



microbiology

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number

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Pathogenic mechanisms in Bacteria

Definitions:

1) pathogenicity:

Pathogenic: causes disease.

We have bacteria which are highly pathogenic, and others are lowly pathogenic

For examples: *Neisseria meningitidis* is highly pathogenic, some strains of *E. coli* can cause meningitidis, (highly pathogenic), but other strains of *E. coli* can't do anything for our body.

2) virulence:

Pathogenic = virulence

What is the difference between virulence and Pathogenicity?

Virulence means disease causing but it is a measure of pathogenicity (quantitative).

We do it in experiment that tell us about LD50 (the dose of the bacteria which kills 50% of animals)

Any experiment in Bacteriology: I need to start with Bacterial strain, for example, I know that is *Streptococcus pneumoniae* but I want to know how virulent it is, so I do this experiment by using different infectious doses and see which dose gives me an infection and shows their virulence factors.

We also have ID50 = 50% of the infectious dose, require to infect half of the host organisms.

Another important terms:

*what the pathogen dose to the host is called virulence.

*what the host dose to the pathogen we called it immunity.

1) innate immunity: it is born with us, like acidity of the stomach, phagocytic cells, it begins before the acquired immunity starts.

2) acquired immunity: have two main arms:

1) cell –mediated immunity.

2) antibody mediated immunity (humoral).

What does infection mean?

The pathogen is inside the host, host is infected, infection means إصابة in Arabic.

This infection may make a disease and may not from immunity (antibody response).

Infection -> when the host encounters the pathogen.

We have asymptomatic, subclinical and inapparent infection

asymptomatic: no symptoms

subclinical: no clinical signs {not severe enough to present readily observable signs}

inapparent: we can't see any signs

the subclinical infection is more common than the clinical infection, in viruses the subclinical is very common.

the only way that can tell us: the way that takes a serum and check if there are antibodies against the pathogen.

virulence is usually related to the pathogen, we have virulence factors like:

- 1) Pili: for adherence to the host.
- 2) flagella: to reach the area very quickly.
- 3) capsule: anti-phagocytic.

Note: spores aren't a virulence factor, they are only resting cells.

4) toxins like:

- 1) endotoxins.
- 2) exotoxins.

3) colonization: we defined it last time

Note: colonization resistance is the function of the normal flora.

4) infectious: معدي

There are a very infectious diseases, we can call it: communicable infection

For example:

- 1) TB: is very highly infectious, infects through respiration.
- 2) HIV.
- 3) Influenza.
- 4) Hepatitis.
- 5) meningitis
- 6) cholera

Note: diabetes isn't infectious, it is metabolism disease .

Some diseases are noncommunicable like:

- 1) endocarditis: endogenous infection caused by normal flora
- 2) food poisoning
- 3) rabies: داء الكلب عن طريق عضه الكلب ، الكلب هو الي بعدينا أما من إنسان مصاب فيه ل إنسان سليم ما بيعدي

5) contagious:

When the disease is very vey infectious we called it is highly contagious

Examples:

Measles: الحصبة

ما في حدا ما عنده مناعة ضد الحصبة بتعرض ل إليها وما بتصيبه

Infectious rate is almost 100%

6) epidemic infection:

We have more cases than the normal in a specific area.

If the bacterial pathogen is transported all over the world, not only in a specific area we called it

7) pandemic infection:

HIV is pandemic.

8) endemic infection:

it is a low rate of infection in a particular area (always there), موجود ع طول بهاي المنطقة

examples:

1) leishmania in our country, leishmania: it is a protozoon that causes leishmaniasis

2) Hepatitis B: in a medium rate

3) Brucellosis: الحمى المالطية عن طريق الحليب

Note: symptoms are: أعراض مرض

But Side effects are: أعراض جانبية بسبب أخذ دواء

They are not the same

*** Note: The material after this is not from the text book!**

9) opportunistic infection:

لما تقل عنا المناعة ينتهزوا الفرصة

Example: our normal flora, when the immune systems is low down the normal flora can cause disease.

10) Symbiosis:

Symbiosis can be defined as:

A) parasitism.

B) commensalism.

C) mutualism.

Symbiosis means living together

1) the normal flora lives with us.

2) the clownfish

3) nitrogen fixing bacteria: in the root nodules in the plants

A) parasitism:

when our normal flora become opportunistic the relationship between the human body and the normal flora is parasitism.

parasitism means disease causing.

the parasites could be: viruses, protozoa, helminths, bacteria, fungus.

the parasites are causing damage to the host we called this case a parasitism.

B) commensalism:

Host = human body, pathogen => the relationship between them could be living together once the pathogen isn't causing any harm, only have a place to live, they don't hurt us.

Example: most of the normal flora, they have place to live and not hurting us.

C) mutuallism : تبادل منفعة

Some of the normal flora which can produce vitamins, these are benefiting us and have a place to live.

*The normal flora can be overlapped between the three definitions, some of them are commensally, and others are parasites like: Bacteroides is the normal flora in colon can move to the peritoneal cavity when the appendix burst .

**Steps required in the establishment of infection:

- 1) acquisition: we need to acquire the infection, connection between the host and the pathogen.
- 2) colonization: when the pathogen binds to host, it starts to multiply.
- 3) penetration: if it is very invasive (make damage), it will be treated by the innate immunity.
- 4) spread: this will cause pathological damage.
- 5) resolution: if your immune system is very well and occurring recovery or resolution.

11) latent infection:

Latent means كامن

You don't see there is an infection but it isn't subclinical

Example you should know from now for ever : (إلى أبد الأبدین):

Cold sore, it is caused by a virus called herpes: it is a simple virus usually type 1, we called it HSV ONE **بيعمل سخونة** fever.

The scientific name is herpes labial.

HSV 1 is a latent virus, HSV-1 is mainly transmitted by oral-to-oral contact to cause oral herpes (which can include symptoms known as “cold sores”)

HSV-2 is a sexually transmitted infection that causes genital herpes. Both HSV-1 and HSV-2 infections are lifelong

1) primary infection: can be:

A) symptomatic infection: in children mainly, these symptoms result in damage, because the virus replicate in our epithelial cells around the mouth, (virus replication), the virus is latent on the genome of the nerve cells then reactivation occurs the virus come out the genome, travel along the axons in ganglia then arrive the epithelial surfaces and start replicating.

B) asymptomatic.

****Steps required in the establishment of infection:**

1) acquisition of microorganisms:

A) exogenous: You are acquiring a pathogen which can be from the outsides called exogenous, enter our body by:

1) respiratory tract.

2) blood to blood contact.

3) sick animals.

B) endogenous: like endocarditis, usually it is our normal flora go to the blood stream and then causing the damage to our heart, another example: urinary tract infection.

What about a baby who have HIV when the mother is HIV positive?

It is exogenous because there is 2 different body.

**** major routes of transmission:**

1) direct contact / sexual contact

2) inhalation = droplet infection like respiratory infection

3) ingestion: GI infection

4) trauma / inoculation

5) transplacental

6) zoonoses: infection we get by animals like: Rabies, Brucellosis , leishmanial .

2) colonization: the pathogen in inside our body and start multiplying

Attributes that help in colonization:

1) adhesions:

* Pili: *Neisseria gonorrhoeae* causes gonorrhoea and meningitis.

Piliated strains: (pathogenic/ virulence) can caused gonorrhoeae,

Nonpiliated strains: (nonvirulence) don't cause gonorrhoea.

Similarly, *E. coli* which have pili can cause urinary tract infection, they can adhere to the epithelial cells to the urethra, then go up of the urethra and cause infection.

*capsules: glycocalyx *Staphylococcus epidermidis* is very important cause in artificial joints and artificial heart valves, glycocalyx help in sticking to the surface, similarly viridians streptococci are very important cause in endocarditis to enter the blood stream and arrive the heart valves and make glycocalyx then make colonization.

2) IgA protease: present in secretions, bacteria producing an enzyme which break down IgA, example:

Hemophilic influenza and all the bacteria cause meningitis like: *Streptococcus pneumoniae*, *Neisseria meningitidis*.

All these bacteria can produce this enzyme that can attack the immune system (surface immunity in our mucosa).

3) mucolytic enzymes: enzymes which break down mucous which is a part of innate immunity, mucous is important to stick the bacteria.

**biofilm: polymers form in artificial surfaces, it is specially formed in IV catheter

Cystic fibrosis is a metabolic disease (genetic).

Curli is a kind of virulence factors, it is proteins on the surface of the bacteria helping bacteria to bind to the endothelium of the blood vessels and bind to proteins found in blood circulation, they cause a blood clot .

Sepsis is a massive infection, the bacteria is in the blood and it is multiplied, but the bacteria we find in blood but not multiply we called it bacteremia.

Some viruses travel via axons like rabies viruses بتنتقل الفيروسات من محل العضة ع طول ال

Axons to the CNS

ما بتنتقل خلال الدم عشان تتجنب جهاز المناعة

Tetanus is very fetal