Neoplasia:

Tumor or *neoplasm :*

A mass of tissue in which the growth rate is excessive and uncoordinated when compared with normal tissues.

Benign neoplasm:

Benign tumors usually will not cause death unless they interfere with vital function. Specific names end with "*oma."*For example, an adenoma is a benign tumor of the glandular tissue , whereas an adenocarcinoma is a malignant tumor.

Characteristics of Neoplasia

Benign	**Malignant**
Slow growth rate	Rapid growth rate
Encapsulated	Non-encapsulated
Well-differentiated cells	Undifferentiated (anaplasia)
Resemble tissue of origin	Loss of contact inhibition
Do not metastasize	Metastasize readily
	Express foreign antigens
	Abnormal gene expression

Malignant neoplasm

Tumors that have the ability to *metastasize* or break loose and spread to other areas of the body. If untreated, such tumors can cause great suffering and death. Specific examples:

Carcinoma— Malignant tumor of *epithelial cell origin.*

Sarcoma— Malignant tumor of *skeletal or connective tissue origin*.

Lymphoma— Malignant tumor of *lymphatic tissue*.

Glioma— Malignant tumor of the *glial support cells* in the central nervous system.

Differentiation of benign and malignant tumors depends on rate of growth,differentiation and anaplasia,local invasion and metastasis.

Rate of growth:

Benign tumors have slow growth rate comparing with malignant ones in which the rate of growth greatly affected by degree of differentiation.

Differentiation and anaplasia:

Represent the degree of similarity(morphologic and functional) between original tissue and tumorous one. So,it is either well ,moderate or poorly differentiated.

Local invasion:

The ability of tumor to infiltrate,invade and destruct adjacent tissues .

Metastasis

The ability of tumor cells to spread to other parts of the body and establish secondary tumors. Malignant tumor cells can break off and utilize blood vessels or lymphatic vessels to spread to other areas of the body. Tumor cells enhance their potential for metastatic spread by

releasing *protease* enzymes that digest the extracellular matrix surrounding adjacent cells. Malignant tumor cells may also produce *growth factors* that stimulate the formation of new blood vessels (*angiogenesis*), which in turn support the rapid growth of tumor cells. Certain organs such as the lungs are prime locations for the formation of metastases because of the large amount of blood flow they receive from the body. The liver is also a common site of metastasis for tumors originating in the gastrointestinal tract because blood draining the intestines must first pass through the liver via the hepatic portal system.

Theories of oncogenesis

Oncogenesis ,is the process by which normal cells are transformed into cancer cells.

Four genes regulate cell growing cycle,*growth promoter genes(oncogenes),apoptosis regulating genes,tumor suppressor genes and DNA repair genes.*

Abnormalities of tumor suppressor and oncogenes

Several proteins produced within cells such as the *p53* protein are known to limit cellular division by regulating certain parts of the normal cell cycle. The genes that code for these proteins are referred to as *Tumor suppressor genes* since they suppress cell growth. Failure of these anti-oncogenes may lead to the unregulated cellular division that is characteristic of cancer cells. In contrast, other groups of genes are classified as *proto-oncogenes* since they produce proteins and substances that enhance cellular growth and proliferation.

Excessive activity of these genes (or a lack of their regulation) may likewise cause excessive cellular division and growth.

How Does Cancer Happens?

Most of the numerous theories about carcinogenesis suggest that it involves three steps: initiation, promotion, and progression.

Initiation

Initiation refers to the damage to or mutation of DNA genes (any of the mentioned genes) that occurs when the cell is exposed to an initiating substance or event (such as chemicals, virus, or radiation) during DNA replication (transcription). Normally, enzymes detect errors in transcription and remove or repair them(via DNA repair genes). But sometimes an error is missed. If regulatory proteins recognize the error and block further division, then the error may be repaired or the cell may self-destruct(apoptosis). If these proteins miss the error again, it becomes a permanent mutation that is passed on to future generations of cells.

Promotion

Promotion involves the exposure of the mutated cell to factors (*promoters*) that enhance its growth. This exposure may occur either shortly after initiation or years later.*Promoters* may be hormones, such as estrogen; food additives, such as nitrates; or drugs, such as nicotine. Promoters can affect the mutated cell by altering:
function of genes that control cell growth and duplication ,cell response to growth stimulators or inhibitors.

Progression

Some investigators believe that progression is actually a late promotion phase in which the tumor invades, metastasizes, and becomes resistant to drugs. This step is irreversible.

Possible Cancer-Causing Agents

Chemicals — Many such as benzene, vinyl chloride, cigarette smoke, aromatic hydrocarbons
Radiation, radon gas, radioactive materials, ultraviolet radiation
Occupational exposure — Asbestos, coal dust, uranium, solvents
Oncogenic viruses
Dietary factors — High-fat diet, excessive alcohol intake, nitrosamine preservatives, grilled or charred foods
Hormones — Estrogens, progesterone

Oncogenic Viruses in Humans
A number of DNA and RNA viruses have been shown to be "oncogenic," meaning they can cause cancers in the hosts they infect.
Human Papillomavirus— Cervical carcinoma
Hepatitis B Virus— Liver cancer
Epstein–Barr Virus— Burkitt's lymphoma, nasopharyngeal cancer
*HIV Viru*s — Kaposi's sarcoma

Hereditary

A genetic predisposition has been observed for a number of cancers including colon cancer, breast cancer, retinoblastoma and certain forms of leukemia and lymphoma. A great deal of recent research has focused on identifying certain genetic markers in individuals that might pinpoint them as at risk for the development of certain types of cancer.

Manifestations of cancer

Many cancers may be asymptomatic in the early stages. As the tumors continue to grow, they affect local tissues as well as the overall body.

1. Local effects of cancer
• Compression of blood vessels
• Ischemia
• Pain
2. Systemic effects of cancer
• Fatigue
•*Cachexia*

Cachexia

A complex syndrome characterized by anorexia, weight loss and lean body (muscle) wasting seen in a significant percent of patients with cancer and AIDS.

Tumor staging

Tumors are classified or "staged" based upon the "TNM" system that includes a description of tumor size (T), involvement of lymph nodes (N) and metastasis (M).

Tumor cell markers

• Substances produced by or found on the surface of tumor cells.
• Tumor cell markers may be used clinically to screen for the presence of tumor cells in the body ,example for these tumor markers ,alpha Fetopotein, secreted by embryonic liver cells .High levels seen in liver, ovarian and testicular cancer.Prostate-specific antigen (PSA),markedly increased in prostatic cancer ,slightly elevated in benign prostatic hypertrophy.

Factors that interact to increase a person's likelihood of developing cancer are age, nutritional status, hormonal balance,and response to stress; these can be considered as risk factors.

The healthy body is well equipped to defend itself against cancer. Only when the immune system and other defenses fail does cancer prevail.

Treatment of cancer

Surgical removal

If accessible, tumors should be surgically removed. Often accompanied by chemotherapy or radiation therapy to kill any cancer cells that are not removed or have metastasized.

Chemotherapy

Drugs used for chemotherapy of cancer fall into several categories

Hormonal therapy

Sex hormones are routinely used to inhibit tumor growth in breast, prostate and uterine cancer. The estrogen inhibitor *tamoxifen* has also been shown to be effective in the treatment of breast cancer and may eventually be used as a prophylactic agent in women who are at a high risk for developing breast cancer. The androgen inhibitor *flutamide* has also been approved for treatment of prostate cancer.

Radiation therapy

Radiation therapy utilizes ionizing or particle beam radiation to destroy cancer cells that are highly mitotic and most susceptible to the lethal effects of radiation. Radiation therapy can have a number of localized and systemic side effects including alopecia, diarrhea, tissue irritation and organ inflammation.

Immune-based therapies

"Biologic response modifiers" such as *interferons, immunomodulators, tumor antigens* and *lymphokines/cytokines* are being investigated as means of enhancing the immune system response of individuals with cancer. *Monoclonal antibodies* have also been studied as a highly specific means of delivering chemotherapeutic drugs directly to and only to cancer cells.

Table

Chemotherapy Drugs

Alkylating agents and nitrosureas

(examples: cyclophosphamide, carmustine)

Cytotoxic to cancer cells due to alkylation of cancer cell DNA

Major toxicities include nausea and vomiting, and bone marrow suppression

Antimetabolites

(examples: methotrexate, fluorouracil)

Inhibit synthesis of essential nucleotides and nucleic acids in cancer cells

Major toxicities include myelosuppression, nausea, vomiting, oral and gastrointestinal ulceration

Plant alkaloids

(examples: vinblastine, vincristine)

Disrupt mitosis in cancer cells by interfering with formation of the mitotic spindle .Numerous toxicities including cardiotoxicity, bone marrow depression, neurologic and muscle effects as well as alopecia

Antibiotics

(examples: doxorubicin, bleomycin)

Bind directly to cancer cell DNA to block the formation of new RNA or DNA .Major toxicities include bone marrow suppression, alopecia