Sepsis
Definition

• **Sepsis** is defined as the presence (probable or documented) of infection together with systemic manifestations of infection.
Main features

Sepsis is a generalized infectious disease with special characteristics:

• Various etiology (polyethiological) – can be caused by various bacteria [or fungi]
Main features

• Non-contagious – doesn’t spread from person to person

Impossible to create animal model
Main features

- Acyclic – no stages or phases

Always leads to death

- Acute infection
- Chronic infection
- Sepsis

Prodromal → Remission → Recovery

Height → Exacerbation

Disease vs. time
Main features

• Specific immune state:
  – inadequate, imperfect immune reaction;
  – inability to limit spreading of infection in the organism;
  – hyperergic reaction leading to tissue damage;
  – no postinfectious immunity
Main features

• No specific morphology
Main trends

• Over the past 50 years the incidence of sepsis in most countries has increased more than 10 times
• Mortality has not changed significantly – about 30-50%
• Most common admission diagnosis to ICU
• In the US, approximately 750,000 cases yearly with 225,000 fatalities
High incidence and mortality rate due to:

- changes in epidemiological situation;
- growth of pathogenicity of microflora (including endogenous);
- changes in immunoreactivity of the organism caused by environmental and socio-economic factors;
High incidence and mortality rate due to:

- increase in the number of diseases and states leading to secondary immunodeficiency (e.g. immunosuppressive therapy);
- ungrounded and incorrect use of antibiotics leading to antibiotic resistance of microbes;
- changes in the definition of sepsis;
- high number of invasive procedures
Classification

• According to etiology:
  – aerobic:
    • Gram (+): staphylo- or streptococci
    • Gram (-): E. Coli, Ps. aeruginosa, Proteus
  – anaerobic:
    • clostridial
    • non-clostridial
  – [fungal]
  – {nosocomial} – hospital-acquired infection
Classification

• **According to site of entry:**
  – otogenic;
  – odontogenic;
  – urogenic;
  – umbilical;
  – uteral;
  – osteogenic;
  – surgical;
  – pneumoniagenic etc.
Clinical features

• Sepsis = bacteremia + SIRS

Systemic Inflammatory Response Syndrome
Bacteremia

• is the presence of viable bacteria in the blood;
• is most commonly diagnosed by blood culture;

• Some medical procedures (catheterization, intubation and even oral hygiene, such as brushing teeth or flossing) can cause transient but harmless bacteremia
Systemic inflammatory response syndrome (SIRS)

- SIRS is the body’s response to infection, inflammation, stress (non-specific reaction);
- Must have **at least 2** of the following:
  - Temperature $>38.5^\circ \text{C}$ or $<36^\circ \text{C}$
  - Heart rate $>90$ beats/min
  - Respiratory rate $>20$ breaths/min or $\text{PaCO}_2 < 32 \text{ mmHg}$
  - WBC $>12,000$ cells$/\text{mm}^3$, $<4000$ cells$/\text{mm}^3$, or $>10\%$ immature (band) forms
Severe sepsis

Severe sepsis = sepsis + *at least one* sign of organ hypo-perfusion or dysfunction:

- Areas of mottled skin
- Capillary refill > 3 secs
- Lactate > 2mmol /L
- Altered mental status
- Abnormal EEG

- Disseminated intravascular coagulation
- ARDS
- Cardiac dysfunction on echo
- Plt < 100
- etc.
Septic shock

• Septic shock – sepsis-induced hypotension despite adequate fluid resuscitation
Who is most likely to get severe sepsis?

- Elderly
- Immunocompromised
- Chronically ill
- Newborns
Morphology, local changes

• **Site of entry** – site of penetration of microbes into the organism

• **Septic focus** – focus of inflammation (usually purulent)

• Usually septic focus is localized in the site of entry (except of *septic endocarditis*)
Morphology, local changes

• Infection spreads through the lymph and blood vessels from septic focus.

lymphangitis, lymphadenitis, thrombophlebitis
Confluent bronchopneumonia. Affection involves multiple areas of the lung. The foci may flow together giving rise to abscesses.
Morphology, general changes

• inflammatory and...
• ... dystrophic changes in parenchymal organs (liver, kidneys, myocardium etc.);
• hyperplastic changes in lymphoid tissue (spleen, lymph nodes) and bone marrow;
• generalized vasculitis
Clinical and morphological forms

- septicemia;
- septicopyemia;
- septic (infective, bacterial) endocarditis;
- chronic sepsis
Septicemia, clinical features

• pronounced toxemia;
• hyperergic reaction;
• no septic “metastases”,
• rapid clinical course (fulminant);
• septic focus is poorly expressed or absent (cryptogenic sepsis)
Septicemia, morphology

• hemolytic jaundice;
• hemorrhagic syndrome (petechial rash on the skin, bleeding in the mucous and serous membranes);
• marked hyperplasia of lymphoid and hematopoietic tissue (immature hematopoietic cells, foci of extramedullary hematopoiesis);
• vasculitis (toxic-allergic, with fibrinoid changes of vessel walls);
• interstitial inflammation in parenchymal organs
Septicemia, morphology

Interstitial myocarditis
Septicemia, morphology

Lymph node hyperplasia
Septicemia, morphology

Splenomegaly
Septicemia, morphology

Hemolytic jaundice and hemorrhagic syndrome
Septicopyemia, clinical features

- less pronounced toxemia;
- weak hyperergic reaction;
- septic "metastases",
- prolonged clinical course;
- septic focus is prominent
Septicopyemia, morphology

• suppurative inflammation at the site of entry;
• septic focus is accompanied with suppurative lymphangitis and lymphadenitis, thrombophlebitis;
• septic “metastases” – secondary abscesses in organs and tissues, phlegmon, empyema
Septicopyemia, morphology

Embolic purulent nephritis
Septicopyemia, morphology

Embolic purulent nephritis
Septicopyemia, morphology

Liver abscess
Septicopyemia, morphology

Brain abscess
Septicopyemia, morphology

Purulent meningitis
Septic endocarditis

• form of sepsis, which is characterized by heart valves lesion
Septic endocarditis

• Hyperergic reaction is typical
• It is associated with the action of circulating immune complexes, which contain the antigen of the pathogen
Septic endocarditis

• on intact valves - primary septic endocarditis (Chernogubov’s disease)
• on previously affected valves – secondary septic endocarditis (70-80%), mainly
  – after rheumatic heart disease;
  – after valvular atherosclerosis;
  – due to congenital valvular defects;
  – on prosthetic valves
Septic endocarditis

- 50% - aortic valve;
- 10-15% - mitral valve;
- 25-30% - aortic and mitral valves;
- 5% - other
Septic endocarditis

• Polypous ulcerative endocarditis:
  – Destruction of valve
  – Extensive thrombotic masses that easily break away from valve leading to thromboembolysis
Septic endocarditis

• ulcerative defects on sclerosed and deformed valve;
• defects may lead to a violation of the integrity of the valve;
• acute aneurysm and rupture of the valve;
• massive (purulent) destruction of the valve.
Septic endocarditis
Septic endocarditis
Septic endocarditis, general changes

• Alterative-productive changes in vessels (plasmorrhages, fibrinoid necrosis of the walls of capillaries, arterioles and veins, endo- and perivasculitis)

• In medium-caliber vessels these changes may lead to aneurysm, rupture which can lead to hemorrhage in vital organs. The size of the aneurysm ranged from a pea to a walnut. Sometimes they can be thrombosed, causing circulatory disorders.
Septic endocarditis, general changes

- Hemorrhagic syndrome: petechial hemorrhages in the skin, serous and mucous membranes
- Spleen - enlarged, with infarcts.
- Kidney - diffuse immune complex glomerulonephritis, infarcts.
- Brain - foci of infarcts and hemorrhage (as a result of vascular changes and thromboembolism)
Septic endocarditis

Spleen infarcts
Septic endocarditis

Kidney infarcts
Septic endocarditis, classical signs

• petechial hemorrhages in conjunctiva at the inner corner of the lower eyelid (Liebman spots);
• nodules on the palmar surface of hands (Osler nodules);
• thickening of distal phalanxles (drumsticks);
• hemorrhages in the skin and subcutaneous fat (Janeway spots);
• jaundice
Septic endocarditis

Petechial haemorrhages in the conjunctiva
Complications and causes of death in sepsis

- septic metastasis in vital organs;
- thromboembolysis syndrome;
- congestive heart failure at the massive destruction of the valve;
- chronic heart failure in the progression of sclerosis in valve;
- acute adrenal insufficiency;
- respiratory failure as a result of pneumonia, lung abscess, pleural empyema;
- development of secondary amyloidosis;
- bacterial (septic) shock