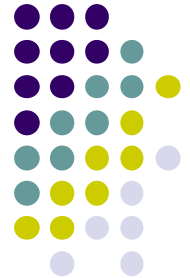


- In most clinical situations, both hypovolemia and blood redistribution occur.
- First of all, they diagnose and try to eliminate hypovolaemia;
- component not amenable to volume adjustment is considered distributive (or decrease in heart inotropic function)

Hemorrhagic shock

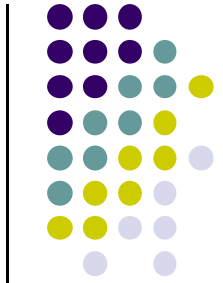
- Model hypovolemic shock
- Develops from the proportional loss of all blood components.
- The leading factor in circulatory disorders is hypovolemia.
- Factors affecting the oxygen status of tissues - hypoperfusion and anemia (decrease in blood oxygen capacity)

Infusion rate



- Inversely proportional to blood pressure
- In severe hypotension, the rate of infusion can be 200-300 ml per minute
- It is limited by the central venous pressure (can not exceed 8 mm Hg or 12 cm H_2O). If these indicators are exceeded, the rate of infusion has to be reduced, despite continued hypotension

Vasopressors?

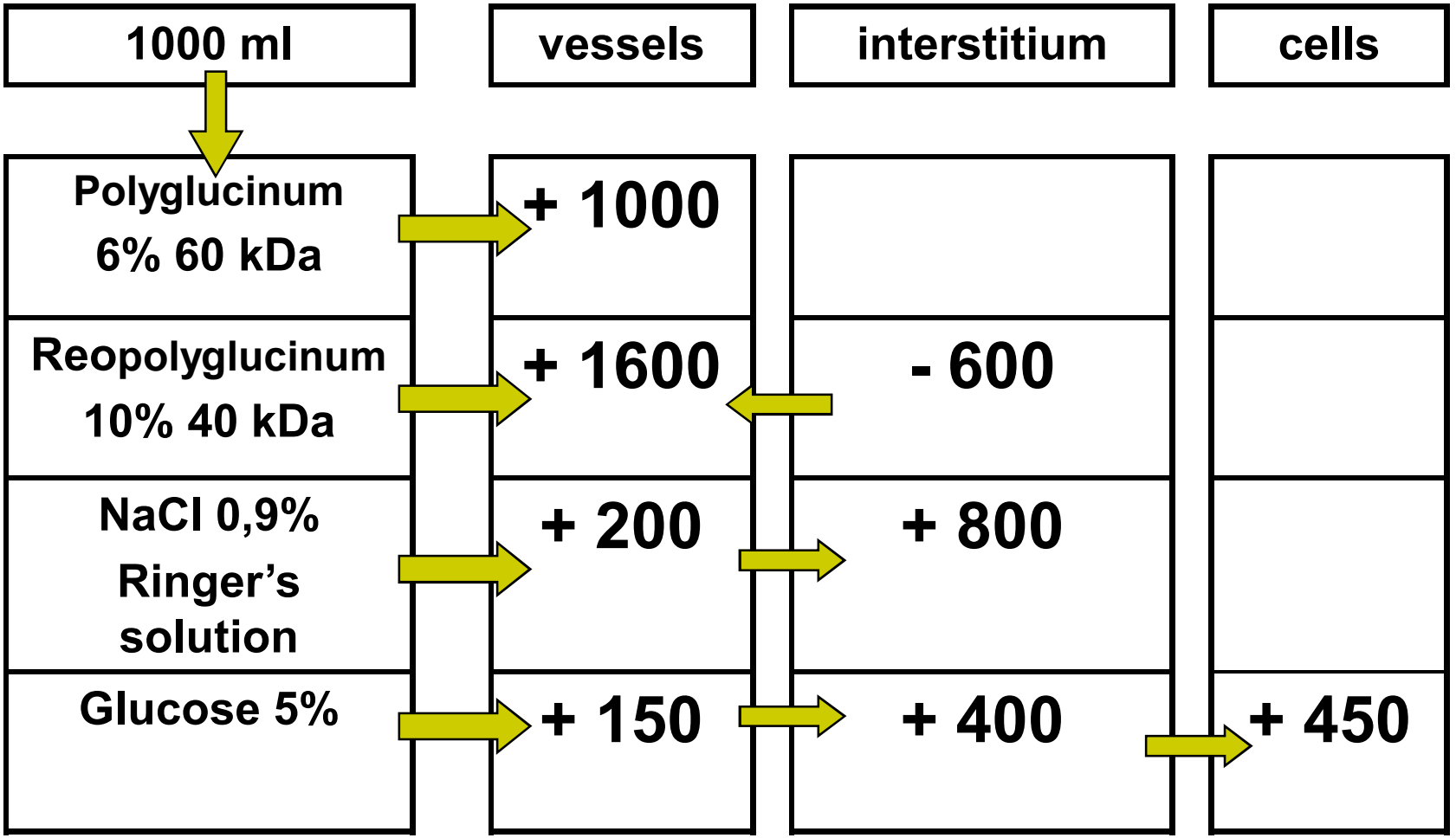


- In general, infusion of vasopressors in the early stages of hemorrhagic shock worsens survival results.
- Can be used as a means of despair.

Glucocorticosteroids?

- Glucocorticosteroids are used when adequate volume replacement does not lead to stabilization of blood pressure.
- In essence, this is a situation where we suspect acute adrenal insufficiency.
- The preferred drug is hydrocortisone.

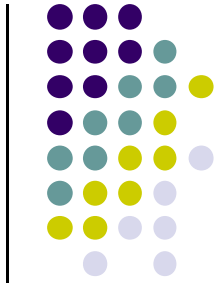
The approximate distribution of infusion media in the aquatic sectors of the body



CRITERIA OF EFFICIENCY OF CONDUCTED INFUSION-TRANSFUSION THERAPY

- Systolic blood pressure (BP) stabilization is not lower than 100 mmHg;
- The mean blood pressure (MBP) is not less than 80 mmHg;
- CVP at the level of 10-12 cmH2O (CVP below 3-5 cmH2O indicates continued hypovolemia).
- When CVP above 14-15 cmH2O a reduction in the rate of infusion and prescription of drugs with a positive inotoropic effect;
- Hourly diuresis at the level of 40-50 ml / hour;
- pO2 is not less than 80 mmHg, SaO2 not lower than 95%;
- Hematocrit is not lower than 25%.

Anaphulactic shock



Shock mixed by genesis - there is a significant loss of intravascular volume due to an increase in vascular permeability (in 10 minutes up to 50% of the liquid can escape from the vessels!)

and

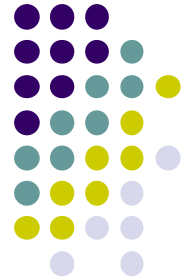
expansion of the capacitive veins, which forms a mechanism for redistribution.

RESULT: both hypovolemic and distributive disorders are present

Anaphylactic shock - features:

- Unforeseen, unavoidable complication
- Does not require verification of the diagnosis before treatment - therapy is started on suspicion alone
- Subsequent verification of the diagnosis - according to the activity of serum tryptase.

Clinical signs of anaphylaxis



Symptoms groups	Symptoms	Rate
Skin	Urticaria and swelling, redness, itching without redness	90%
Respiration	Shortness of breathing, wheezing, edema of respiratory tract mucosa, rhinitis	40-60%
Hemodynamic	Dizziness, fainting, hypotension	30-35%
Abdominal	Nausea, vomiting, diarrhea, abdominal pain	25-30%
Other	Головная боль, загрудинная боль, судороги	5-8%

Conclusions from the symptom table

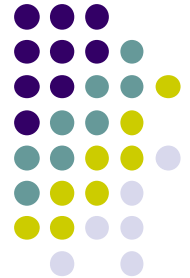
- Anaphylaxis usually develops two or more symptoms.
- Following any symptom you should wait for the next one, why not critical arterial hypotension?
- Skin symptoms are the most frequent. But not mandatory!
- Respiratory disorders occur in more than half of anaphylaxis cases.

Epinephrine - the first line drug in the treatment of anaphylaxis

Very important!

- Epinephrine is a treatment for any anaphylaxis, not just anaphylactic shock!
- While anaphylaxis has been diagnosed, but shock has not been diagnosed, epinephrine can be administered intramuscularly in a dose of 0.2-0.5 ml in adults (0.01 mg / kg for children, maximum 0.3 mg) every 5 minutes to control the symptoms of anaphylaxis

Shock Epinephrine - Tactics



- Intravenous - only with shock or with circulatory arrest
- From 0.1 to 0.3 ml per 10 ml of 0.9% sodium chloride intravenously every few minutes

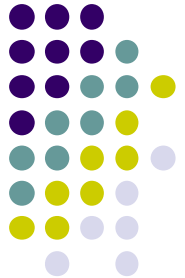
Or

- With a speed of 5-15 μg / min drip or dispenser constantly

Anaphylactic Shock - Urgent Events

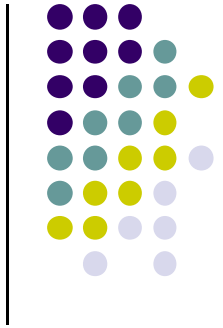
- Lay the patient, raise the lower limbs, if the situation allows
- Control of the respiratory tract and mechanical ventilation
- Adrenalin
- Oxygen therapy: with a long course, with pre-existing hypoxemia, with myocardial dysfunction, if β-agonists are applied, if necessary more than one dose of epinephrine
- 0.9% sodium chloride at a speed of 5 to 10 ml / kg of body weight in the first 5 minutes, you may need up to 7 liters.
- Consider second-line drugs: diphenhydramine (dimedrol), β-agonists by inhalation, vasopressor (dopamine), glucagon, glucocorticosteroids

Septic shock



- By the mechanism - almost pure distributive shock, but often superimposed on pre-existing hypovolemia
- Currently, there is no differential diagnosis between “hypovolemic shock in sepsis” and “true septic shock” - there is a single treatment protocol.

Septic shock - emergency



- Ventilation and oxygenation control
- Hemodynamic management - early targeted therapy
- Emergency diagnosis of flora
- Antibacterial therapy
- Emergency diagnosis and control of the source of infection
- Blood glucose control

Всероссийское научное общество кардиологов

Диагностика и лечение
острой сердечной недостаточности

Российские рекомендации

Разработаны Комитетом экспертов
*Всероссийского научного общества кардиологов**

Секция неотложной кардиологии

Москва 2006

«Cardiogenic shock – clinical syndrome, characterized by hypoperfusion of tissues because acute cardiac failure, which persist after preload correction».

European Heart Journal (2008) 29, 2388–2442
doi:10.1093/eurheartj/ehn309

ESC GUIDELINES

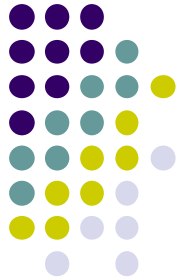
ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2008‡

The Task Force for the Diagnosis and Treatment of Acute and Chronic Heart Failure 2008 of the European Society of Cardiology. Developed in collaboration with the Heart Failure Association of the ESC (HFA) and endorsed by the European Society of Intensive Care Medicine (ESICM)

Authors/Task Force Members: Kenneth Dickstein (Chairperson) (Norway)*,

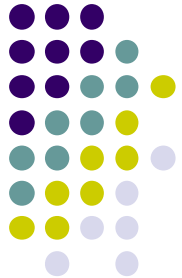
Cardiogenic shock (low output syndromes)

SHOCK TREATMENT



- 1. Elimination of the shock factor, first aid.
- 2. Blockade of the flow of pain and non-painful pathological impulses
- 3. Elimination of hemodynamic disorders strictly in accordance with their pathogenesis.
- 4. The fight against reperfusion syndrome (correction of the acid-base state, water and electrolyte balance, metabolic correction, detoxification, treatment of DIC, maintenance of vascular tone)
- 5. Elimination of manifestations of multiorgan dysfunction.

Indications for opertions

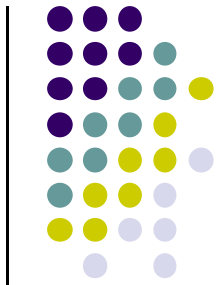


1. Continuing bleeding that cannot be stopped by other methods.

2. Asphyxia

3. The presence of a septic focus during septic shock with stabilization of central hemodynamics.

Exit Shock Criteria



1. Stable blood pressure more than 110 mm Hg

2. Stability of the contractile function of the myocardium (not more than 100-110 beats / min)

3. Sufficient diuresis (more than 50 ml / hour)

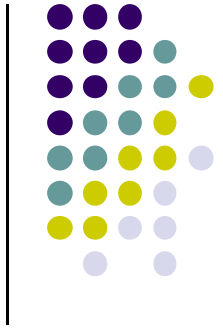
4. Normal or elevated body temperature

5. Lack of respiratory disorders

6. Lack of neurological disorders

7. Relief of acidosis and DIC

8. Positive values of CVP.



Thank you for attention!