Lec. : 9 **General Microbiology** **Dr. Selda S. Yaseen**

VETERINARY BACTERIOLOGY

Why do we study bacteria in Veterinary ?

Introduction .

We study bacteria in Veterinary Medicine or Medicine because bacterial diseases are among the most important and common problems that animal and fish keepers or managers must deal with . Therefore, the veterinarian must be equipped to know about these organisms , Because infections frequently involve more than one system, veterinary microbiologist / bacteriologists have generally resisted the systemic approach to teaching infection diseases .

We study these organisms to know which disease they are involved so as to find a treatment . Therefore, the approach to their study will include knowing fully about them .e.g. There :-

- History
- Habitat
- Characteristics – Colonial / Culture characteristics
  - Cell morphology
  - Staining Characteristics
  - Biochemical Characteristics
  - Genetic Characteristics

BACTERIAL PATHOGENICITY

The pathogenesis of bacterial infection includes initiation of the infectious process and the mechanisms that lead to the development of signs and symptoms of disease .

Pathogen : A microorganism capable of causing disease .

Pathogenicity : The ability of an infectious agent to cause disease .

Microbiota : Microbial flora present by normal, healthy individuals.

- Majority of bacteria are non - pathogenic saprophytes .
- Bacteria which causes disease in humans and animals are small in number compared to those that do not cause disease .
- Bacteria that cause disease are said to be pathogenic .
- The development and severity of bacterial infections are influenced by host - related determinants such as physiological status and immune competence .
- Commensal bacteria can cause opportunistic infection in the host .

Steps in Bacterial Infection

The route of bacterial entrance into the host cell include : skin, mucus membranes , teat canal and umbilicus .

Steps in Bacterial Pathogenesis :-

Bacterial Pathogenesis steps in host cell mechanism include :-

1- Adhesion to the host cells .

Adherence (adhesion, attachment) : The process by which bacteria stick to the surfaces of host cells. After bacteria have entered the body, adherence is a major initial step in the infection process .

2 - Local proliferation or multiplication .

3 - Damage to the host tissue .

4 - Invasion : The process where by bacteria , animal parasites, fungi, and viruses enter host cells or tissues and spread in the body.

5 - Dissemination .

6 - Toxigenicity and ability to survive the host specificity or immune system .

- Virulence of bacteria relates to the ability to invade and produce disease in a normal animal , **Virulence:** The quantitative ability of an agent to cause disease. Virulent agents cause disease when introduced into the host in small numbers. Virulence involves adherence, persistence, invasion, and toxigenicity .

- ❖ Ability to adhere : virulent pathogens often possess specific surface molecule which allow adherence to receptors on host cells .
- ❖ Adherence factors include : adhesions, fimbriae, pili , invasion (all in gram negative bacteria) .
- ❖ Adherence factors in gram-positive bacteria : protein F (a fibrionectin -binding protein) is necessary for adherence of streptococci to respiratory epithelial - the coagulase of pathogenic staphylococci promotes adherence to fibrinogen - coated surfaces .
- ❖ Capsule - like material in *Klebsiella pneumoniae* enhance its interaction with human intestinal cells .
- ❖ Iron is essential for bacterial respiration and most iron in the animal host is bound by iron-binding proteins like lactoferrin and transferring , and therefore unavailable for the bacteria
- ❖ Pathogenic bacteria obtain iron from the host by producing iron - chelation compounds like siderophores which can remove iron from transferring and lactoferrin .
- ❖ Other lyse erythrocytes to obtain iron from hemoglobin .

Mechanisms employed by bacteria for survival in the host .

Mechanism important to bacteria survival and virulence include Antigenic heterogenic , tissue - degrading enzymes , Antiphagocytic Factors , IgA proteases and ability to chelate iron .

✍ O antigen (Somatic) polysaccharide chain: length of polysaccharide chain hinders binding of the membrane attack complex of complement to the outer membrane of many gram- negative bacteria .

✍ Capsular antigen (K) : incorporation of sialic acid by some gram-negative bacteria has an inhibitory effect on complement activity .

✍ H-protein , M protein production : Antiphagocytic activity e.g. *Streptococcus equ*i.

✍ Production of Fc-binding proteins: *Staphylococci* and *Streptococci* produce protein which bind to the Fc region of IgG and prevent interaction with the Fc receptor on membranes of phagocytes .

✍ Production of leukotoxins: cytolysis of phagocytes by toxins produced by *Actinobacillus species* and other pathogenic bacteria .

✍ Interference with phagosome -lysosome fusion, allows the survival of pathogenic mycobacterium within phagocytes .

✍ Escape from phagosomes: survival mechanism used by *Listeria monocytogenes* and *Rickettsiae* .

✍ Antigenic mimicry of the host antigens: adaptation of surface antigens by *Mycoplasma spp* to avoid recognition by the immune system .

✍ Antigenic variation of surface antigens: permits survival of *Mycoplasma spp* and *Borreliae* despite the host's immune response to these pathogens .

✍ Coagulase production: conversion of fibrinogen to fibrin by *Staphylococcus aureus* can isolate site of infection from effective immune response .

Dissemination (Invasion) of bacteria in the host .

Invasion is the term commonly used to describe the entry of bacteria into host cells, implying an active role for the organisms and a passive role for the host cells. In many infections, the bacteria produce virulence factors that influence the host cells, causing them to engulf (ingest) the bacteria . The host cells play a very active role in the process.

Toxin production and other virulence properties are generally independent of the ability of bacteria to invade cells and tissues . Toxins produced by bacteria are generally classified into two groups :-

Exotoxins and Endotoxins, Exotoxins are proteins that are most often excreted from the cell. However some exotoxins accumulate inside the cell and are either injected directly into the host or are released by cell lysis. Endotoxins are lipid molecules that are components of the bacterial cell membrane.

- ✍ Avoidance of host defense mechanism is essential for successful invasion and dissemination of the pathogen .
- ✍ Enzymes such as Collagenases, lipases, hyaluronidases and fibrinolysin produced by bacterial pathogens facilitate breakdown of host tissue .

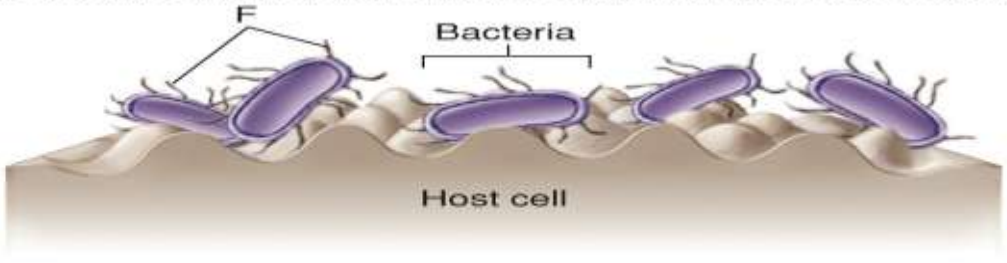
- ✍ **Bacteraemia** is the transient presence of the bacteria in the blood stream without replicating .

- ✍ **Septicemia** is the persistent presence of bacteria multiplying in the blood stream Damage to host tissue and associated clinical signs .

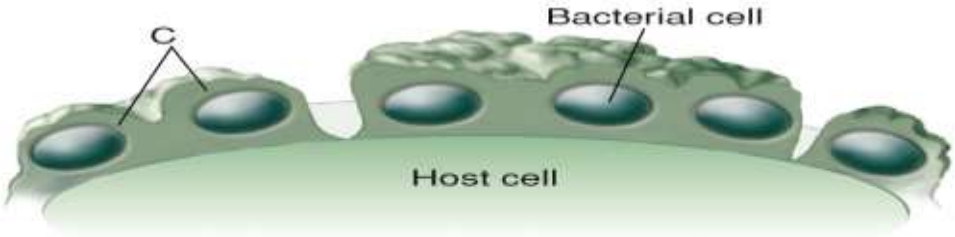
- ✍ Direct damage is caused by exotoxin and endotoxin production .
- ✍ Indirect damage results from the activity of enzymes secreted by the bacteria and host immune response to infection .

Comparison of Exotoxins and Endotoxins .

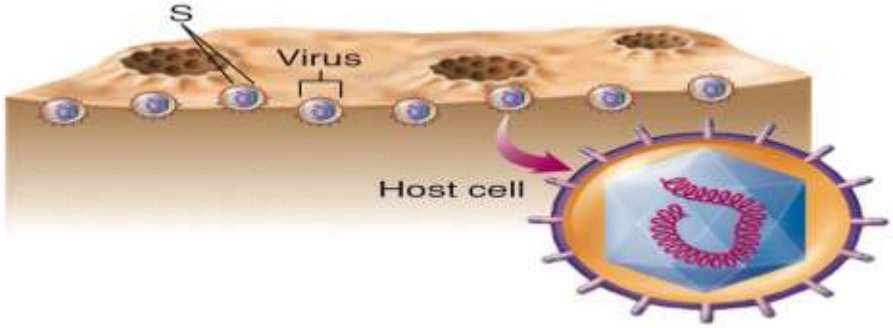
Exotoxin	Endotoxin
Produced by living bacteria cell	released during death and lysis of cells and in part during growth
Secreted actively	component part of cell wall
Produced by both gram positive and gram negative bacteria	produced by gram negative bacteria
Polypeptides High molecular weight protein	lipopolysaccharide complex containing lipid A the toxic component
Heat - labile	Heat - stable
Potent toxins, usually with specific activity	Toxin with moderate non-specific activity
Do not produce fever in the host	Produce fever in the host
Highly antigenic	Weakly antigenic
Usually bind to specific receptors on cells	Specific receptors not found on cells
Induced neutralizing antibodies	Neutralizing antibodies not associated



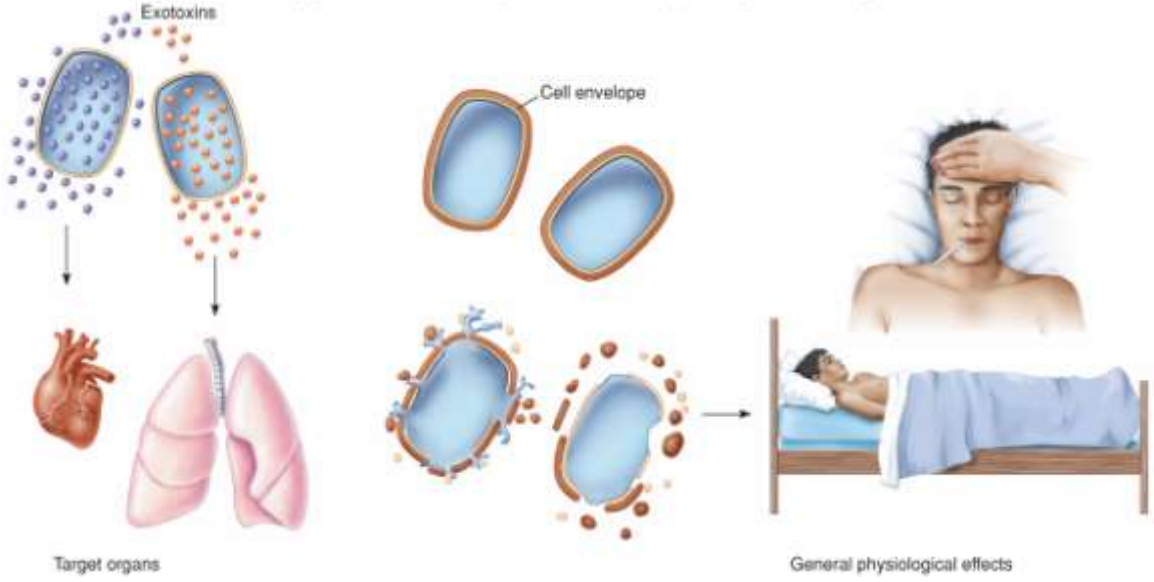
(a) **Fimbriae**

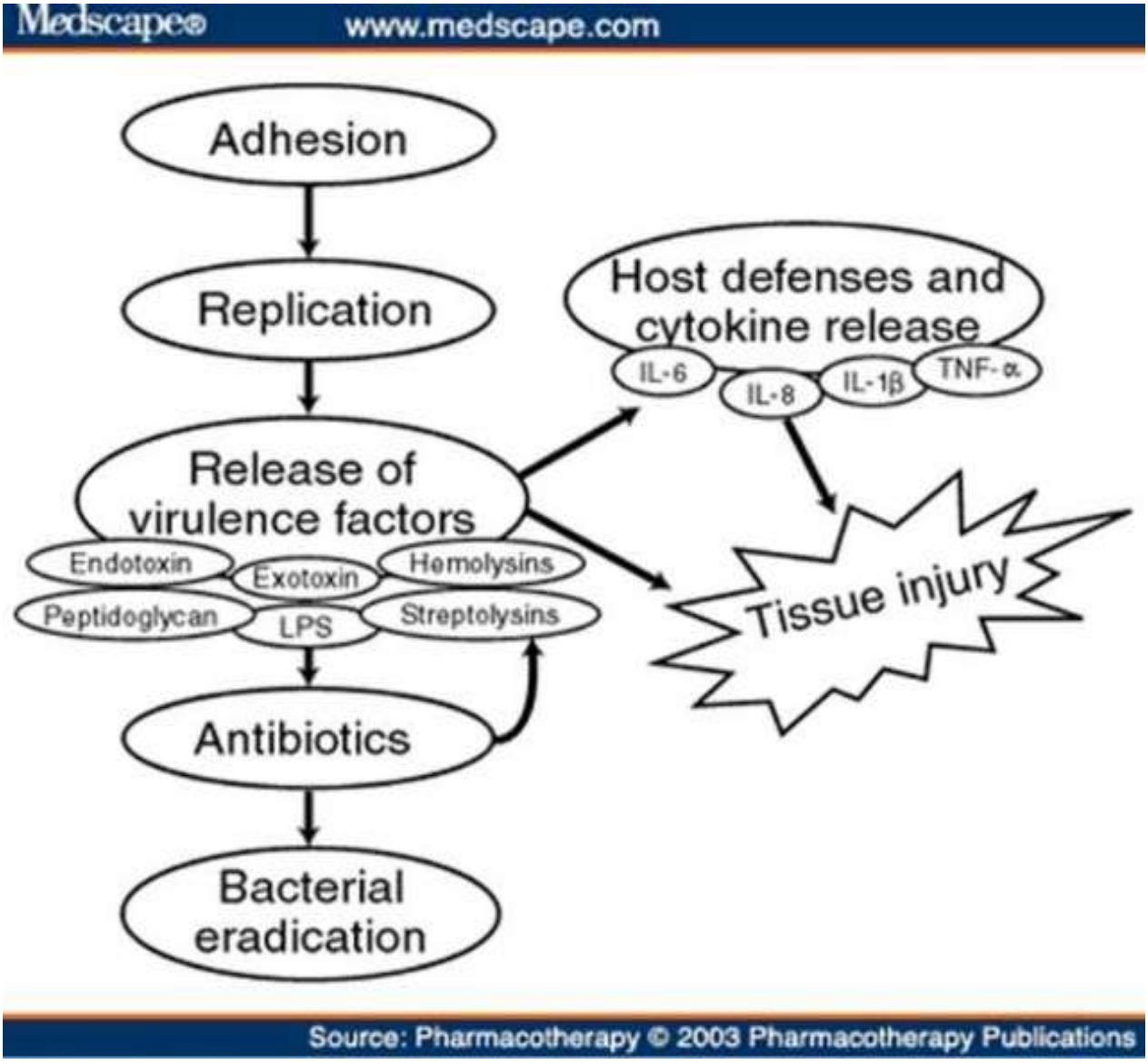


(b) **Capsules**



(c) **Spikes**

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