Host-Parasite Relationship

The relation of bacteria to disease

When microorganism first associated with a host, the host is said to be "**contaminated**". If the microorganisms establish themselves and grow and multiply for period time, the host is said to be "**infected**". If infection causes damage, the host is said to have an" **infectious disease".**

Ecological Interactions between Organisms in a Community:

Dynamic interrelationships based on **nutrition** and **shared habitat**

SYMBIOSIS: neutral, antagonistic or synergistic relationship between two dissimilar organisms living in close association with each other.

MUTUALISM (+/+): mutually beneficial relationship between two species.e.g.**1-** certain indigenous enteric microorganisms produce large amount of the B & K vitamins which absorbed through the intestine wall of the human body and used in metabolism. In the same time the intestine provides the microorganisms with favorable Temp., moisture and nutrients for growth. **2-** growth of *Lactobacillus arabinosus* and *Strept. faecalis*. Lactobacillus produce folic acid and the Streptococcus produce phenylanine, each organism produce a sufficient amount of the factor require by other organism.

COMMENSALISM (+/0): *relationship between two species in which one is benefited and the other is not affected, neither negatively or positively. e.g. Veillonella in the dental plaque require lactate for growth which provided by other dental plaque bacteria bt fermenting glucose to produce lactic acid (such as lactobacilli & Streptococci) the lactic acid used for growth of Veillonella while lactobacilli & Streptococci still unaffected.*

(syntrophism – metabolic products of one are useful nutrients for another)

PARASITISM (+/-): *relationship between two species in which one benefits (parasite) from the other (host); usually involves detriment to the host.*

Amphibiosis(opportunistic pathogens): *Commensal microorganism of the human body that possess the potential for causing infection disease when conditions becomes favor for their invasion of tissue.*

***Antibiosis*:** is a relationship of antagonism. The antagomism among microorganisms is important to the host because it helps control the microbial population and thus helps prevent the over growth of certain microorganism.(e.g. some bacteria produce lethal substances called colicins or bacteriocins which inhibit the growth of other bacteria, also production of antibiotics is an example of antagonism relationship).

***Synergism*:** two usually independent organisms cooperate to break down a nutrient neither one could have metabolized alone (This is relationship in which different organisms produce a reaction that none can produce by individual growth.). (e.g. the relationship of *Proteus vulgaris* and *Staph.aureus* when growing separately both organisms ferment glucose resulting in the production acid only. When the species are grown together they produce acid and gas).

Entry of a Microbe

• Need to adhere, penetrate, and then cause damage .

Portals of Entry :

1st. portal of entry : Mucous membranes

• **Mucous Membranes: *Respiratory*** (microbes inhaled into mouth or nose in droplets of moisture or dust particles. Easiest and most frequently traveled portal of entry)

 Common cold, Flu, Tuberculosis, Whooping cough, Pneumonia, Measles, Strep Throat, Diphtheria

• **Mucous membranes: *G.I. Tract* :**

 Salmonellosis(*Salmonella sp.*)

 Shigellosis (*Shigella sp.*)

 Cholera(*Vibrio cholorea*)

 Ulcers(*Helicobacter pylori*)

 Botulism(*Clostridium botulinum)*

Fecal - Oral Diseases

• These pathogens enter the G.I. Tract at one end and exit at the other end.

• Spread by contaminated hands & fingers or contaminated food & water

• Poor personal hygiene.

• **Mucous Membranes of the *Genitourinary System:***

 Gonorrhea(*Neisseria gonorrhoeae*), Syphilis*(Treponema pallidum*), Chlamydia(*Chlamydia trachomatis*), HIV, Herpes Simplex II

• **Mucous Membranes: Conjunctiva**

 Trachoma(*Chlamydia trachomatis*)

2nd. Portal of Entry: Skin

Skin - the largest organ of the body. When unbroken is an effective barrier for most microorganisms.

Some microbes can gain entrance thru openings in the skin: hair follicles and sweat glands.

3rd. Portal of Entry: Parenteral

Microorganisms are deposited into the tissues below the skin or mucous membranes

Punctures, injections, bites, scratches, surgery, splitting of skin due to swelling or dryness

Preferred Portal of Entry:

• Just because a pathogen enters your body it does not mean it's going to cause disease.

• pathogens **- preferred portal of entry**

 Streptococcus pneumoniae (if inhaled can cause pneumonia, if enters the G.I. Tract, no disease)

 Salmonella typhi (if enters the G.I. Tract can cause Typhoid Fever, if on skin, no disease)

source of infection includes

1- Exogenous infection:

- Infections due to some microbial species are acquired from **ill persons** with active or manifest infection (e.g. T.B, leprosy. Whooping cough)

- **Healthy carrier:**

Convalescent carrier: are persons limits localized infection continues for a period of week or months after clinical recovering from manifest infection.
Contact carrier: those of them who acquire the pathogen from patient.
Paradoxical carrier: those of them who acquire the pathogen from other carriers.

- **Infected animals**:

some pathogens that are primarily parasites of different animal species spread from the infected animal to man and cause human disease such infection are called zoonoses (e.g. anthrax, Brucellosis)

- **Soil**: a few infection disease of man are caused by microbes derived from soil (e.g. tetanus, gas-gangrene).

2- Endogenous infections: the source of endogenous infection are microorganisms grow as a commensal in the certain site of patient's body and under abnormal condition, these microorganisms cause disease in the other site of the body, e.g. *E.coli* have a commensalisms relationship and grow in the intestine as a normal flora but can caused urinary tract infection when invade the urinary tract.

Types of bacterial pathogens:

1-Oppertunistic pathogens: these rarely cause disease in individual with intact immunological and anatomical defenses. Only when such defenses are impaired or compromised, as a result of congenital or acquired disease or by the use of immune-suppressive therapy or surgical techniques, are these bacteria able to cause disease. Many opportunistic pathogens (e.g. coagulase-negative staphylococci & *E.coli*) are part of the normal human flora and are carried on the skin or mucosal surface where they cause no harm and may actually have a beneficial effect by preventing colonization by other potential pathogens. However, introduction of these organisms into anatomical sites in which they are not normally found, or removal of competing bacteria by the use of broad-spectrum antibiotics, may allow their localized multiplication and subsequent development of disease.

2 –primary pathogens: these are capable of establishing infection and causing disease in previously healthy individuals with intact immunological defenses.

Microbial Pathogenicity:

The structural and biochemical mechanisms where by microorganisms cause disease.

Numbers of Invading Microbes:

Virulence: The degree of the pathogenicity (measure of pathogenicity).can be measured by:

- **ID50**: Infectious dose for 50% of the test population
- **LD50**: Lethal dose (of a toxin) for 50% of the test population

 ID50 and **LD50** : **are the quantity of organism that will infect or kill 50% of inoculated animals.**

- Example: ID50 for *Vibrio cholerea* 10 to the power 8 cells (100,000,000 cells)

Mechanisms of Bacterial pathogenicity:

- **Colonization of surface(adherence)**
- **Invasion of tissue(invassivenss)**
- **Production of toxin(Toxigenicity)**

Colonization (Adherence Factors):

Adherence alone does not mean that an organism is pathogenic, so the pathogenicity of most microorganisms is related to the sequence of their ability to (adhere, penetrate& multiplication, bring about pathogenic changes that resulting disease)

Once bacteria enter the body of the host, they must adhere to cells of a tissue surface. If they did not adhere, they would be swept away by mucus and other fluids that bathe the tissue surface. Adherence, which is only one step in the infectious process, is followed by development of microcolonies and subsequent steps in the pathogenesis of infection.

Invasion of tissue (invasiveness)

The ability of organisms to penetrate tissues. The invasion of a host by a pathogen may be aided by the production of bacterial extracellular substance which acts against the host by breaking down primary or secondary defenses of the body.

Examples:

- Hyaluronidase(spreading factor)….. produce by Staph., Strept.,,, Clostridium tetani.
- Collagenase…… produce by Clostridium, Bacteroides
- Lecithinase…. produce by Clostridium
- Catalase…. Produce by T.B, Brucella
- Hemolysins…. Produce by Staph., Strept.

TOXIGENICITY:

The ability of a microorganism to cause disease as determined by the toxin.

1. **ENDOTOXIN:** a complex bacterial toxin that is composed of protein, lipid, and polysaccharide (LPS) which is released only upon lysis of the cell. Endotoxins - part of the Gram (-) Bacterial cell wall. Lipid A - Toxin portion of the LPS.

2- EXOTOXINS: a potent toxic substance formed and secreted by species of certain bacteria. Mostly seen in Gram (+) Bacteria. Most genes that code for exotoxins are located on plasmids or phages (LD50Small -Very potent1 mg of *Clostridium botulinum* toxin can kill 1 million guinea pigs).

Exotoxins - three types:

1-Cytotoxins (kill cells)

2. Neurotoxins (interfere with normal nerve impulses)

3. Enterotoxins(effect cells lining the G.I. Tract)

Other factors that enhance the pathogenicity of bacteria are:

❖ **AVOIDING THE HOST DEFENSE :**

1- Capsules

Allow some organisms to avoid phagocytosis and digestion

2- Changing the antigenic determinants

Some organisms can avoid the immune system

3- Similar protiens

Others avoid the host defense by coating themselves with proteins similar to that coating red blood cells

4- Special proteins

M protein or protein A of some organisms prevent opsonization

❖ **IRON**

Most bacteria require iron for certain enzymes to function

In humans

Iron forms a complex with iron-binding proteins that are bacteriostatic

transferrin in blood

lactoferrin in milk and saliva

This bacteriostatic effect is lost when these molecules are saturated with iron some bacteria secrete **Siderophores** remove iron from the host for their growth and enhance their virulence Examples of siderophores are:

Aerobactin

Enterobactin

The properties which are essential for pathogenicity are:

- **Transmisibility**
- **Infectivity**
- **Virulence**

The pathogens can transmit by:

- Direct transmission of the disease(**e.g**. syphilis, gonorrhea)
- From carrier(**e.g**. *Salmonella typhi*)
- Transmisssion by droplets(**e.g**.T.B, whooping cough)
- By toxin(Food born infection)(**e.g**. neurotoxin of *Clostridium botulinum*, Enterotoxin of *Staph. aureus*)
- By vector insect (arthropod-blood infection)(**e.g**. mosquito/ malaria, yellow fever, flea/ plague, louse/typus fever, tick/ Rocky-mountain spotted fever)
- Water born infection(**e.g**.typoid, cholera)