

نوال جاسم شنيور

## Introduction

### **Classification of Bacteria**

The treating physician often identifies the disease causing organism on the basis of his clinical findings and accordingly treats the patient. There are many clinical conditions which are manifested only by fever and can be caused by a large number of organisms. The laboratory comes to the aid of physician in all such cases. Many a times even when clinical syndrome is diagnosed such as sore throat, urinary tract infection and acute diarrhea, it becomes difficult to prescribe most appropriate chemotherapeutic agent because of large number of organisms which can

cause these syndromes. Laboratory investigation provides the information regarding organisms as well as the drug to be used.

Medical microbiology is the biological study of bacteria, viruses, fungi and algae which are collectively called as microorganisms, and unlike macroscopic organisms that are readily visible, these require magnification to be seen with the help of a microscope. It is concerned with etiology, pathogenesis, laboratory diagnosis and treatment of infections in an individual and with the epidemiology and control of infection in the community. Medical microbiology plays an important role in the diagnosis, prevention, treatment and control of infectious diseases. All living organisms on earth are composed of one or the other of two types of cells: prokaryotic and eukaryotic cells based on differences in cellular organization and biochemistry. There are many differences between the two major divisions: prokaryotes and eukaryotes, of cellular organisms. These include the following: In prokaryotes: • A distinct nucleus is absent. • DNA is in the form of a single circular chromosome. • Additional 'extra-chromosomal' DNA is carried in plasmids. • Transcription and translation can be carried out simultaneously. In eukaryotes: • DNA is carried on several chromosomes within a nucleus. • The nucleus is bounded by a nuclear membrane. • Transcription requires formation of messenger RNA (mRNA) and movement of mRNA out of the nucleus into the cytoplasm. • Translation takes place on ribosomes.

## **Bacterial Classification**

Bacteria can be classified by their wall structure, intracellular/extracellular invasive, cell morphology, growth characteristics and finally by their genotype (Phylogenetic tree).

### **A: Wall structure**

The bacterial cell wall is complex, consisting of one of two basic forms: a gram positive cell wall with a thick peptidoglycan layer (*Staphylococcus*,

*Streptococcus*, *Clostridium*, *Bacillus*), and a gram-negative cell wall with a thin peptidoglycan layer and an overlying outer membrane such as Enteric rods (*Escherichia*, *Shigella*, *Salmonella* and *Enterobacter*). Gram staining is not a dependable test for bacteria that are starved (e.g., old or stationary-phase cultures) or treated with antibiotics. Bacteria that cannot be classified by Gram staining include mycobacteria, which have a waxy outer shell and are distinguished with the acidfast stain, and mycoplasmas, which have no peptidoglycan.

- *Mycobacterium* contain large amounts of lipid substances within their cell walls called mycolic acids. These acids resist staining by ordinary methods such as a Gram stain. It can also be used to stain a few other bacteria, such as *Nocardia*.

- *Mycoplasma* are a mollicute genus of bacteria that lack a cell wall around their cell membranes.

## **B: Intracellular/extracellular invasion**

Pathogenic bacteria can be grouped into two categories on the basis of their invasive properties for eukaryotic cells. 1. Extracellular bacteria 2. Obligate intracellular bacteria

- **Extracellular bacteria:** Extracellular bacterial pathogens do not invade cells and proliferate instead in the extracellular environment which is enriched with body fluids. Some of extracellular bacteria even don't penetrate body tissues (e.g. *Vibrio cholera*, *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus pyogenes*), but adhere to epithelial surfaces and cause disease by secreting potent toxins

- **Obligate intracellular**

This group of bacteria can't live outside the host cells. For e.g. Chlamydial cells are unable to carry out energy metabolism and lack many biosynthetic pathways, therefore they are entirely dependent on the host cell to supply them with ATP and other intermediates. Because of this dependency Chlamydiae were earlier thought to be virus (All viruses are obligate intracellular parasites). Obligate intracellular bacteria cannot be grown in artificial media (agar plates/broths) in laboratories but requires viable eukaryotic host cells (e.g. cell culture, embryonated eggs and susceptible animals).

C: Cell morphology 1- Shape of bacteria Based on the shape of the bacterial cell, bacteria can be mainly classified into four major categories namely . Spherical bacteria or Coccus - Rod-shaped bacteria or Bacillus - Spiral bacteria - Filamentous bacteria. 2- Arrangement of bacteria i. Diplococci: Cocci may be arranged in pairs (diplococci) when cocci divide and remain together.