Veterinary Microbiology (Unit-1)

Pathogenicity, virulence, bacteraemia, septicaemia and toxaemia

Dr. Savita Kumari
Department of Veterinary Microbiology
Bihar Veterinary College, BASU, Patna

Pathogenicity

- Pathogen- Microbe capable of causing disease
- Pathogenicity- Ability/capacity of a microorganism to cause disease
- Damage host
- Pathogens vary in their ability to produce disease

Stages of pathogenicity:

1) Gain access to the host
2) Multiplication of the pathogen
3) Inhibition/avoidance of host protective mechanisms
4) Production of disease or damage to host

- Microbes express their pathogenicity by means of their **virulence**

- **Factors determining Bacterial Pathogenicity:**
- Host Susceptibility
- Host Resistance
- Presence of Bacterial Virulence Factors
- Presence of Host-mediated Pathogenesis
- Ability for Intracellular Growth

Virulence

- Degree of pathogenicity of microorganism
- Refers to the intensity of the disease produced by pathogens
- Quantitative measure of the pathogenicity
- Virulence is variable
- Varies among different microbial species
- Also varies among members of the same species of pathogen
- Bacterial traits that confer pathogenicity- virulence factors

- Genes encoding virulence factors not uniformly distributed among all strains of a particular bacterium

Pathogenicity islands

- Specific genes or gene clusters in the genome
- Encode various virulence factors- toxins, adhesins, invasins etc.
- Present in pathogenic strains but usually absent from genome of nonpathogenic strains of same species
- Present on the chromosome or on plasmid
- Present in a wide range of both Gram-positive and Gram-negative bacterial pathogens
- Role in the virulence of bacterial pathogens
- Virulence of organism is modulated by genes harboured

Determinants of Virulence/Virulence factors

- Any of its genetic or biochemical or structural features that enable it to produce disease in a host
- **Invasiveness**-ability of a pathogen to invade and grow in host tissues, related to particular virulence factors
- Helps in establishment of disease or infection
- Pathogenicity of microorganism determined by nature and type of its virulence factors
- During the process of infection, virulence factors combat with defense mechanism of host

Some examples of virulence factors

- Attachment factors/ Adhesins
- Anti-phagocytic factors
- Spreading factors and enzymes
- Toxins; exotoxin and endotoxin

Virulence factors

- **1. Attachment factors/ Adhesins:**

Adhesins-

- Specialized molecules or structures on bacteria's cell surface
- bind to complementary receptor sites on host cell surface
- Attachment to skin or mucus membrane to establish infection
- Different microorganism- different structure

Capsule, Pili, Lipoteichoic acid, Glycocalyx etc.

2. Antiphagocytic factors:

- Capsule
- Superoxide dismutase and other enzymes:
  prevent from phagocytic killing

Adherence Factor	Description
Fimbriae	Filamentous structures that help attach bacteria to other bacteria or to solid surfaces
Glycocalyx or capsule	A layer of exopolysaccharide fibers with a distinct outer margin that surrounds many cells; it inhibits phagocytosis and aids in Adherence, when the layer is well organized and not easily washed off it is called a capsule
Pili	Filamentous structures that bind prokaryotes together for the transfer of genetic material
S layer-	Proteinaceous surface layer in cell envelopes of some archaeobacteria and eubacteria that may promote adherence to surfaces
Slime layer	A bacterial film that is less compact than a capsule and is removed easily
Teichoic and lipoteichoic acids	Cell wall components in gram-positive bacteria that aid in adhesion

3. Spreading factors and enzymes:

Coagulase	Coagulates (clots) the fibrinogen in plasma. The clot protects the pathogen from phagocytosis
Collagenase	Breaks down collagen that forms the framework of connective tissues; allows the pathogen to spread
Deoxyribonuclease	Lowers viscosity of exudates, giving the pathogen more mobility
Hyaluronidase	Hydrolyzes hyaluronic acid, a constituent of the intercellular ground substance
Streptokinase (fibrinolysin, staphylokinase)	binds to plasminogen, activates production of plasmin, digests fibrin clots, allows pathogen to move from clotted area
protease	Degrade Proteins

4. Toxins:

- Exotoxin – Neurotoxin, Leucocidin, hemolysin etc.
- Endotoxin- Lipopolysaccharide (LPS)

Epizootic diseases

- Serious animal infectious disease that is widespread
- Has potential for very serious and rapid spread
- Large numbers of host population become infected and die
- Generally refers to outbreaks of disease which cause serious economic or public health issues
- Refers to peaks in disease incidence that exceed the endemic baseline or expected incidence of disease
- Corresponds to epidemic in human medicine
- Panzootic - Epizootic that spreads across a large region, or even worldwide

Equivalent in human populations- pandemic

Enzootic diseases

- Always present in a certain animal population, at a certain time only affects a small number of animals
- Are of only weak virulence
- Herd health problems
- A pathogen circulates within a given animal population without any major mortality observed
- Result in the continuous occurrence of disease in a population.
- Corresponds to endemic in human medicine
- Enzootic pneumonia in pigs, caused by *Mycoplasma hyopneuminiae*

Bacteremia

- Presence of viable bacteria in bloodstream

- No multiplication
- In relatively small numbers
- In cases of injury (cut, abrasion, teeth cleaning)
- Transient, host immune mechanisms eliminate bacteria from the blood
- *Escherichia coli*, *Streptococcus pneumoniae*, *Staphylococcus aureus*
- Settle in various parts of body and produce lesions

Septicaemia

- Presence and multiplication of bacteria in blood
- Bacteria of high pathogenicity
- Large amounts of bacteria
- Can arise from infections
- Life-threatening
- Causative Agents
- Gram +ve bacteria :- *Staphylococcus aureus*, *Streptococcus pyogenes*, *Streptococcus pneumoniae*
- Gram -ve bacilli:- *E. coli*, *Enterobacter*, *Klebsiella*, *Pseudomonas*, *Proteus*

Toxaemia

- Presence of toxins in blood
- Circulation of bacterial toxins in blood with production of clinical manifestations and pathologic changes
- **Toxin-** substance poisonous to other organisms
- Biological poisons – to invade and cause damage to tissues, host
- Toxigenicity- Ability of a pathogen to produce toxins to cause damage to host cells
- Some bacteria produce toxins
- **Exotoxins**
- **Endotoxins**