



### Sepsis

Lecture of general surgery Chorna I.O.



Poltava



Sepsis is a serious medical condition that is characterized by a whole-body inflammatory state (called a systemic inflammatory response syndrome or SIRS) and the presence of a known or suspected infection..

- It is a severe illness caused by overwhelming infection of the bloodstream by toxin-producing bacteria, virus, parasites or fungus.
- The body may develop this inflammatory response to microbes in the blood, urine, lungs, skin, or other tissues



An **incorrect** layman's term for sepsis is blood poisoning, more aptly applied to Septicemia, below is a serious medical condition that is characterized by a whole-body inflammatory state (called a systemic inflammatory response syndrome or SIRS) and the presence of a known or suspected infection. The body may develop this inflammatory response to microbes in the blood, urine, lungs, skin, or other tissues. An incorrect layman's term for sepsis is blood poisoning, more aptly applied to Septicemia, below.



### Causes

- Sepsis is caused by a bacterial infection that can begin anywhere in the body.
- Common places where an infection might start include:
- The bowel (usually seen with peritonitis)
- > The kidneys (upper urinary tract infection or pyelonephritis)
- > The lining of the brain (meningitis)
- > The liver or the gall bladder
- The lungs (bacterial pneumonia)
- The skin (cellulitis)
- In children, sepsis may accompany infection of the bone (osteomyelitis). In hospitalized patients, common sites of infection include intravenous lines, surgical wounds, surgical drains, and sites of skin breakdown known as bedsores (decubitus ulcers).



### Classification

There is the primary and secondary sepsis.

- The primary or cryptogenetic is appeared under the lack of fixed primary focus.
- The secondary is appeared on the back-ground of primary purulent focus.
- On localization of primary focus distinguish:
- Surgical (wound);
- Angiogenic
- Obstetric-gynecological;
- Urologic;
- Odontogenus,
- Kateterus
- Otogenous;
- Oral and others.



### Etiology

- Gram-positive (staphylococcal, streptococcal);
- Gram-negative (intestinal, pyocyanogenetic, proteus);
- Anaerobic (clostridium and an clostridium);
- Fungus

# Necrotizing soft tissue infection of the lower abdominal wall causing sepsis





# Line sepsis







#### 1.Petechiae rash

2.More advanced septicemia

### Flegmon of hand



#### Umbilicalis sepsis





#### Odontogenical sepsis



# Candida sepsis



# **Populations at risk**

- Although anyone at any age is potentially at risk of developing sepsis from a minor infection (flu, urinary tract infections, gastroenteritis...), certain populations may be at greater risk:
- the elderly and the very young
- immunocompromized patients
- people with pre-existing conditions (such as trauma, burns, surgery, or cancer)
- hospitalized patients are particularly vulnerable, since they are already sick, often require an intravenous tube, urinary catheter or wound drainage, and may become infected with an antibiotic-resistant microorganism due to widespread use of antibiotics in hospitals.



# Stage of sepsis

- **Bacteremia** is the presence of viable bacteria in the bloodstream. Elementary (primary) phase (toxemia, toxicemia, toxicohemia, toxinemia);
- Septicemia medical term referring to the presence and reproduction of pathogenic organisms in the blood-stream, leading to sepsis. Likewise, the terms viremia and fungemia simply refer to viruses and fungi in the bloodstream.
- Septicopyemia is the purulent metastasis in different organs.



- Sepsis is common and also more dangerous in elderly, immunocompromised, and critically-ill patients.
- It occurs in 1–2% of all hospitalizations and accounts for as much as 25% of intensivecare unit (ICU) bed utilization. It is a major cause of death in intensive-care units worldwide, with mortality rates that range from 20% for sepsis to 40% for severe sepsis to >60% for septic shock.





### Sepsis

#### A critical condition resulting from the immune response to bacteria in the bloodstream.

# **Development and progressins**

Tissue



GeneEd

Tissue

# The modern concept of sepsis

- The modern concept of sepsis is that the host's immune response to the infection causes most of the symptoms of sepsis, resulting in hemodynamic consequences and damage to organs. This host response has been termed systemic inflammatory response syndrome (SIRS) and is characterized by hemodynamic compromise and resultant metabolic derangement.
- Outward physical symptoms of this response frequently include a
- high heart rate (above 90 beats per minute),
- high respiratory rate (above 20 breaths per minute),
- elevated WBC count (above 12,000) and
- elevated or lowered body temperature (under 36°C or over 38°C).
- Sepsis is differentiated from SIRS by the presence of a known pathogen. For example SIRS and a positive blood culture for a pathogen indicates the presence of sepsis. Without a known infection you can not classify the above symptoms as sepsis, only SIRS.



### **Symptoms**

- In sepsis, blood pressure drops, resulting in shock. Major organs and body systems, including the kidneys, liver, lungs, and central nervous system, stop working properly.
- A change in mental status and hyperventilation may be the earliest signs of sepsis. In general, symptoms of sepsis can include:
- Fever (increased temperature) or coolness (decreased temperature)
- Chills
- Confusion or delirium, mental changes, Fatigue, Headache, Anxiety
- Decreased urine output (kidney dysfunction)
- Fever or low body temperature (hypothermia)
- Hyperventilation-Rapid breathing, Difficulty breathing, cough
- Lightheadedness due to low blood pressure
- Rapid heart beat, Chest pain (abnormal function of the heart)
- Shaking
- Skin rash
- Warm skin
- Abdominal pain
- Nausea and vomiting
- Pelvic or flank pain



# **Clinical stage**

- Sepsis bacteriemia-cepticemia-cepticopiemia
- Lightning;
- Acute;
- Sub-acute;
- Severe sepsis
- Septic shock
- Chronic





#### Sepsis is the host response to infection



# **Severe Sepsis/SIRS**

- Severe sepsis arises when sepsis occurs in combination with problems in one or more of the vital organs, such as the heart, kidneys, lungs, or liver (Hypoperfusion and perfusion abnormalities may include, but are not limited to, lactic acidosis, oliguria, or an acute alteration in mental status.).
- Multiple organ dysfunction syndrome (MODS) is characterized by the presence of altered function of two or more organs in an acutely ill patient, such that homeostasis cannot be maintained without intervention.
- Because of problems with their vital organs, people with severe sepsis are likely to be very ill and are more likely to die (in 30% to 35 % of cases) than those with uncomplicated sepsis.





### Systemic Inflammatory Response Syndrome(SIRS) Prognosis



www.ipgdx.com



### **Septic Shock**

- Septic shock occurs when sepsis is complicated by low blood pressure that does not respond to standard treatment (fluid administration, use of vasopressors) and leads to problems in one or more of the vital organs as described above.
- The condition means that the body does not receive enough oxygen to properly function. Septic shock patients are very ill and need rapid emergency admission to the hospital intensive care unit (ICU). Despite active treatment in the ICU, the death rate is around 50%.
- In some people the syndrome progresses through all three stages. Despite optimal care, some patients may not respond to treatment and may develop MODS, and eventually die.



### Lungs

### acute lung injury (ALI) (PaO<sub>2</sub>/FiO2 < 300) or acute respiratory distress syndrome (ARDS) (PaO<sub>2</sub>/FiO<sub>2</sub> < 200)</li>







### Brain

- encephalopathy symptoms:
- agitation
- confusion
- coma
- etiologies:
- ischemia
- hemorrhage
- microthrombi
- microabscesses
- multifocal necrotizing leukoencephalopathy





disruption of protein synthetic function: manifests

Liver



- acutely as progressive coagulopathy due to inability to synthesize clotting factors
- disruption of <u>metabolic functions</u>: manifests as cessation of bilirubin metabolism, resulting in elevated unconjugated serum bilirubin levels (indirect bilirubin)





oliguria and anuria
electrolyte abnormalities
volume overload







 systolic and diastolic heart failure, likely due to cytokines that depress myocyte function

 cellular damage, manifest as a troponin leak (although not necessarily ischemic in nature)





### Toxic lien





# Septic Shock

xtranormai

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#### Effects of Sepsis



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CALL

Leaking vessels impair the body's ability to pump blood, (containing vital nutrients) to surrounding tissues and organs.

Decreased blood flow to organs results in poor nutrient exchange and tissue swelling



Vasodilation occurs, and fluid leaks from blood vessels into surrounding tissues



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### SIRS, Sepsis, and Septic Shock Criteria

#### Defines the severity of sepsis and septic shock.

#### SIRS Criteria (≥ 2 meets SIRS definition)

- Temp >38°C (100.4°F) or < 36°C (96.8°F)?</p>
- Heart Rate > 90?
- Respiratory Rate > 20 or PaCO2 < 32 mm Hg</p>
- WBC > 12,000/mm>3, < 4,000/mm>3, or > 10% bands?

#### Sepsis Criteria (SIRS + Source of Infection)

Suspected or Present Source of Infection?

#### **Severe Sepsis Criteria**

- Organ Dysfunction, Hypotension, or Hypoperfusion?
- Lactic Acidosis, SBP <90 or SBP Drop >40 mm Hg of normal, etc

#### Septic Shock Criteria

- Severe Sepsis with Hypotension, despite adequate fluid resuscitation? Multiple Organ Dysfunction Syndrome Criteria
- Evidence of ≥ 2 Organs Failing?
- Patient has none of these

None presense

### Welcome to:

# Sepsis, Sepsis Syndrome, and Septic Shock

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We will be starting shortly...

#### Table 1 – Sepsis, SIRS, and MODS: Defining the terms<sup>12</sup>

Term	Definition
Systemic inflammatory response syndrome (SIRS)	Response is manifested by 2 or more of the following conditions: • Temperature > $38^{\circ}$ C ( $100.4^{\circ}$ F) or < $36^{\circ}$ C ( $96.8^{\circ}$ F) • Heart rate > 90 beats per minute • Respiration rate > 20 breaths per minute or Paco <sub>2</sub> < $32 \text{ mm Hg}$ • White blood cell count > $12,000/\mu$ L, < $4000/\mu$ L,
	or > 10% immature (band) forms
Sepsis	Systemic response to an infection defined by 2 or more SIRS criteria as a result of an infection
Severe sepsis	Sepsis associated with organ dysfunction, hypoperfusion or hypotension
Septic shock	Sepsis-induced hypotension despite adequate fluid resuscitation along with presence of perfusion abnormalities
Multiple organ dysfunction syndrome (MODS)	Presence of altered organ dysfunction in an acutely ill patient



## **Exams and mains tests**

The infection is often confirmed by a blood test - Blood culture –to detect microorganisms and evaluate their susceptibility to antimicrobial drugs. However, a blood test may not reveal infection in people who have been receiving antibiotics.

#### Other tests that may be done include:

- Blood gases
- Kidney function tests
- Platelet count
- White blood cell count
- Blood differential
- Fibrin degradation products
- Peripheral smear



### Laboratory Tests

#### **Testing may include:**

- Urine culture and cultures of other body fluids as indicated to detect the source and type of infection
- CBC (Complete blood count) to evaluate red and white blood cells and platelets
- Lactate increased levels can indicate organ dysfunction
- Blood gases to evaluate oxygen in the blood and acid-base balance
- Procalcitonin sometimes used to distinguish sepsis and other conditions that cause similar symptoms
- Comprehensive metabolic panel (CMP) to monitor organ status, electrolyte balance, and blood glucose
- PT and/or PTT or other clotting tests to evaluate clotting status
- C-reactive protein (CRP) to detect inflammation in the body
- In addition to the tests listed above, CSF analysis may sometimes be ordered if it is thought that the person has meningitis.
- Other tests as indicated may be done to help evaluate health status or to rule out other conditions, such as cardiac biomarkers to detect a heart attack.



# **Blood culture**

optimum conditions to have the best possible chance of detecting the bacteria/yeast responsible for the infection.

#### Method

- A minimum of 10 ml of blood is taken through vein puncture and injected into two or more "blood bottles" with specific media for aerobic and anaerobic organisms.
- The blood is collected using aseptic technique. This requires that both the tops of the culture bottles and the venipuncture site of the patient are cleaned prior to collection with swabs 70% isopropyl alcohol.
- Normal results. Normal results will be negative. A single negative culture does not rule out a blood infection. False negatives can occur if the person was started on antibiotics before the blood was drawn, if the environment for growth was not right, the timing was off, or for some unknown reason the microorganism just didn't grow. Three negative cultures may be enough to rule out bacteremia



### Abnormal results

- The physician's skill in interpreting the culture results and assessing the person's clinical condition is essential in distinguishing a blood culture that is positive **because of a true infection from a culture** that is positive because it became contaminated. In true bacteremia, the patient's clinical condition should be consistent with a blood infection caused by the microorganism that was found. The microorganism is usually found in more than one culture, it usually grows soon after the bottles are incubated, and it is often the cause of an infection somewhere else in the person's body.
- When the culture is positive because of contamination, the patient's clinical condition usually is not consistent with an infection from the identified microorganism. In addition, the microorganism is often one commonly found on skin, it rarely causes infection, it is found in only one bottle, and it may appear after several days of incubation. More than one microorganism often grow in contaminated cultures.

### Enterococcus faecalis in a Blood Culture



## E. coli bacteria in blood culture.

### SCIENCEPhotoLIBRARY

### Enterococcus histological pneumoni





# **Non-Laboratory Tests**

- May be ordered to evaluate organ status, detect complications, and to detect location of infection:
- ECG to evaluate heart rhythm or injury
- X-ray
- CT (Computed Tomography) scan
- MRI (Magnetic Resonance Imaging)
- Ultrasound



# Treatment - 4 essential principles

- The International Surviving Sepsis Campaign has developed novel evidence-based guidelines around 4 essential principles:
- Hemodynamic resuscitation.
- Eradication of the infection (source control, systemic antibiotics).
- Sustained support of organ dysfunction in ICU(e.g. fluid therapy, mechanical ventilation, vasopressors, etc.)
- Use of target-specific mediators (e.g. recombinant human activated protein C, glucocorticosteroids).
- The **aim** of implementing these principles is to reduce the high level of mortality associated with sepsis.



### Treatment

- If patients have sepsis, its will be admitted to a hospital, usually the intensive care unit (ICU).
- Antibiotics are given through a vein (intravenously).
- Oxygen, fluids given through a vein, and medications that increase blood pressure may be needed.
- **Dialysis** may be necessary if there is kidney failure.
- A breathing machine (mechanical ventilation) is necessary if there is lung failure.
- For some patients, treatment with powerful antiinflammatory medications called corticosteroids or recombinant human activated protein C may be helpful.
- Surgical procedures are sometimes necessary to remove medical devices such as catheters that may be the source of the infection, to drain abscesses or fluids, to remove and/or fix damaged tissue, and to remove blockages.



# **Possible Complications**

- Death
- Disseminated intravascular coagulation
- Problems with blood flow to vital organs (brain, heart, kidneys)
- Septic shock



### Prevention

The risk of sepsis can be reduced, especially in children, by following the recommended immunization schedule. Careful handwashing procedures and care of medical equipment can help prevent hospital-related infections that lead to sepsis. Thomas to the second se