Microbiology Team
Med441

Host Parasite Relationship

MED441
KING SAUD UNIVERSITY

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Microbiology Team 441

Color Index:
- Main text
- Boys slides only
- Girls slides only
- Doctor's notes
- Extra information
- ***Important***

Editing file

Objectives

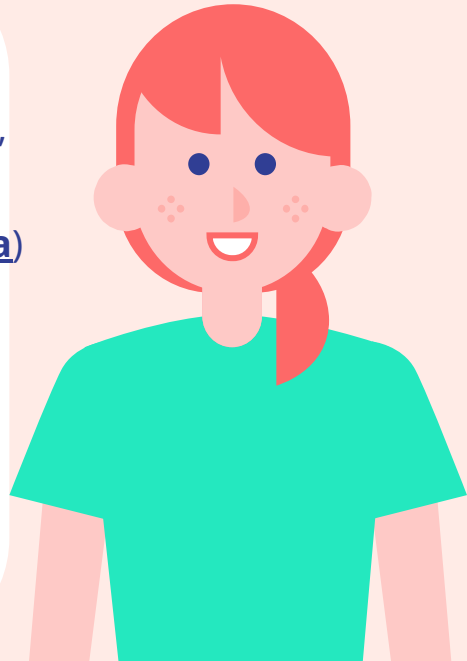
- Define core terms related to host-parasite relationship.
- Recall host response to parasite invasion (specific & non-specific responses).
- Know important examples of primary and secondary pathogens.
- Recognize the differences between virulence and pathogenicity and how virulence is measured.
- Recall the transmissibility of pathogens.
- Describe the attributes of pathogenicity (including: adherence, survival, multiplication ,invasion & tissue destruction) and recall examples.
- Know Koch's postulates.

Helpful video

Host-Parasite Relationship

Dr. Note:
Parasite: cause harm to the host
Normal flora: without harm to the host
Mutually: benefit for both

- **Host**: human, animal, or others that support the growth, survival, and protection of the parasite.
- **Parasite**: bacteria, viruses, fungi or parasites which live in or within the host, may cause disease or live mutually with the host.
- Human host is normally in contact with many microorganisms (**normal flora**)
- Only a small number of these microorganisms (primary and opportunistic pathogens) can cause disease
- Host-parasite relationships (interaction) is characterized by fighting the organism to invade the body and the body defending itself by protective measures
- Host-parasite relationship is discussed under: pathogenicity & normal flora



Definitions

- **Infection:** invasion of cells and multiplication by microorganisms without tissue destruction
  (ممكن الشخص يحمل العدوى لكن ما يتأثر أو ما تموت الانسجة)
- **Disease:** is the end product of an infectious process (signs & symptoms appear).
- **Resistance:** The ability of the host to prevent establishment of infection by using its defense mechanisms.
- **Susceptibility:** Lack of resistance to an organism and establishment of disease.
- **Transmissibility:** The ability to spread from one host to another. This enables the microorganism to maintain continuity of its species in the event of death of the original host.
- **Modes of transmission:** airborne (transported by air) (respiratory=more serious), contact, Body fluids, vehicle (water, food..), or vector (mosquitos, etc..)

Definitions, cont.

- **Pathogen:** a microorganism having the capacity to cause disease in a particular host.
- **Pathogenicity:** the ability of the microorganism to cause diseases
- **Virulence:** is the degree of pathogenicity, or the ability to invade and destroy tissue to produce disease.

The Lethal dose 50 (LD50)

- **Virulence** is measured by the Lethal dose 50 (LD50)
- Lethal dose 50 (LD50) : is the number of organisms or mg of toxins that will kill 50% of susceptible lab animals (usually mice) when injected into such animals.

- When the LD50 is small, the microorganism is considered highly virulent and when it is high the organism is considered having low virulence.

  eg. Shigella spp. is more virulent than Salmonella spp.
- **LD50** is inversely proportional to **Virulence**. (علاقة عكسية)

Pathogens

Pathogens :
Can be divided according to the degree of pathogenicity **(Virulence)**

Primary (true) pathogens (strong)

An organism that cause disease in healthy individual who is non-immune to that organism.

Associated with a specific and recognizable disease
e.g : **Bordetella** species & **Mycobacterium tuberculosis**

Secondary (Opportunistic) pathogens

An organism that has a low pathogenicity and infects people with low immunity

Causes disease in immunocompromised host (with low immunity)

Gain access (injury) to sterile regions
eg :**Pseudomonas** & S. **epidermidis**

A pathogen may infect one body organ or multiple organs.

Some pathogens enter into latent state (infection but no symptoms) eg. Mycobacterium tuberculosis .

Host Resistance to Parasite Invasion

1. **Non specific defense** is part of the natural constitution of the host.
   Examples:
   - Skin mechanical barrier
   - Ciliated epithelium of respiratory tract
   - Competition by normal flora
   - Low pH of the stomach
   - Cough
   - Peristalsis
   - Lysozymes
   - Neutrophils

2. **Specific defense** is an acquired resistance to certain organism:
   e.g. Antibodies

Dr. Note: adherence and colonization, survive (resist) multiply, tissue destruction
All of these include in incubation period

Determinants Of Pathogenicity

Before causing disease the microorganism should have the ability to:

	Description
-**Adhere and colonize**	Attachment to host epithelial surface.
-**Survive** (**resist**)	Resist host natural defence mechanisms. (nonspecific)
-**Multiply**	Multiply to large numbers.
-**Tissue destruction**	The ability to overcome host defence, invade the tissues and cause destruction to produce clinical disease

Adherence & Colonization

Adhesins:
Adherence factors

Adhesins found on host cells

Fibronectin

Proteins and **glycopeptide parts**

Dr. Note: Fibronectin , proteins and glycopeptide parts is the binding site

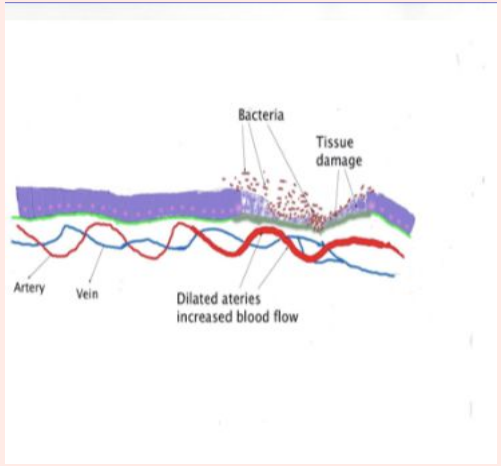
Adhesins found on bacterial surface

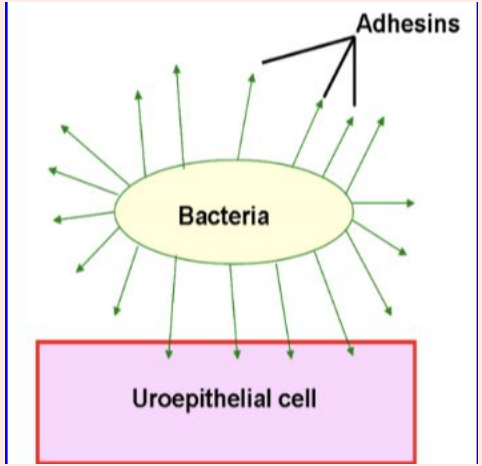
Pili

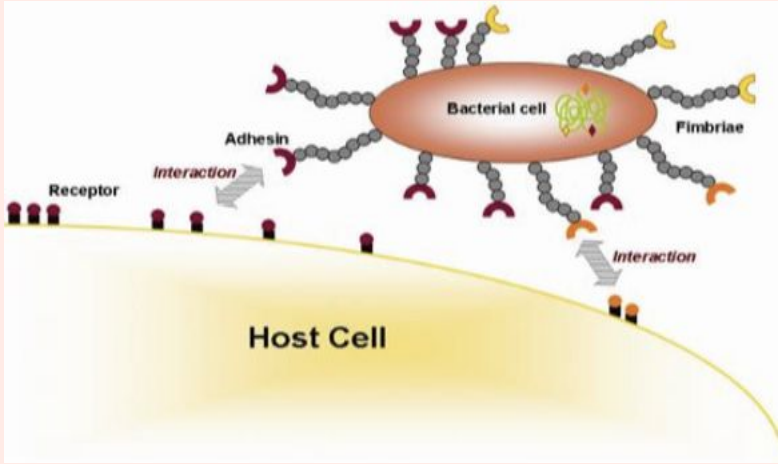
Other **protein surface structures**

Capsid spikes (of viruses) (like **COVID-19**)

Adherence & tissue destruction







Tissue destruction

Helpful video

Notes: capsule work like shill to bacteria to hide it from immune system.

Tissue destruction by:

Toxin production Either:

Endotoxin
Only found in gram negative bacteria
eg: E-coli

Exotoxin:produced outside the gram positive and gram negative bacteria
Eg: **cholera toxin**

Membrane active exotoxin

Eg: Haemolysin of group A streptococci

A-B type exotoxins:
A:active unit
B: binding unit for attachment

Eg: **cholera toxins**

Invasion by:

Non-Capsulated
Bacteria that don't have capsule

Resist intracellular killing so called: **intracellular** (IC) organisms
They are intracellular to hide from immune system

Eg: Mycobacterium tuberculosis,

Salmonella typhi,

Brucella species

Capsulated
Bacteria that have capsule

- Bacterial Capsules are polysaccharide except the capsule of **Bacillus anthracis** is (polypeptide)
- Capsule prevent phagocytosis and capture by immune system
-
- The organisms are readily killed once phagocytosed .so called **extracellular** (EC) organism

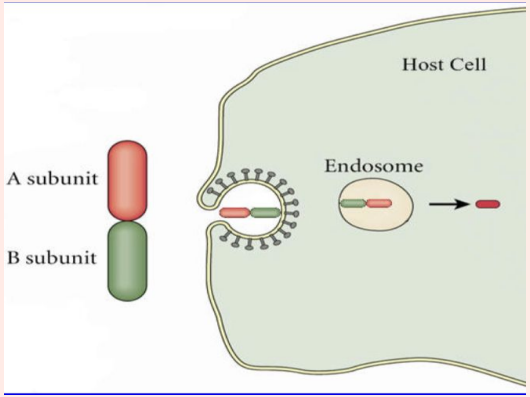
Eg: S.pneumonia (pneumococcus)

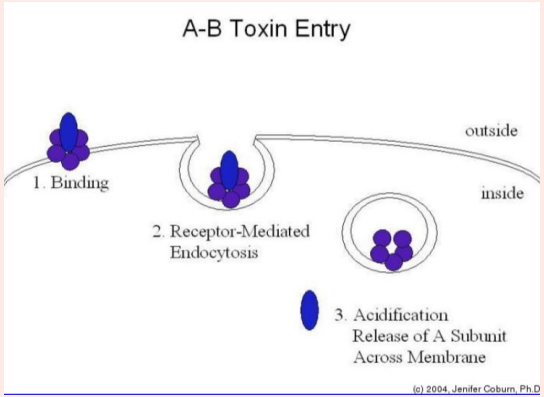
Haemophilus influenzae

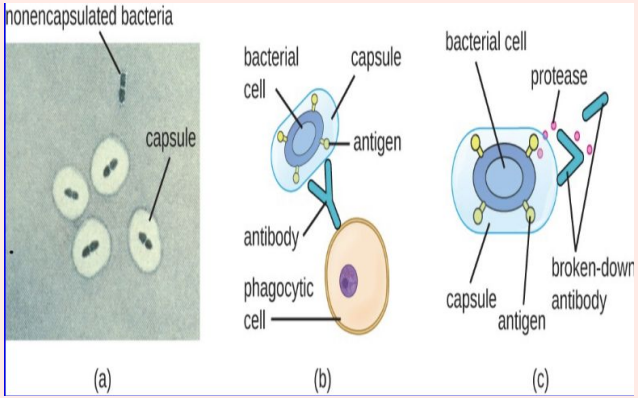
Dr. Note: in exotoxin :

- **(A) Active unit goes and binds with ribosomes to synthesize proteins (enzyme), (functions may vary)**
- **(B) Binding unit binds with the surface of the cell for entrance to the cell**

Exotoxin

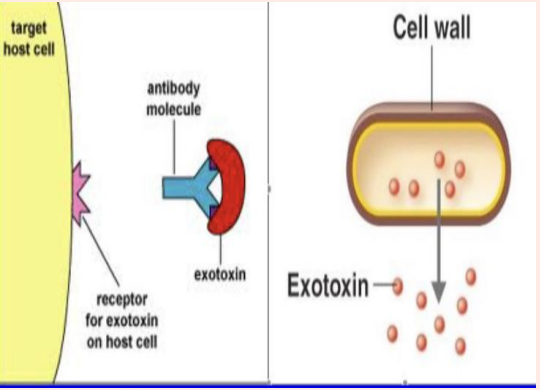






Exotoxin vs Endotoxin

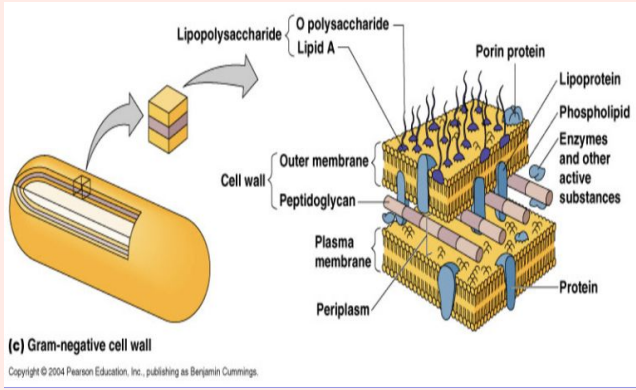
Exotoxin



Endotoxin vs exotoxin

Exotoxin	Endotoxin
1- Protein	Lipopolysaccharide
2- Soluble & Diffusible	Part of cell wall
3- Heat Labile	Heat stable
4- Pharmacologically specific action	Non-Specific
5- High Immunogenicity	Low Immunognicity
6- Inactivated by chemicals to toxoids	Do not form toxoids
7- No Fever	Induce Fever

Endotoxin



The chain of infection

Dr's Note: mosquito is a great example for vector transmission

1. ***Pathogen source/reservoir*** *(animate or inanimate)*
2. **Transmission modes**: Airborne, contact, vehicle, vector
3. **Host susceptibility**: immune state, host nutrition, virulence of pathogens, genetic predisposition
4. **Existing the host**: excretion feces, urine, droplets, blood, saliva, or shed from the body

The chain of infection

Transmission modes:
- Direct contact
- Indirect contact

Eg: hands, droplets, food

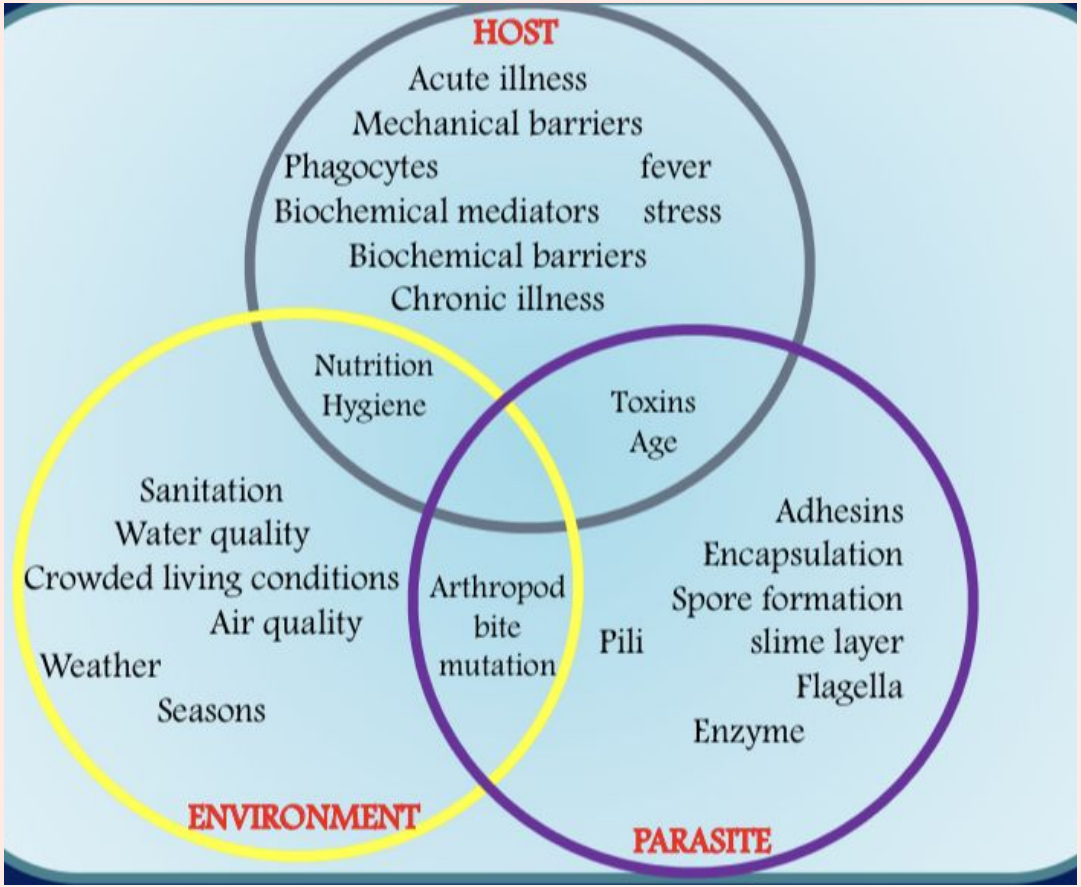
Portal of entry:
- Respiratory tract
- Gastrointestinal tract
- Broken skin
- Genitourinary tract

Host susceptibility:
- Immunocompromised host
- Overcome normal defences
- Invasive devices

Causative agent:
-Microorganism capable of causing a disease

Reservoir:
- Environment
- Humans
- Animals

Portal of exit:
- Excretion, secretion
- Skin
- Droplets

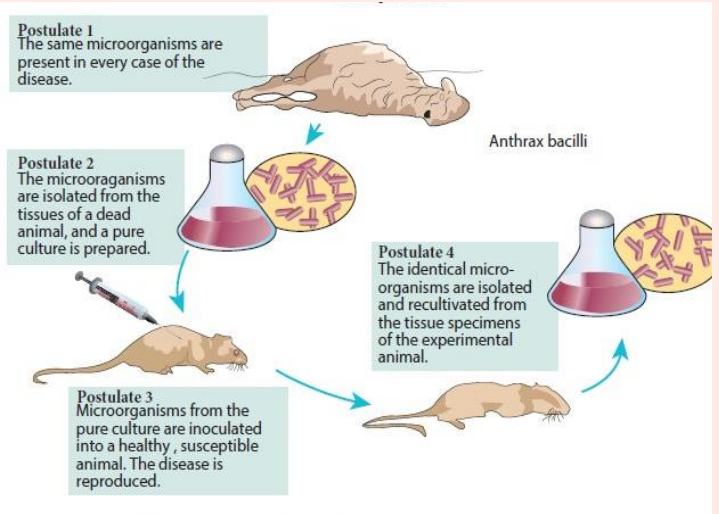

HOST
Acute illness
Mechanical barriers
Phagocytes
fever
Biochemical mediators
stress
Biochemical barriers
Chronic illness
Nutrition
Hygiene
Toxins
Age
Sanitation
Water quality
Crowded living conditions
Air quality
Weather
Seasons
Arthropod bite mutation
Pili
Adhesins
Encapsulation
Spore formation
slime layer
Flagella
Enzyme
ENVIRONMENT
PARASITE

Boys slide

Infection disease process

1. ***Incubation period**: from entry to sings/symptoms*
2. **Prodromal stage**: Clinical signs not sufficient
3. **Illness**: sever disease, immune system triggered
4. **Convalescent period**: (recovery)

Koch's Postulates



For microorganisms to be accepted as the cause of an infectious disease, it must satisfy all or most of these criteria:

01

Pathogen must be found in subject **suffering from the disease**, but should never be found in a healthy subject.

02

Pathogen **can be isolated** from a sick person and grown (purely cultured) in the lab.

03

Pathogen injected into healthy person should **cause an infection with the same disease**. (have the ability to reproduce the disease in other hosts).

04

Injected pathogen can be isolated from newly infected individual and it must be **identical to the original** pathogens (Reisolated, yet identical).

1-Which of the following bacteria is an opportunistic pathogen?			
A. Brucella	B. Bordetella species	C. Pseudomona aeruginosa	D. Mycobacterium tuberculosis
2-Which one of the following bacterial structures is responsible for adhesion and colonization?			
A. Flagella	B. Mesosomes	C. Pili	D. Spores
3-Which one of these bacteria has a polypeptide capsule?			
A. Streptococcus pneumoniae	B. Neisseria meningitidis	C. Haemophilus influenzae	D. Bacillus anthracis
4-Which of the following found only in gram negative bacteria?			
A. Endotoxin	B. Exotoxin	C. Both A and B	D. Pili
5-Which of the following adhesins found on host cells ?			
A. Pili	B. Fibronectin	C. Capsule	D. Flagella
6-invasion of cells and multiplication by microorganisms without tissue destruction			
A. disease	B. Resistance	C. Parasite	D. Infection

1	C
2	C
3	D
4	A
5	B
6	D

1-Pathogens can be divided according to the degree of pathogenicity (virulence) into:	1
_____	2
2-What are the types of adhesins?	
_____	3
3- list the sequence of the infectious disease process:	
_____	4
4- what are the rules followed to identify what organism causes a specific disease (koch's postulates)?	
_____	

1 Primary pathogens, secondary (opportunistic) pathogens

2 1- on the bacteria: pili and other protein surface structures and capsid spikes of viruses.
2- on the surface of the host: fibronectin and glycopeptide parts.

3 1- incubation period (no symptoms).
2- prodromal stage.
3- illness.
4- convalescent period (recovery).

4 1- pathogen found in diseased subjects only.
2- pathogen can be isolated.
3- isolated pathogen injected in healthy subject will give same symptoms.
4- pathogens from injected subjects identical to original pathogens.

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