Pathogenesis of Infectious Diseases

CLS 212: Medical Microbiology

Definitions

- **Path-** means disease.
- **Pathogenesis**

The steps or mechanisms involved in the development of a disease.

- **Infection**

The presence and colonization of a pathogen in human body.

- **Infectious Disease**

Is a disease caused by a pathogen (microorganism).

- **Not all pathogens entering human body will cause disease because humans are protected by normal flora and the immune system.**

Course of an Infectious Disease

There are 4 phases or periods in any infectious disease:

1. **The incubation period:**

The time between entry of the pathogen and the onset of symptoms.

2. **The prodromal period:**

The time when the person feels abnormal and week.

3. **The period of illness:**

The time when the person feels typical symptoms associated with that specific disease.

4. **The convalescent period:**

The time when the person recovers from the infection but may develop permanent damage to the area of infection.

Localized vs. Systemic Infection

Localized Infection

The pathogen is only present at the original site of infection (eg. Pimples or abscesses)

Systemic Infection (Generalized)

The pathogen is carried to other parts of the body by blood, lymph,..

Acute, Subacute, and Chronic Disease

Acute Disease

Rapid onset of disease and rapid recovery.

e.g. Influenza, measles,..

Chronic Disease

Slow onset of disease and last a long time.

e.g. Tb, syphilis,..

Subacute Disease

The disease with onset less than acute but more than chronic. **e.g.** bacterial endocarditis.

Signs vs. Symptoms

A Sign of a Disease

Evidence of disease found or seen by the doctor **e.g.** abnormal heart or breath sounds, blood pressure, LAB results, radiology,..

A Symptom of a Disease

Evidence of disease felt and explained by the patient **e.g.** headache, stomachache, pain, nausea, itching,..

Latent Infections

- infectious disease may go from symptomatic to asymptomatic, and then some time later go back to being symptomatic again. Eg. Herpes virus infections

Virulence (virulent)

- Is the degree of ***pathogenicity*** of an organism, i.e. the relative ability of a pathogen to cause disease.

- See page 242 , chapter 14

Steps in the Pathogenesis of Infectious Diseases

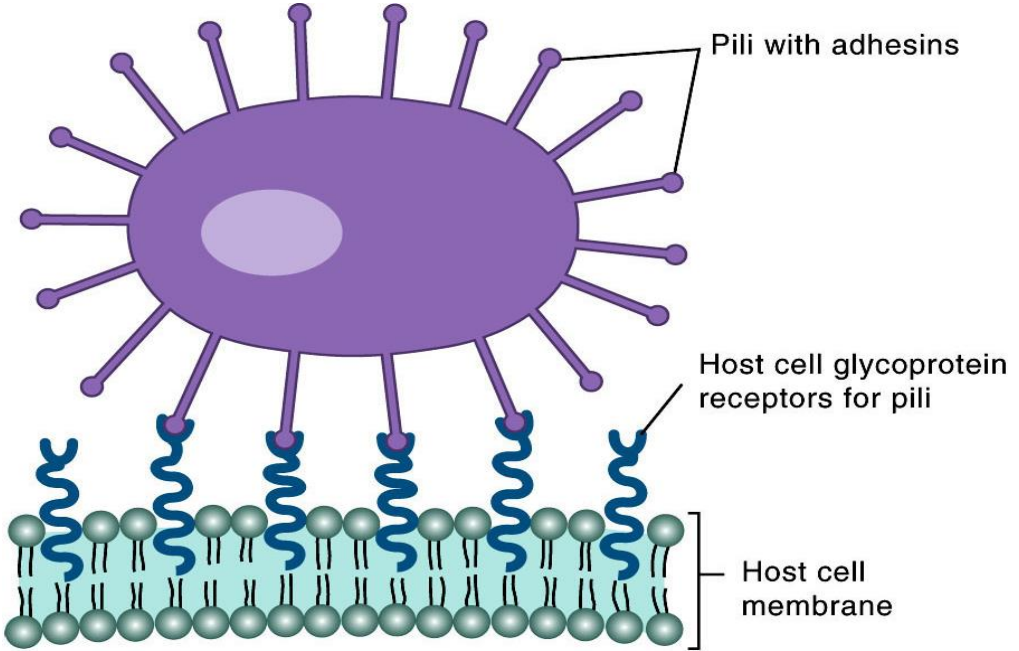
1. Entry.
2. Attachment.
3. Colonization.
4. Invasion.
5. Immune response Inhibitors.
6. Damage to the host.

1. Entry

- Penetration of skin → Skin is very difficult to penetrate, most microorganism gain entry via trauma.
- Introduction of pathogen by an arthropod.
- Inhalation (respiratory tract)
- Ingestion (gastrointestinal tract)
- Through genitourinary tract.
- Introduction of the pathogen directly into the blood (eg. Blood transfusion, use of shared needles)

II. Attachment (Adhesion)

- Microorganisms have macromolecules (proteins or carbohydrates) that promote attachment to tissue surfaces.
- Viruses and many bacteria must first bind to host cell surfaces.
- Prevents early clearance.
- Pathogens often bind host tissues via surface receptors. e.g. pili in bacteria.



2. Attachment (=Adherence)

- It is a necessary **first step** in the establishment of infection.

- Once they have attached themselves to host cells, they then **multiply** to high enough numbers to produce toxin or invade host tissue or both.

- Bacteria use **adhesions** to attach themselves to host cells (can be found on capsules cell wall proteins or tips of pili).

2. Attachment (=Adherence)

- The **surface receptors** on animal cells to which the bacteria attach are usually glycoproteins or glycolipids.

- Binding of an adhesion to surface receptor is **highly specific**, dictating the type of cells to which the bacterium can attach.

- **Example:** E.coli strains that cause (UTI) urinary tract infections generally produce a type of pili that attach to bladder cells. While E.coli strains that cause watery diarrhea produce a type of pili that attach specifically to cells of small intestine.

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III. Colonization

- Some virulent bacteria produce special proteins that allow them to colonize parts of the host body.
- Pathogens start multiplication and maintenance.
- Pathogens compete with normal flora for residence.
- Pathogens will resist body reactions e.g. Bile, stomach acid, skin secretions, IgA (mucosal antibodies).
- **e.g.**

  Helicobacter pylori is able to survive in the acidic environment of the human stomach by producing the enzyme **urease.**

4. Invasion

Some virulent bacteria produce proteins that either:

a. Disrupt host cell membranes or

b. Stimulate endocytosis into host cells

- Endocytosis

is the process by which cells absorb material (molecules such as proteins) from outside the cell by engulfing it with their cell membrane

- Eg. Mycobacterium tuberculosis produces surface proteins that facilitate their uptake by the alveolar macrophages. And so the macrophage is not activated and the organism can live in it.

5. Immune Response Inhibitors

- Many bacteria produce virulence factors that inhibit the host's immune system defenses.

Example:

✓ The polysaccharide capsule of *Streptococcus pneumoniae* inhibits phagocytosis of the bacterium by host immune cells.

✓ Some bacteria can hide inside the host cells away from phygocytosis, complement or Ab's.

6. Damage to the Host