

Histopathology

Lecture 1

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Pathology : is the science study of disease. It involves the investigation of the causes of disease and the associated changes at the levels of cells, tissues, and organs, which in turn give rise to the presenting signs and symptoms of the patient.

-There are many important terms that will encounter throughout their study of pathology:

1. Etiology: is the origin of a disease, including the causes and modifying factors. It is now clear that most common diseases, such as hypertension, diabetes, and cancer, are caused by a combination of inherited genetic susceptibility and various environmental triggers.

2. Pathogenesis: it refers to the steps in the development of disease. It describes how etiologic factors trigger cellular and molecular changes that give rise to the specific functional and structural abnormalities that characterize the disease. Whereas **etiology** refers to why a disease arises, **pathogenesis** describes how a disease develops.

*Defining the **etiology** and **pathogenesis** of disease not only is essential for understanding a disease but is also the basis for developing rational treatments.*

3. Treatment: The pathologist helps in treatment of the disease by giving information to the surgeon or physician or dermatologist about the lesion whether it is benign or malignant & activities of tumor.

Surgeon sometimes asks the pathologist about the type of tumor, so they can choose the correct treatment, also help in planning of the prognosis of the disease.

4. Prognosis: Means the outcome of the disease, is it curable or is it fatal?

5. Prevention: When you know the causes & the pathogenesis you can plan for prevention of the disease by isolation or vaccination.

Histopathology is a branch of pathology which deals with the study of disease in a tissue section. The tissue undergoes a series of steps before it reaches the examiners desk to be thoroughly examined microscopically to arrive at a particular diagnosis. To achieve this it is important that the tissue must be prepared in such a manner that it is sufficiently thick or thin to be examined microscopically and all the structures in a tissue may be differentiated.

*The cell is the single structural unit of all tissues. The study of cell is called **cytology**.
A **tissue** is a group of cells specialized and differentiated to perform a specialized function.
The tissues together form an **organ**.*

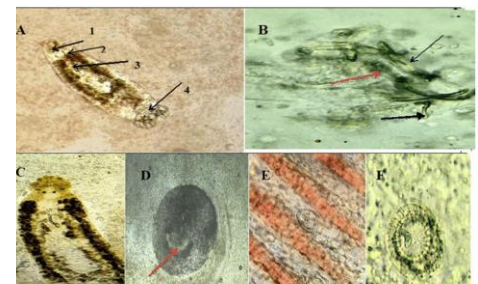
Type of material obtained in laboratory:

1. Biopsy- A small piece of lesions or tumor which is sent for diagnosis before final removal of the lesion or the tumor which called (**Incisional biopsy**) but if the whole of the tumor or lesion is sent for examination and diagnosis by the pathologist, it is called (**excisional biopsy**).

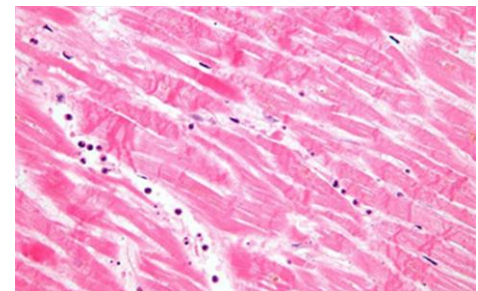
2. Tissues from the autopsy are sent for the study of disease and its course, for the advancement of medicine.

Types of histological preparation:

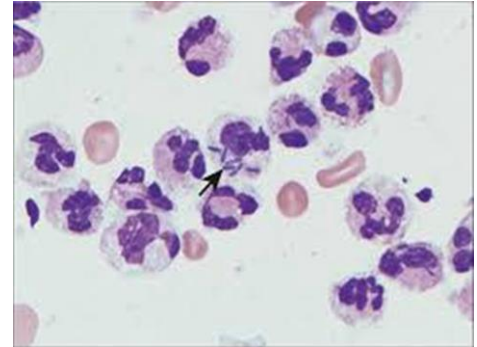
1. Whole mount : These are whole animal preparations, such as fungi and parasites. The thickness of these preparations shouldn't be greater than **0.2–0.5 mm**.



2. Sections : The majority of the preparations in histology are sections.



3. **Smears:** Any fluid, including pleural or ascetic fluid, can be used to make smears. Blood and bone marrow can also be used.

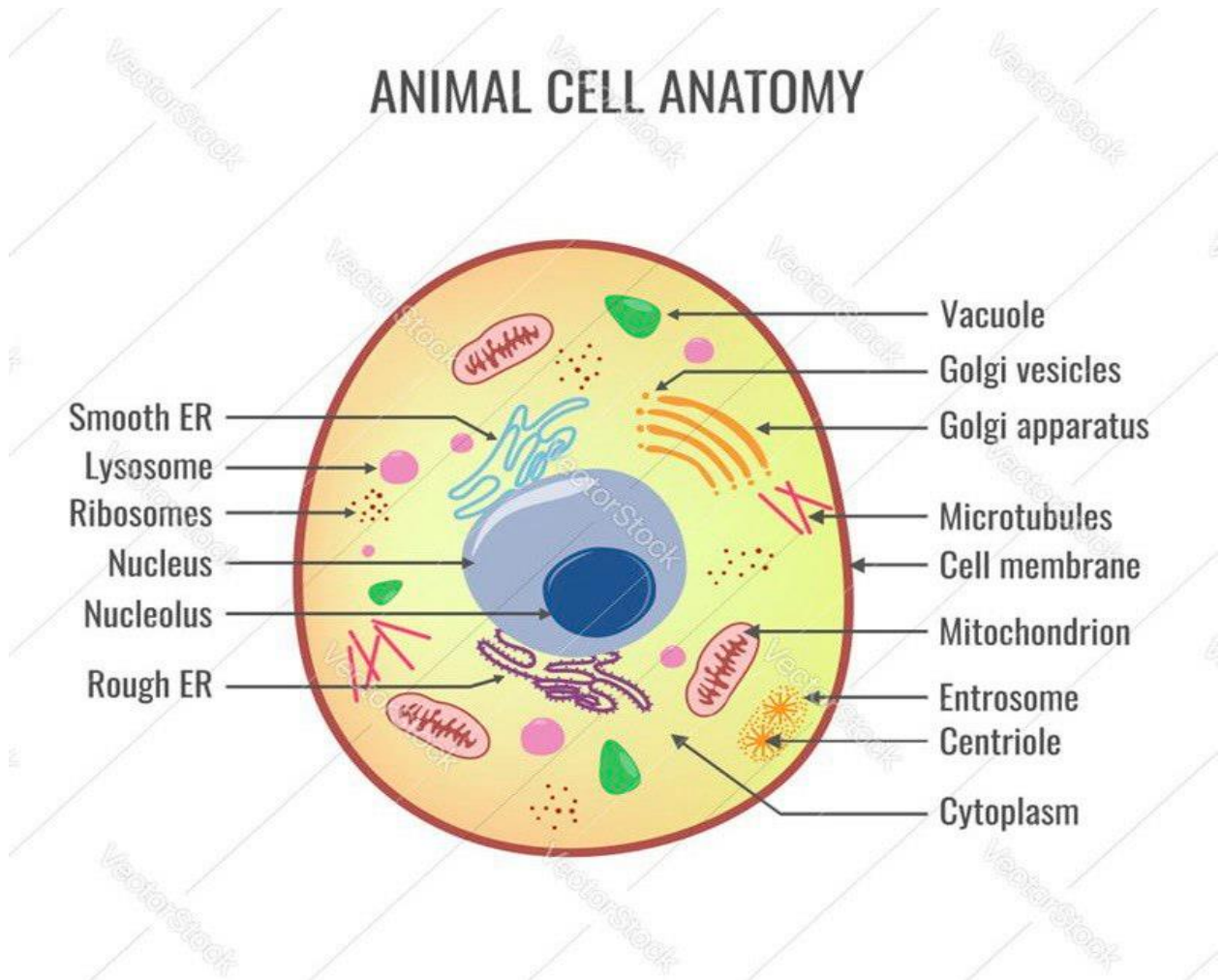


The Cell.

The cell is the basic structural, functional, and biological unit of all known living organisms.

Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids. Organisms can be classified as unicellular (consisting of a single cell; including bacteria) or multicellular (including plants and animals).

All animal cells are multicellular; they are eukaryotic cells. Animal cells are of various sizes and have irregular shapes. Most of the cells size range between 1 and 100 micrometers and are visible only with help of microscope. Trillions of cells are found in the human body.



Parts of the animal cell:

1- **Cell membrane**- forms the outer covering of the cell, and is semi-permeable. It controls how substances can move in and out of the cell and is responsible for many other properties of the cell as well. Membranes are composed of **phospholipids, proteins** and **carbohydrates** arranged in a fluid mosaic structure.

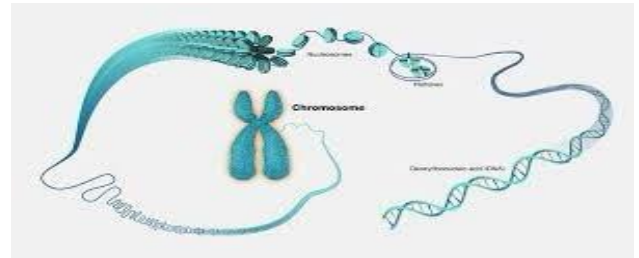
2- **Cytoplasm**-is a gel-like matrix where all the other cell organelles are suspended inside the cell. Cytoplasm is homogenous, clear jelly-like materials that fill the cells. The cytoplasm plays a mechanical role to maintain the shape, the consistency of the cell and to provide suspension to the organelles.

3- Nucleus- contains the hereditary material DNA and directs the activities of the cell. The nucleus is a membrane-bound organelle that contains genetic material (DNA) of eukaryotic organisms. As such, it serves to maintain the integrity of the cell by facilitating transcription and replication processes.

The term **protoplasm** includes the "living part" of the cell. It can be differentiated into cytoplasm and the nucleus

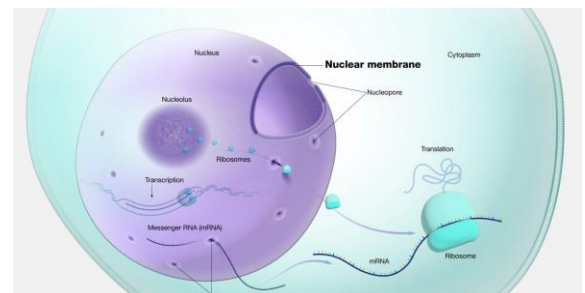
4- Chromosomes

- Usually in the form of chromatin.
- Contains genetic information.
- Composed of DNA.
- Thicken for cellular division.



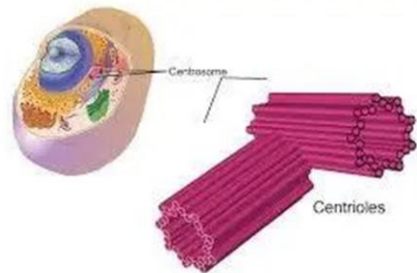
5- Nuclear membrane

- Surrounds nucleus- Composed of two layers.
- Numerous openings for nuclear traffic.



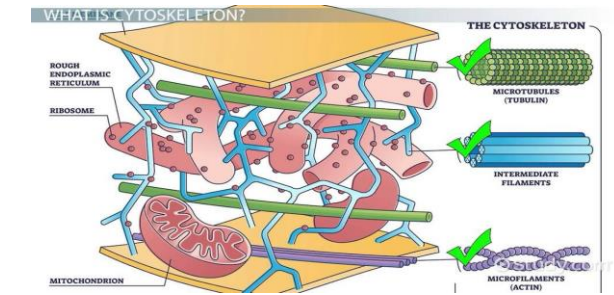
6- Centrioles

- Paired cylindrical organelles near nucleus
- Composed of nine tubes, each with three tubules
- Involved in cellular division
- Lie at right angles to each other



7- Cytoskeleton

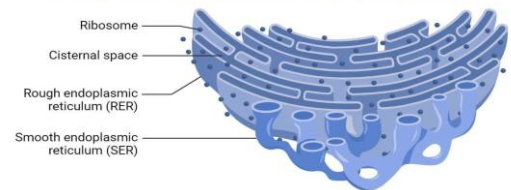
- Composed of microtubules
- Supports cell and provides shape
- Aids movement of materials in and out of cells



8- Endoplasmic reticulum

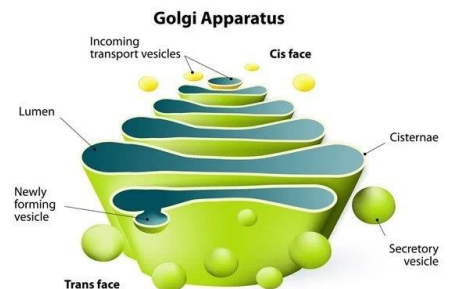
- Tubular network fused to nuclear membrane
- Goes through cytoplasm onto cell membrane
- Stores, separates, and serves as cell's transport system
- Smooth type: lacks ribosomes
- Rough type (pictured): ribosomes embedded in surface

Endoplasmic Reticulum (ER) Structure



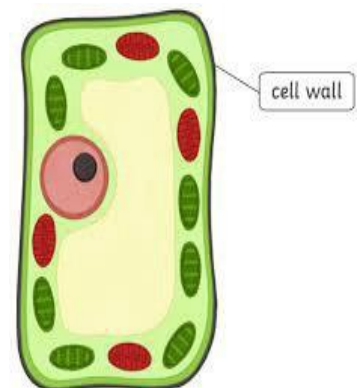
9- Golgi apparatus

- Protein 'packaging plant'
- A membrane structure found near nucleus
- Composed of numerous layers forming a sac



10- Cell wall

- Most commonly found in plant cells
- Controls turgity
- Extracellular structure surrounding plasma membrane
- Primary cell wall: extremely elastic



- Secondary cell wall: forms around primary cell wall after growth is complete

11- Lysosome

12- Mitochondria

13- Ribosomes

14- Vacuoles

Lysosome= digestive system of the cell.

Mitochondria= produce energy.

Ribosomes= site of protein synthesis in the cell.

Vacuoles= storage, waste management, and structural support.

Cellular Responses to stress and noxious stimuli

- Cells normally maintain a steady state called homeostasis in which the intracellular milieu.
- cells encounter physiologic stresses or pathologic stimuli, they can undergo adaptation, achieving a new steady state and preserving viability and function.
- The principal adaptive responses are **hypertrophy, hyperplasia, atrophy, and metaplasia**. if the external stress is inherently harmful, cell injury develops
- Within certain limits, injury is reversible however, if the stress is severe, persistent, it results in irreversible injury and death of the affected cells.
- Cell death is one of the most crucial events in the evolution of disease in any tissue or organ. It results from diverse causes, including **ischemia** (lack of blood flow), infections, toxins, and immune reactions.

Hypertrophy = increase in cell size.

Hyperplasia = increase in cell number.

Atrophy = decrease in cell size.

Metaplasia = change in cell type.

Ischemia is a less-than-normal amount of blood flow to part of your body. This lack of blood flow means your tissues aren't getting the oxygen they need. This can happen in various organs, like your heart and brain.

Hypertrophy

Hypertrophy and hyperplasia also can occur together.

- Hypertrophy is an increase in the size of cells resulting in increase in the size of the organ.
- in pure hypertrophy there are no new cells, just bigger cells containing increased amounts of structural proteins and organelles.
- hypertrophy occurs when cells have a limited capacity to divide.
- Hypertrophy can be physiologic or pathologic and is caused either by increased functional demand or by growth factor or hormonal stimulation.

Hyperplasia

- hyperplasia is characterized by an increase in cell number because of proliferation of differentiated cells
- Hyperplasia is an adaptive response in cells capable of replication,
- Hyperplasia takes place if the tissue contains cell populations capable of replication; it may occur concurrently with hypertrophy and often in response to the same stimuli.
- Hyperplasia can be physiologic or pathologic. In both situations, cellular proliferation is stimulated by growth factors that are produced by a variety of cell type.
- **The two types of physiologic hyperplasia are**
 - (1) hormonal hyperplasia, exemplified by the proliferation of the glandular epithelium of the female breast at puberty and during pregnancy
 - (2) compensatory hyperplasia, in which residual tissue grows after removal or loss of part of an organ. For example, when part of a liver is resected.
- Most forms of pathologic hyperplasia are caused by excessive hormonal or growth factor stimulation. For example after a normal menstrual period there is a burst of uterine epithelial proliferation that is normally tightly regulated

by stimulation through pituitary hormones and ovarian estrogen and by inhibition through progesterone. However, a disturbed balance between estrogen and progesterone causes endometrial hyperplasia, which is a common cause of abnormal menstrual bleeding.

- Hyperplasia also is an important response of connective tissue cells in wound healing, in which proliferating fibroblasts and blood vessels aid in repair. In this process, growth factors are produced by white blood cells (leukocytes) responding to the injury and by cells in the extracellular matrix.
- Stimulation by growth factors also is involved in the hyperplasia that is associated with certain viral infections; for example, **papillomaviruses** cause skin warts and mucosal lesions composed of masses of hyperplastic epithelium. Here the growth factors may be encoded by viral genes or by the genes of the infected host cells.

papillomaviruses HPV infection is a viral infection that commonly causes skin or mucous membrane growths (warts). Some types of human papillomavirus (HPV) infection cause warts, and some can cause different types of cancer.

