

Principles of Pathological Clinical Analyses

Terms and Definitions:

- **Pathology**, branch of Biology, refers to the study of diseases and the abnormalities or alterations induced by an infection either in structure or in function causing the clinical manifestations to appear.
- **Pathogenesis**, the events of disease development producing the pathology.
- **Pathogenic microorganism** is a microbe that can cause pathology.
- **Disease** refers to the existence of pathology, either infectious (resultant from a pathogenic infection like Cholera), or non-infectious disease (resultant from physiological defect like Diabetes).
- **Infectious disease** is a disease caused by a microorganism due to its virulence factors.
- **Virulence** is a term referring to the abilities of a microbe to produce disease in a host, like presence of capsule or production of toxins and enzymes.
- **Immunity** refers to the degree of resistance of the host for the invading microbe.
- **Etiology** refers to the study of disease occurrence, causes, development, modes of transmission and prevention.
- **The host-parasite interaction**, the dynamic process of infectious diseases occurrence when the parasite tries to multiply and the host defenses try to control.
- **Epidemiology** is the study of diseases and public health conditions in a defined population and usually needs statistical analysis.
- **Steps of infectious Diseases:**
 1. Infection.
 2. Inflammation and Tissues Damage.

3. Immune System Response.
4. Recovery and Cure (repairing damage).

Cells Damage due to infection:

Infections can lead to individual cell damage; cell membrane and DNA are the most important cellular component that may be affected by infection, then cellular proteins and fats, and that can cause lose the function of cell. If damage or injury cannot be repaired, cell may die by apoptosis process (programmed cell death).

Tissues Damage due to infection:

1. **Atrophy:** the partial or complete loss of tissue (breakdown of tissues) due to an increase in apoptotic cells.
2. **Hypertrophy:** the increase in the volume of an organ or tissue due to the enlargement of its cells (cells size increase and the number stay fixed not like hyperplasia).
3. **Hyperplasia:** the increase in cells number (proliferation of cells) and sometimes called benign neoplasia or benign tumor. The cells under microscope look normal but increased in number. This change in tissues differ from neoplasia (cancer) because cells still under regulation control mechanisms and the proliferation of them is genetically normal, also the cells able to response to normal stimulations.
4. **Hypoplasia:** the incomplete development of a tissue or organ, cells number below normal due to congenital medical condition, e.g. hypothyroidism during gestation cause hypoplasia in the Mandible of fetus.
5. **Metaplasia:** the change of differentiated cells to another cell type, lead to suppress function of organ, but it is reversible and tissue can return back as it was.
6. **Odema:** the accumulation of liquids in tissues due to imbalance in osmotic pressure of vessels in that organ or tissue due to infections and inflammation process.
7. **Necrosis:** death of living premature cells in tissues due to unregulated digestion of cells components (autolysis), this type of tissue damage is

irreversible injury and can be fatal for whole human body when occurs in important organs like lung or liver.

Necrosis starts by the loss of cell membrane integrity and an uncontrolled release of products of cell death into the intracellular space. This initiates an inflammatory response in the surrounding tissue; phagocytes are prevented from locating and engulfing the dead cells. The result is dead tissue and cell debris at, or near, the site of the cell death and it is necessary to remove necrotic tissue surgically, the classic example is gangrene.

Even after healing, the necrotic tissue will remain in the body. The standard therapy for necrosis is removal of the dead tissue (debridement) either by surgical or non-surgical means. Depending on the severity of the necrosis, the affected limbs or organs may be whole removed to save patient life. In some cases, special maggot therapy using *Lucilia sericata* larvae has been employed to remove necrotic tissue and infection.

Types of Necrosis:

- **Coagulative necrosis** can be observed by light microscopy. Coagulation occurs as a result of protein denaturation, mainly the albumin forming gel like substance, e.g. occurs in tissues such the kidney, heart and adrenal glands.
- **Liquefactive necrosis** occurs due to digestion of dead cells to form a viscous liquid mass. This is typical in bacterial, or sometimes fungal, infections because of their ability to stimulate an inflammatory response. The necrotic liquid mass is frequently creamy yellow due to the presence of dead leukocytes and is commonly known as pus.
- **Caseous necrosis** can be considered a combination of coagulative and liquefactive necroses, caused by mycobacteria (e.g. tuberculosis), fungi and some foreign substances. The necrotic tissue appears as white and like clumped cheese. Dead cells disintegrate but are not completely digested,

leaving granular particles. Microscopic examination shows amorphous granular debris enclosed within an inflammatory border, e.g. Granuloma.

- **Fat necrosis** is specialized necrosis of fat tissue resulting from the action of activated lipases on fatty tissues such as the pancreas.
- **Fibrinoid necrosis** is a special form of necrosis usually caused by immune-mediated vascular damage. It is marked by complexes of antigen and antibodies, sometimes referred to as “immune complexes” deposited together with fibrin.

Note: the recycling of cellular materials process cannot occurs after necrotic cell death due to the apoptotic pathway non-activation.