

Disease development process

- In order to get insight into the process of disease development, it is very essential to understand the role of various pathogens such as:
 - Their adaptive modifications
 - The functional importance of the target tissue
 - Interaction between pathogen and host at the target tissue level
 - Pathogenicity mechanism of pathogens etc.
 - The process of disease development is very complicated.
 - Environmental factors & Stress often can accelerate this process.

- The sequence of disease development will to a large extent depend on the:
 - Nature of pathogen (parasite, bacteria, virus, fungi)
 - Environmental factors
 - Size of the host
- Pathogen load or intensity per unit area or unit weight of the host.
- Pathology is the study of disease
- It involves the investigation of the causes (etiology) of disease as well as the underlying mechanisms (pathogenesis) that result in the presenting signs and symptoms of the diseased fish.

- Pathologists use a variety of molecular, microbiological, and immunological techniques to understand the biochemical, structural, and functional changes that occur in cells, tissues, and organs.
- Pathology in simple is the outcome of three basic process:
 1. Cellular responses to pathogen induced injury
 2. Inflammatory response exhibited by the host
 3. Pathogenicity mechanisms of the pathogen
- The interaction of these three processes in the target tissue of the host produce series of pathological changes.
- Functional failure of the target tissue leads to clinical manifestation of the disease followed by morbidity and mortality.

Cellular response to injuries

- The cellular environment is constantly changing and as a consequence, cells have to make continuous adjustments to accommodate these changes.
- The cells have a great capacity for adaptation to their environment.
- Cells may respond to pathological stimuli by extending their normal physiological adaptive processes.
- These adaptive processes include:
 - **Increased cellular activity**
 - increase in cell size (hypertrophy)
 - increase in cell number (hyperplasia)
 - **Decreased cellular activity**
 - reduced cell size (cell atrophy)
 - reduced number of cell (tissue or organ atrophy)

- **Change in cell type:**

-modification in morphology & function to a cell type more suited to the changed environment (metaplasia).

- **Failure of Cellular adaptation:**

-Cells which are intrinsically unable to adapt, begin to show structural changes which indicate their failure to withstand the changed environment.

-Injury may progress through a reversible stage and culminate in cell death.

- **Reversible cell injury:**

- In early stages or mild forms of injury the functional and morphologic changes are reversible if the damaging stimulus is removed.

- At this stage, although there may be significant structural and functional abnormalities, the injury has typically not progressed to severe membrane damage and nuclear dissolution.

Cell death

- With continuing damage, the injury becomes irreversible, at which time the cell cannot recover (point of no return) and it dies.
- There are two types of cell death— necrosis and apoptosis.
- Necrosis is always a pathologic process, apoptosis serves many normal functions and is not necessarily associated with pathologic cell injury.
- **Necrosis:**
- Necrosis - major pathway of cell death
- Observed in many commonly encountered injuries, such as those resulting from ischemia, exposure to toxins, various infections, and trauma.
- **Apoptosis – (Programmed Cell Death)**
- When a cell is deprived of growth factors or the cell's DNA or proteins are damaged beyond repair, the cell kills itself called apoptosis, which is characterized by nuclear dissolution without complete loss of membrane integrity.
- Apoptosis is an active, energy dependent, tightly regulated type of cell death that is seen in some specific situations.

Inflammatory response

- Inflammation – to set fire.
- Inflammation is a complex biological response of body tissues to harmful stimuli.
- It is a non-specific, protective response.
- It serves to bring defense & healing mechanisms to the site of injury.

Pathogenicity mechanism

- Ability or potential to cause disease attributed to a genus or Species.
- High virulence ↔ low virulence ↔ avirulent (virulence is lost)
- increasing virulence: mutations, GMO, bioterrorism
- decreasing virulence: mutations, attenuation

- **Dependent on ability to**
 - enter the host
 - adapt and multiply in the host
 - exit from the host
 - transmit to new host