WELCOME

TO

PATHOPHYSIOLOGY

UNIT 4

TOPIC :

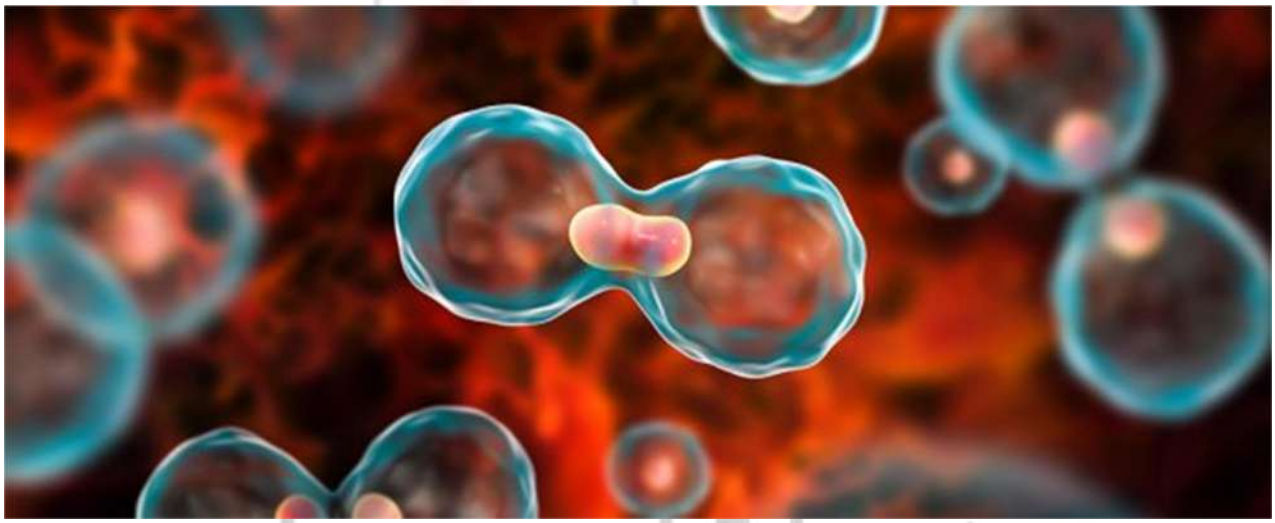
- **Principles of cancer :** classification, etiology and pathogenesis of cancer

Cancer

→ Cancer is a serious and potentially life-threatening disease characterized by the uncontrolled growth and spread of abnormal cells within the body. These abnormal cells divide uncontrollably, ignore normal signals to stop growing, and may invade nearby tissues or organs.

→ In many cases, these cancerous cells form a mass called a tumor. However, not all tumors are cancerous—benign tumors do not spread, whereas malignant tumors can invade and damage other tissues.

→ Cancer cells can spread to distant parts of the body through the bloodstream or lymphatic system. This process is called metastasis.



Sites and Naming of Cancer

- Cancer can affect **any part of the body.**
- It is often **named after the organ or type of cell** where it begins. For example:
  - **Breast Cancer** – starts in the breast tissue.
  - **Lung Cancer** – originates in the lungs.
  - **Leukemia** – cancer of blood-forming tissues.
  - **Lymphoma** – cancer of the lymphatic system.

Terms Commonly Associated with Cancer

- **Neoplasm**: A general term that means *"new growth"*. It can be **benign** (non-cancerous) or **malignant** (cancerous).
- **Tumor**: Often used interchangeably with neoplasm, but typically refers to a **solid mass of tissue**.
- **Malignancy**: Refers specifically to cancerous growth that tends to spread and cause damage.

Classification of Cancer

→ Cancers are classified based on their tissue of origin, cell type, and behavior.

Type	Origin	Examples
Carcinoma	Epithelial cells	Lung, breast, colon, skin cancers
Sarcoma	Connective tissues (bone, muscle)	Osteosarcoma, liposarcoma
Leukemia	Blood-forming tissues (bone marrow)	Acute or chronic leukemia
Lymphoma	Lymphatic system	Hodgkin's, Non-Hodgkin's lymphoma
Myeloma	Plasma cells	Multiple myeloma
Melanoma	Melanocytes (pigment cells)	Skin melanoma
Blastoma	Embryonic or immature tissue	Retinoblastoma, neuroblastoma

Etiology of Cancer (Causes)

Genetic Factors:

- **Oncogene activation** (e.g., RAS, MYC)
- **Tumor suppressor gene inactivation** (e.g., TP53, RB)

- **Inherited mutations** (e.g., BRCA1/BRCA2 in breast cancer)

Environmental and Lifestyle Factors:

- **Radiation** (UV, ionizing): Causes DNA damage (e.g., skin cancer)
- **Chemicals**: Tobacco smoke, asbestos, benzene
- **Diet**: High-fat, low-fiber, processed foods
- **Alcohol**: Increases risk of liver, breast, and GI cancers
- **Viruses:**
  - HPV → Cervical cancer
  - HBV/HCV → Liver cancer
  - EBV → Lymphoma
  - HIV → Kaposi's sarcoma
- **Occupational exposure**: Dyes, pesticides, metals

Hormonal Factors:

- Prolonged estrogen exposure → Breast/endometrial cancer
- Androgens → Prostate cancer

Pathogenesis

1. Initiation
   - A carcinogen (radiation, chemical) causes **irreversible DNA mutation** in a normal cell.
2. Promotion
   - Promoters (e.g., hormones, chronic inflammation) stimulate the **clonal expansion** of mutated cells without further DNA damage.
3. Progression
   - Additional mutations occur, making cells more **aggressive, invasive,** and **immortal**.
4. Metastasis
   - Cancer cells invade surrounding tissue, enter the bloodstream/lymphatic system, and form **secondary tumors** in distant organs.

Non-Pharmacological Management

Healthy Lifestyle Modifications:

- **Balanced diet:** Emphasize fruits, vegetables, whole grains, and lean proteins.
- **Avoid carcinogens:** Stop **smoking**, limit exposure to **radiation**, **pollutants**, and **chemicals**.
- **Limit alcohol** intake.
- **Regular physical activity** to maintain healthy body weight.
- **Sun protection:** Use sunscreen and avoid excessive UV exposure to prevent skin cancers.

Screening and Early Detection:

- Regular **cancer screenings** (e.g., Pap smear, mammogram, colonoscopy).
- **Genetic counseling/testing** for individuals with family history.

Psychosocial Support:

- **Counseling, support groups**, and **mental health therapy**.
- **Palliative care** for symptom relief and quality of life improvement in advanced stages.

Pharmacological Management

1. Chemotherapy

- Use of **cytotoxic drugs** to kill or inhibit cancer cell division.
- Examples:
  - **Cyclophosphamide**, **Methotrexate**, **Doxorubicin**, **5-Fluorouracil (5-FU)**
- Often given in **cycles** and may be combined (combination therapy).

2. Hormonal Therapy

- Used for **hormone-sensitive cancers** like breast and prostate cancer.
- Examples:
  - **Tamoxifen**, **Letrozole** (breast cancer)
  - **Leuprolide**, **Flutamide** (prostate cancer)

3. Targeted Therapy

- Targets specific **molecular markers** or pathways in cancer cells.
- Examples:
  - **Imatinib** (for CML)
  - **Trastuzumab** (HER2+ breast cancer)

4. Immunotherapy

- Boosts the body's **immune system** to recognize and fight cancer.
- Examples:
  - **Checkpoint inhibitors** like **Pembrolizumab**, **Nivolumab**

5. Radiotherapy

- Uses **ionizing radiation** to destroy cancer cells or shrink tumors.
- Can be **external beam** or **internal (brachytherapy)**.

6. Surgery

- Physical removal of tumor—may be **curative, palliative, or preventive.**

7. Palliative Medications

- For **pain relief, nausea**, and **other symptoms** in terminal cancer cases.
  - **Morphine, Ondansetron, Corticosteroids**