Neoplasia – “new growth”

Uncontrolled growth of cells that cannot be appropriately controlled by normal regulatory mechanisms
Neoplasia

- Cancer is 2nd leading cause of death in the US
- Estimated that 1 in 3 people will be diagnosed with some form of invasive cancer in their lifetime
Normal Cell Growth

- Regulated by:
  - Genetic program of each cell
  - Signals transmitted from one cell to another through direct contact
  - Various soluble substances that have growth promotion or inhibition properties
Once growth begins, proliferation stops and allows for differentiation

- Assumption of specific functions
- Activation of specific functions
  - Suppression of other genes
Neoplastic Proliferation

- Do not achieve same level of differentiation because:
  - Autonomous
    - Independent of factors promoting normal cell growth
  - Excessive
    - Does not stop despite regulatory factors
  - Disorganized
    - Does not follow rules of normal tissue/organ function
Tumor Cells

- Masses of proliferated cells that are undifferentiated
- Serve no useful purpose
- May harm the host organism
- Not all neoplasms form tumors
Tumor Growth

In order for tumor to grow, it must:

- Resist attack from immune system
- Undergo angiogenesis
Oncology

- Scientific discipline concerned with the study of neoplastic growths
Oncology

- Study of neoplastic growth
  - Tumors are classified
    - Clinical
      - Benign
      - Malignant
    - Histologic
      - Based on cytologic and histologic examination via microscope
Tumor Classification - Clinical

- **Benign**
  - Limited growth potential
    - Good prognosis
  - Differentiated
    - Resemble the cells from which they have arisen
  - Often encapsulated
    - Promotes easy excision
  - Composed of a uniform cell population
  - Little to nor vascularity
Tumor Classification - Clinical

- **Malignant**
  - Grow uncontrollably
    - Eventually kill the host
  - Lack a capsule
    - Not clearly separated from normal tissue
    - Cannot be removed as easily
- **Undifferentiated**
  - Entire metabolism geared toward rapid growth and replication
- **Highly vascular**
Malignant
- Invade tissue through pseudopods, like roots on a tree
- Heterogenous cell population
Metastasis

- Process where cells move from one site to another within the body
  - Attach and form new tumor mass
- Only malignant tumors metastasize
Cells spread by 3 main pathways
- Lymphatic system
- Circulating blood
- Seeding surfaces of the body cavities
Tumor Classification - Histological

- Benign
  - Named according to the tissue from which they arise
  - Suffix “-oma”
  - Examples:
    - Lipoma – Benign tumor composed of fat tissue
    - Adenoma - Benign tumor composed of glandular epithelial cells
      - Polyp – adenoma of the intestines which protrudes through surface of intestines
      - Papiloma- benign adenoma protuberances of the skin, urinary bladder, mouth or larynx
Tumor Classification - Histological

- Malignant
  - Suffix “-sarcoma” or “-carcinoma”
  - Named according to tissue from which they arise
  - Examples:
    - Lymphomas - Malignant tumors of lymphoid cells
    - Blastomas - Malignant tumors of embryonic cells
    - Osteosarcoma - Malignant tumor of bone cells
  - Mets still named for the source of neoplasm
Cancer Cell Physiology

- Require little oxygen
- Do not have contact inhibition
  - Cells continue to divide, piling up on each other into aggregates or nodules
  - Have few surface adhesion molecules
    - Malignant cells detach and float within a culture medium
    - Do not need a vessel wall to attach to
CA Cell Growth Properties

- Tumor cells have less stringent requirements for nutrients and can survive in test tubes
  - Many malignant cells are virtually immortal
Etiology of CA

- Mostly unknown
  - It is a process more than a single disease
  - Multifactorial with numerous forms
  - Caused by carcinogens
    - Exogenous factors
      - Chemicals
      - Physical agents
      - Viruses
Etiology of CA

- Caused by carcinogens
  - Endogenous factors
  - Reside in the genomes of the cells
    - Genetic traits
    - Discovery of oncogenes
      - Identical to exogenous viral genes
      - Can be used like viruses to infect normal cells
Human Carcinogens

- Industrial (preventable)
  - Asbestos (airborne-lung CA)
  - Napthylamine (dyes- bladder CA)
  - Nickel ore mining (nasal CA)
  - Insecticides (skin CA)
Human Carcinogens

- Drugs
  - Many drugs used in the treatment of cancer are also carcinogenic
    - Secondary cancer develops in patients treated with some of the agents
      - The risk is low
      - The secondary cancer is not as lethal as the untreated primary cancer
Hodgkin’s Lymphoma

- Treatable disease
  - With chemotherapy
- Most patient are cured of the disease after chemo
  - 1-3% of the treated patients develop related CA
Human Carcinogens

- Chemical carcinogens
  - Natural
  - Man-made
    - Sex hormones may induce tumors in sensitive tissues
    - Estrogens produced in excess endogenously by the ovary and adrenals can cause CA of the breast and uterus
    - Exogenous estrogen ingestion may have the same result
Action of Chemical Carcinogens

- Locally
  - Skin carcinogens act at the site of contact
  - Inhaled pulmonary carcinogens act on the bronchial mucosa

- At the site of digestion in the intestine
  - Mediated by intestinal bacteria
Action of Chemical Carcinogens

- At the site of metabolic activation in the liver
  - Primary organ involved in degrading carcinogens
- At the site of excretion of urine
Physical Carcinogens

- Radiation
  - UV light
  - X rays
  - Radioactive isotopes
  - Atomic bombs

- Mechanism
  - Changes in cellular DNA structure, translation
Natural Biologic Carcinogens

- Some
  - Fungi
  - Parasites
  - Viruses
    - Herpes
    - Hepatitis
    - Human T-cell leukemia virus
    - Human papillomavirus
Hereditary Cancers

- Neurmfibromatosis type I
  - Subcutaneous neural sheath tumors
  - Café au lait spots
- Hereditary polyposis coli
  - The colon contains numerous polyps which may become malignant
- Breast cancer
Clinical Manifestations: Neoplasia

- Clinical features are dependent upon:
  - Type of tumor
  - Location
  - Histologic grade
  - Clinical stage
  - Immune status of the host
  - Sensitivity of the tumor cells to the therapy
Clinical Manifestations

- Localized symptoms
  - Depend on location of tumor

- Systemic symptoms
  - Generalized weakness
  - Weight loss
  - Loss of appetite
Risk Factor for Cancer

- Family history
- Age
- Previous cancer
- Lifestyle
  - Alcohol
  - Sexual behavior
  - Sun exposure
  - Diet and nutrition
Diagnosis of Cancer

- blood tests
- X-ray
- CT
- MRI
- Mamogram
- Colonoscopy
- biopsy
Treatment of cancer

- Surgery
- Chemo
- Radiation
Clinical Stages of Cancer

- Describes extent of disease at time of diagnosis
- Stage 0 – premalignant
- Stage 1 – early stage, local cancer
- Stage 2 – increased risk of spread due to tumor size
- Stage 3 – local cancer has spread, but not to distant regions
- Stage 4 – local cancer has spread to distant sites
7 warning signs of CA

- **CAUTION**
  - **C**hange in bowel or bladder habits
  - **A** sore throat that doesn’t heal
  - **U**nusual bleeding or discharge
  - **T**hickening or lump in breast or elsewhere
  - **I**ndigestion or difficulty swallowing
  - **O**bvious change in wart or mole
  - **N**agging cough or hoarseness