

Us and Them

Microbe-Human Interactions: Infection and Disease

Human Host

- Acquire resident flora
- Newborn exposure

Acquire resident flora

- The human body supports a wide range of habitats
 - temperature, pH, nutrient, oxygen tension
- Wide range of microbes can inhabit
- Resident flora or microflora
 - Microbes that inhabit but do not harm the host
- Beneficial outcome
 - Removed by immune system
 - Microbial antagonism
- Adverse effects
 - Escape immune system
 - Multiply and disrupt tissue

Newborn exposure

- Mother's birth canal
- Mother's breast milk
- Bottle-feeding
- People

Progress of an Infection

- Pathogenicity
- Portals of entry
- Attachment
- Surviving host defenses
- Causing disease
- Process of infections and disease
- Portals of exit

Pathogenicity

- True pathogens
- Opportunistic pathogens
- Virulence

True pathogen

- Cause disease in healthy individuals
- Associated with a specific and recognizable disease

Opportunistic pathogen

- Cause disease in immune compromised host

- Gain access (injury) to sterile regions

Virulence

- Virulence factors
 - Ability to establish itself in the host
 - Cause damage

Portals of entry

- Most pathogens have specific portals on entry
 - Skin
 - Gastrointestinal tract
 - Respiratory tract
 - Urogenital
 - Placenta
 - Inoculum size

Skin

- *Staphylococcus aureus*
 - Boils
- *Haemophilus aegyptius*
 - Pink eye

Gastrointestinal tract

- *Salmonella, Shigella, Vibrio*
- Viruses – polio, hepatitis A
- Protozoan – *Giardia lamblia*
- Enter via ingestion or the anal route

Respiratory tract

- *Streptococcus pneumoniae*
 - Sore throat, meningitis
- Fungi – *Cryptococcus*
 - pneumonia

Urogenital

- Numerous sexual transmitted diseases (STDs)
- Virus – human papillomavirus
 - Genital warts
- Protozoan – *Trichomonas*
 - trichomoniasis
- Bacteria – *Neisseria gonorrhoeae*
 - Gonorrhea
- Acquire by intercourse or intimate contact

Placenta

- Some bacteria can penetrate the placenta barrier
 - *Treponema pallidum*

- Birth canal
 - Herpes simplex virus

Inoculum size

- Infectious dose (ID)
 - minimum number of bacteria required to cause disease
 - Low ID = high virulence

Attachment

- Adhesion
 - Binding between specific molecules on both the host and pathogen
- Structures
 - Capsules
 - Pili or fimbriae
 - Hooks

Surviving host defenses

- Antiphagocytic factors
 - Capsule
 - Prevent phagocytosis
 - Leukocidins
 - Toxic to phagocytes
 - Some microbes survive inside phagocytes

Causing disease

- Virulence factors
 - Exoenzymes
 - Toxins
 - Capsule
- Occurrence of infection
- Signs and symptoms

Exoenzymes

- Mucinase – digest protective coating on mucous membranes
- Keratinase – digest the principal component of skin and hair
- Collagenase – digest the principal fiber of connective tissue
- Hyaluronidase – digest the substance that cements cells together

Bacterial toxins

- Exotoxins
 - Gram positive and Gram negative cells
 - Excreted (ex. Hemolysins)
 - Highly toxic in small amounts
- Endotoxins
 - Gram negative cells
 - Membrane associated

- Lipopolysaccharide (LPS)
- Fever associated

Process of infections and disease

- Establishment
- Signs and symptoms

Establishment

- Localized
- Systemic
- Focal
- Mixed
- Primary and secondary
- Acute and chronic

Signs and symptoms

- Signs - objective evidence of disease based on observation
 - Inflammation – edema, granulomas, abscesses
- Symptoms – subjective evidence of disease based on the patient
 - Inflammation – calor, ruber, dolor, tumor
 - heat, redness, pain, swelling
- Syndrome – sign and symptoms

Portal of exit

- Enables pathogen to spread to other hosts
 - Respiratory
 - Salivary
 - Skin
 - Fecal
 - Urogenital
 - Blood
- Persistence

Persistence

- Latency
 - Viral
 - Herpes virus
 - Bacterial
 - Tuberculosis
- Sequelae – long-term damage to tissues or organs

Epidemiology

- The study of disease in populations
 - Frequency data
 - Distribution data
- Center for Disease Control and Prevention (CDC)

Epidemiology

- Statistics
- Strategies
- Reservoir
- Carriers
- Vectors
- Acquisition and transmission
- Nosocomial
- Koch's postulates

Reservoirs

- Carriers
- Vectors
- Nonliving

Carriers

- Asymptomatic
- Incubation
- Convalescent
- Chronic
- Passive

Vectors

- Biological
 - Participates in the pathogen's life cycle
 - Infected with the pathogen
 - Transmit by bites, defecation
- Mechanical
 - Not part of pathogen's life cycle
 - Not infected with the pathogen

Non-living Reservoirs

- Soil
 - Transmit bacteria, protozoa, helminths, fungi
 - Transmit spores, cysts, ova, larvae
- Water – similar to soil

Acquisition and transmission

- Communicable
- Non-communicable
- Patterns of transmission

Communicable

- Infected host transmits an infectious agent to another host
- Receiving host must become infected

Non-communicable

- Host acquires infectious agent
 - From self (compromised individual)- microflora
 - Nonliving reservoir - soil

Patterns of transmission

- Horizontal
- Vertical
- Direct (contact)
- Indirect

Horizontal

- Disease is spread through a population from one infected person to another
 - Kissing, sneezing

Vertical

- The disease is transmitted from parent to offspring
 - Ovum, sperm, placenta, milk

Direct (contact)

- Kissing, sex
- Droplets
- Vertical
- Vector

Indirect

- Contaminated materials
 - Food, water, biological products (blood, serum, tissue), fomite (door knobs, toilet seats, etc.)
 - Oral-fecal
- Air
 - Droplet nuclei (dried microscopic residue)
 - Aerosols (dust or moisture particles)

Nosocomial infections

- Infectious diseases that are acquired or developed from a hospital stay
 - Urinary tract infections
 - Respiratory infections
 - Surgical incisions

Koch's postulates

- Method used to determine the etiologic agent
- Ex. Toxic shock syndrome, AIDS, Lyme disease, Legionnaires

Koch's Postulates

- First, the specific organism should be shown to be present in all cases of animals suffering from a specific disease but should not be found in healthy animals.
- Second, the specific microorganism should be isolated from the diseased animal and grown in pure culture on artificial laboratory media.
- Third, his freshly isolated microorganism, when inoculated into a healthy laboratory animal, should cause the same disease seen in the original animal.
- Lastly, the microorganism should be re-isolated in pure culture from the experimental infection.