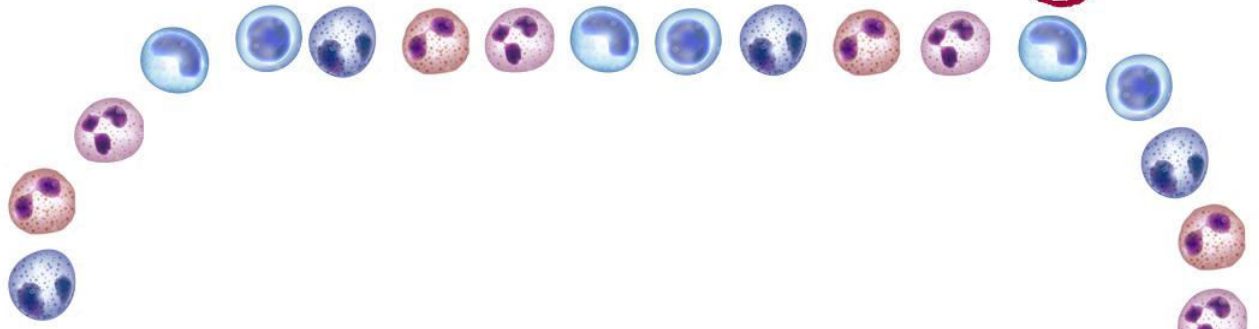


血 Hematology 血



-  Histology
-  Biochemistry
-  Pathology
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-  Physiology
-  Microbiology

 Handout

 Slide

 **Sheet**

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 lecture number : 1

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BACTEREMIA/SEPTICEMIA

Bacteremia :

- **Bacteremia : bacteria floating in the blood.**
- Bacteria can be introduced to the blood simply by brushing your teeth, then some bacteria will pass from your gum to the blood, also when you go to dentist and have a procedure with your teeth like tooth extraction. actually this bacteria will be removed very quickly by reticular endothelial system in the spleen with no bad consequences , **except in valvur heart disease which is a severe case .**

In valvular heart disease, patients had a rheumatic fever when they were young, and it had damaged their heart valves, so their valves are no longer smooth and this actually precipitates bacteria that will set in the valves and damage them and this infection is known as **sub-acute bacterial endocarditis** ,so really bacteremia is not a problem in a normal person .but Sometimes in normal persons you can have the bacteria that will go to some side in the body and produce infection there for example: osteomyelitis can be blood borne like in femur infection or whatever place actually originate from bacteria that travels in blood ,sometimes even kidney infections may be blood borne !

Septicemia :

Septicemia : is poisoning of the blood.

nowadays we do not use septicemia anymore, it became old fashioned and we use the term sepsis, so **sepsis is the presence of bacteria, their toxins or their toxic metabolites in the blood.** (The blood is involved in the infection)

Sepsis can vary in severity, so at one end of the spectrum there is mild sepsis then in the middle there is intermediate, and in the other side of the spectrum we have the most serious complication which is called **septic shock. shock: is a state of very low blood pressure and the patient loses of consciousness because of severe hypotension .**

And Shock can be of many etiologies, like we have anaphylactic shock , hypovolumic shock and septic shock.

Sepsis is associated with theses symptoms:

- 1- **Fever:** the temperature above 38°C in most people, but in young or old people you may find a low temperature below 36°C .
- 2- **Increase heart rate** because there is infection , so usually you got a heart rate which is **above 90 per minute**.
- 3- **Increase in respiration** usually **above 20 per minute** .
- 4- **Evidence of infection:** like increase in white blood cells, or a shadow on the lung in case of pneumonia, or symptoms that belong to urine extract or there is an abdominal pain

You must have at least 2 of the previous 4 to say that this person has sepsis. in **mild** sepsis you should have at least 2 from the 4. It has to be detected and treated immediately because if you ignore it ,you will get a more severe sepsis and end with septic shock .

The mortality rate of septic shock is more than 50% (may reach to 70%) . So the faster you diagnose sepsis, the more likely to be able to save the patient.

Now how do you decide that this person has to go to from mild sepsis to severe sepsis ? 'Symptoms other mentioned above'

- 1- sudden onset of **confusion**, means you get to severe sepsis .
- 2- Distress in respiration.
- 3- **malfunction of the heart** : the heart is not pumping blood properly, it start going to heart failure .
- 4- **severe decrease in urine output** that means your kidneys do not work properly .
- 5- you may have **severe abdominal pain** because of abdominal pathology .
- 6- **drop of platelets**

If any of these symptoms is added to those mentioned before, this means that the patient's state is worse and he has become under severe sepsis. the last stage after that is actually **septic shock**, in which severe hypotension 'that can't be relieved' is accompanied to the previous symptoms, and the patient most properly will die .

So from that you can know that there's infection in the blood and it's what developed the malfunction of heart , kidney , liver and also there is endocrine glands malfunction : hyperglycemia because no enough insulin is

being produced , also your adrenals will not respond to the cortico-axis coming from the brain, so you'll find that there is no enough corticosteroid.

Organ failure is actually caused by the severe hypotension, that leads to low blood perfusion, so there's no enough blood reaching the organs then the organ fails. In addition to that, microthrombi will develop in small blood vessels with an extensive coagulation inside the vasculature of the body which is known as disseminated intravascular coagulation (DIC).

The main pathology in septic shock is the extensive immune response , in which macrophages secrete too much cytokines that damage our body. Normally, immune system is activated to get rid of the pathogen , but the extensive response leads to deleterious effect. "Too much of a good thing is a bad thing". -a reason of immune response is to get rid of bacteria and to kill them but in some cases you find that this immune response is so extensive that produce so much cytokines that do a lot of damage in the body and these cytokines are produced by macrophages .

The presence of lots of bacteria means lots of activated macrophages that produce large amounts of cytokines involved in septic shock . **Tumor necrosis factor (TNF) , IL-1 and IL-6** are the 3 main cytokines responsible for the pathogenesis of septic shock .

TNF especially activates Neutrophils and increases the adhesiveness of the endothelium to these neutrophils and macrophages. These cells in turn stick to the Endothelial cells and release their hydrolytic enzymes causing injury to the endothelium. The injury then promotes coagulation along with the coagulation system found within these cells (this is increased by IL-1 and TNF mainly). This excessive coagulation is related to **Disseminated intravascular coagulation DIC**, in which the number of platelets goes down because they are used up through this coagulation. This may result later on in bleeding that cannot be stopped since most of the coagulation factors have been used up. DIC also clogs up blood vessels, especially small ones, and this deprives organs from blood supply which subsequently leads to their failure.

In addition to this, TNF has an effect on the heart and the blood vessels as it actually reduces the contractility of myocardium so it doesn't pump as well . It also produces dilatation of blood vessels leading to reduced peripheral resistance and a progression into severe hypotension of septic shock.

Toxic shock syndrome is produced by bacteria or their products. The main culprit is lipopolysaccharide (LPS). This means that septic shock is mostly derived from gram negative bacteria and we can call it Gram negative

septicemia. LPS activates macrophages that produce cytokines which damage the body. However, lipoteichoic acid and peptidoglycans of gram positive bacteria can also be a reason for toxic shock.

Some other bacterial products/toxins:

- 1- endotoxin: is a part of the bacterial cell and it's mainly LPS.
- 2- exotoxins are secreted by bacteria and are distributed into the environment. Some examples are streptococcus that produce toxic shock toxin and staphylococcus that produce Toxic shock syndrome toxin 1 (TSST1). These toxins actually do their job by acting as super antigens that connect the T-cell to the APCs non specifically and helps produce polyclonal activation.

Toxic shock due to the toxin or septic shock due to the bacteria are actually the same because sepsis is a condition caused either by bacteria or their products. Staph aureus for example produces toxins as it lives in tampons and causes toxic shock to menstruating women. Also in streptococcus infection not everybody who has tonsillitis or pharyngitis will end up with rashes and toxic shock syndrome unless erythrogenic toxins have been produced and act as super antigens.

Toxic shock is not only caused by bacteria, it can also be produced by fungi (Candida sepsis) or viruses. It's very important that you look for the source of infection which is usually a chest infection or abdominal sepsis like in appendicitis (appendix may rupture and cause sepsis) or meningitis.

During diagnosis you have to look for all these sources and you have to see the CSF, urine and take a swab of the womb. The specimens are then sent to the lab for examination and culture, however the lab results shouldn't be waited and these patients must be administered with intravenous broad spectrum antibiotics. After the results of culture specify different outcomes you may alter the treatment. Fluid transfer may also be needed and sometimes we have to put CP to monitor the pressure. Other vasopressor drugs may be used to contract and raise the peripheral resistance. You may have to do C.T. scans, ultrasounds and other means of diagnosis to actually discover the cause of infection. The earlier the infection is dealt with the better to avoid the patient getting into septic shock.

The most common causes are bacteria and usually it is more associated with gram negative bacteria and the most common cause of septic shock is E.choli



followed by *Pseudomonas aeruginosa* . The gram positive bacteria are staphylococcus and streptococcus.

***Waterhouse–Friderichsen syndrome (WFS), is an infection that also causes septic shock and death. Typically the pathogen is the meningococcus *Neisseria meningitidis*. It affects the adrenal glands causing failure due to bleeding.

I tried my best to write this sheet

Please forgive me for any mistake

Shaima Al-Haj