Neoplasia part I

By

Dr. Mohsen Dashti

Clinical Medicine & Pathology 316

2nd Lecture

Lecture outline

- Review of structure & function.
- Basic definitions.
- Classification of neoplasms.
- Morphologic features.
- Life history & spread of cancer.
- Grading & staging.

Review of structure & function

- **Where is our cell factory & when does it start working?**

- The cells of the body are derived from one cell. Which is?
- The fertilized ovum (the female reproductive cell, which is capable of developing, usually only after fertilization, into a new individual). in which during embryonic development successive cell divisions lead to more and more specialized cell types. So what happens to the less specialized cells?
- Simply start to disappear.
- So what do we call the specialized cells?
- Epithelial cells, connective tissue cells, muscle cells, and nervous tissue cells.
- **Review the previous lecture for the difference between epithelial and connective tissue cells!!!**

Review of structure & function

- **So what do they control in the body?**

1. Epithelial cells:

- They generally control the majority of our body organs. They compose the skin, mouth, pharynx, larynx, esophagus and anus.
- They also compose the urinary tract including renal pelvis, ureter, bladder and urethra.
- They line the nose, trachea, bronchi, stomach, small intestine, colon and many ducts including bile ducts and breast ducts.
- They are also responsible to compose the different glands, thyroid, pancreas and the kidneys.

Review of structure & function

2. Connective tissue cells.

- They mainly compose cartilage, osteocytes with bone, and endothelial cells with blood vessels.

3. Muscle cells.

- They derived from the same composition of connective tissue cells, but differ in their close approximation to each other.
- They off course compose the muscles and muscle fibers.

4. Nervous tissue cells.

- They derived from the same composition of epithelial cells and formulate neurons and their supporting cells.
- They mainly compose the glial cells and Schwann cells responsible for the brain and spinal core, and peripheral nerves, respectively.

Review of structure & function

- **Refreshment time… what is hyperplasia & neoplasia?**

- Hyperplasia is a proliferation reaction to a prolonged external stimulus and will usually regress when the stimulus is removed.
- Neoplasia is presumed to result from a genetic change producing a single population of new (neoplastic) cells, which can proliferate beyond the degree allowed.
- So how do cells undergo hyperplasia or neoplasia?
- Remember cell injury???
- The tendency of cells to undergo hyperplasia or neoplasia is roughly related to their involvement in physiologic replacement. What does that mean?

Review of structure & function

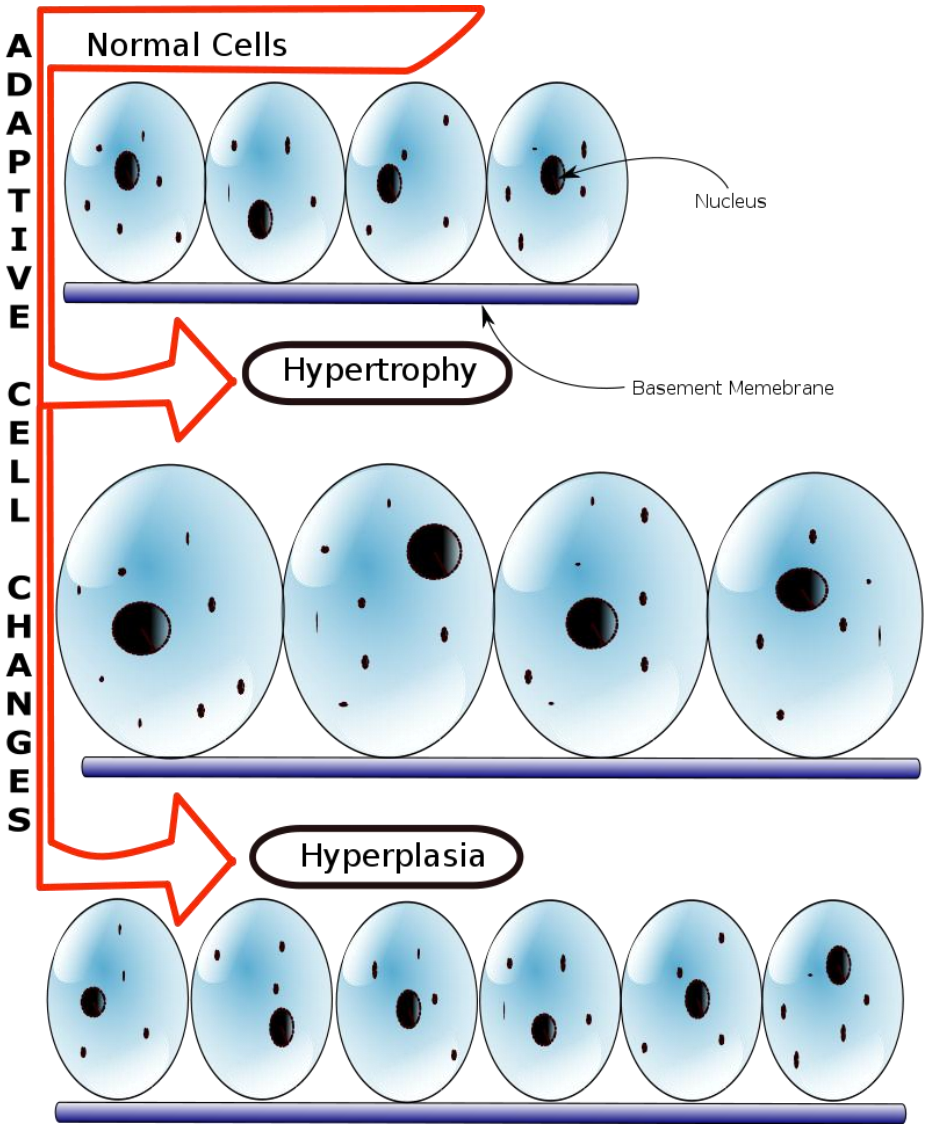
- Some cells are more susceptible to undergo hyperplasia or neoplasia more than others. How, and examples?
- Surface epithelial cells undergo continuous replacement, and this process of replacement can be accelerated by mild injury. Therefore, skin for example; can easily undergo hyperplasia or neoplasia compared to the thyroid or pancreas.
- Again remember location location location.
- Different cell types have different degrees of cell proliferation.
- The proliferative capacity of cells also relates to the process of differentiation in which cells mature from a nonspecific cell type into a specialized cell. Example?
- Daughter cells of the stem cell pass through several intermediate stages of differentiation until they become mature differentiated white or red blood cells. Along the way the proliferation could undergo hyperplasia or neoplasia if the cells are injured.

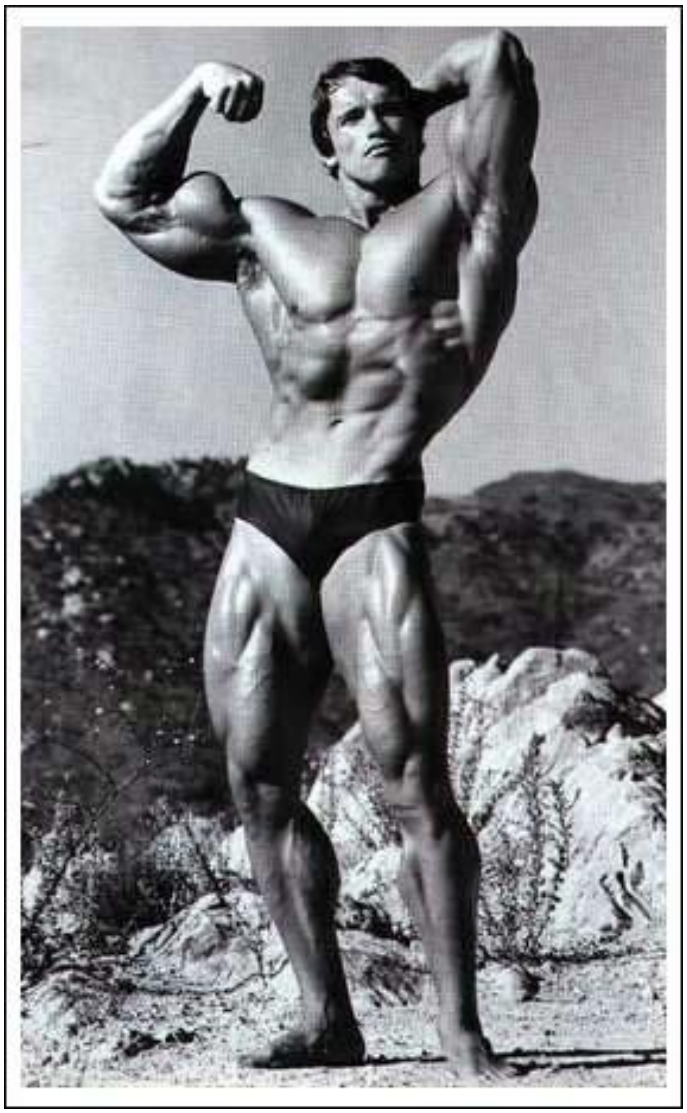
Basic definitions

- **We now know that both hyperplasia & neoplasia are both characterized by proliferation of cells that increase tissue mass. How do they caused?**

- Hyperplasia may be caused by a wide variety of stimuli, such as a remote response to inflammation (lymph node hyperplasia), hormone excess or hormone deficiency , hyperplasia of the bone marrow, and chronic irritation (skin).
- It should be always remembered that the very basic definition of hyperplasia refers to an increase in cell numbers. So what does an increase in cell size called?
- Hypertrophy. Example?
- Muscle fiber enlargement as a response to increased work load.

Basic definitions





Basic definitions

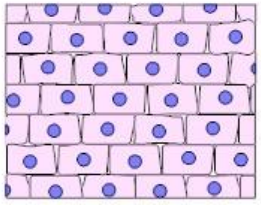
- Neoplasia represents an overgrowth of a single cell type in most cases that goes sometimes out of control.
- Almost all cells in the body can undergo neoplasia, but some do so much more frequently than others.
- As mentioned in previous lectures, neoplasia can develop into??
- Benign or malignant neoplasms.
- Benign is localized single mass of cells that remain localized at their site of origin and limited in their growth.
- Malignant neoplasms are defined by their potential to invade and metastasize (transplantation of cells into new site) at some point in their life history.
- Tumor or cancer are used as synonym for neoplasm.

Basic definitions

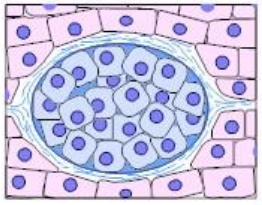
Understanding Tumor
Benign and Malignant Tumor

SmartDraw

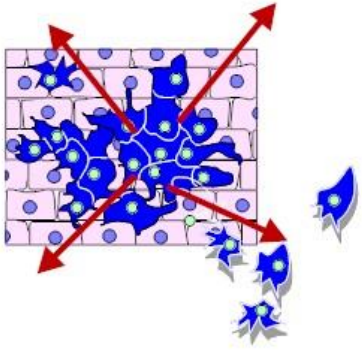
Tumors are abnormal growths of body tissue. The word tumor is used to describe both abnormal growths that are new (neoplasms) and those present at birth (congenital tumors). No matter where they are located in the body, tumors are usually classed as benign or malignant.



Normal Tissue

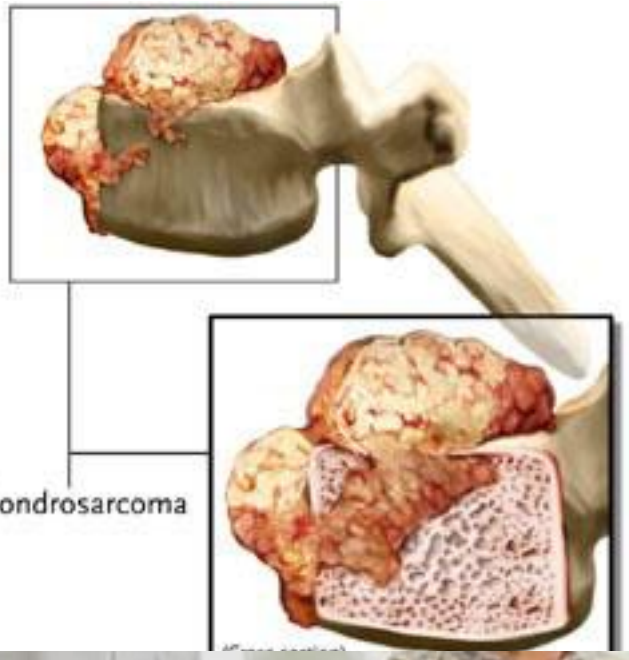


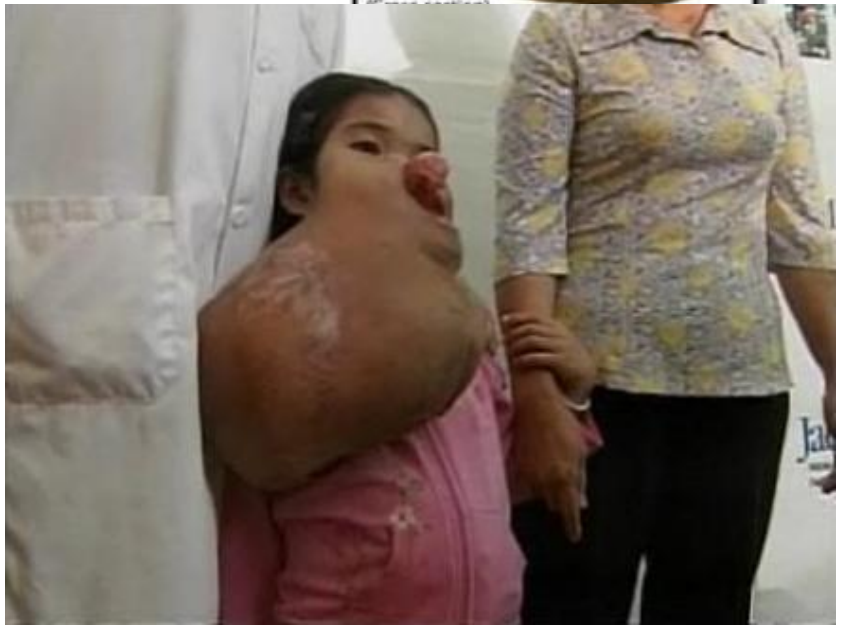
Benign
(or non-cancerous)
Not cancer
the cells that make up the growth are similar to other normal cells, grow relatively slowly, and are confined to one location.



Malignant
(or cancerous)
Cancer
the cells are very different from normal cells, grow relatively quickly, and can spread easily to other locations.

Source: U.S. Department of Health and Human Services, National Institutes of Health, National Institute of Neurological Disorders and Stroke. www.ninds.nih.gov





Classification of neoplasms

- **Is there a system to name different classification of neoplasms?**

- Yes & no. what is the most common suffix for cancer?
- *"oma"*. Most benign neoplasms are named by the cell or tissue they resemble plus the suffix *oma* indicating neoplasm. Example?
- Fibroma, lipoma, adenoma…etc.
- With malignant neoplasms, either carcinoma or sarcoma is added to the name of the tissue to name the type of neoplasm. Example?
- Adenocarcinoma of the breast (breast glands), bronchogenic carcinoma (bronchial epithelium of lung), osteosarcoma (bone), chondrosarcoma (cartilage).

Classification of neoplasms

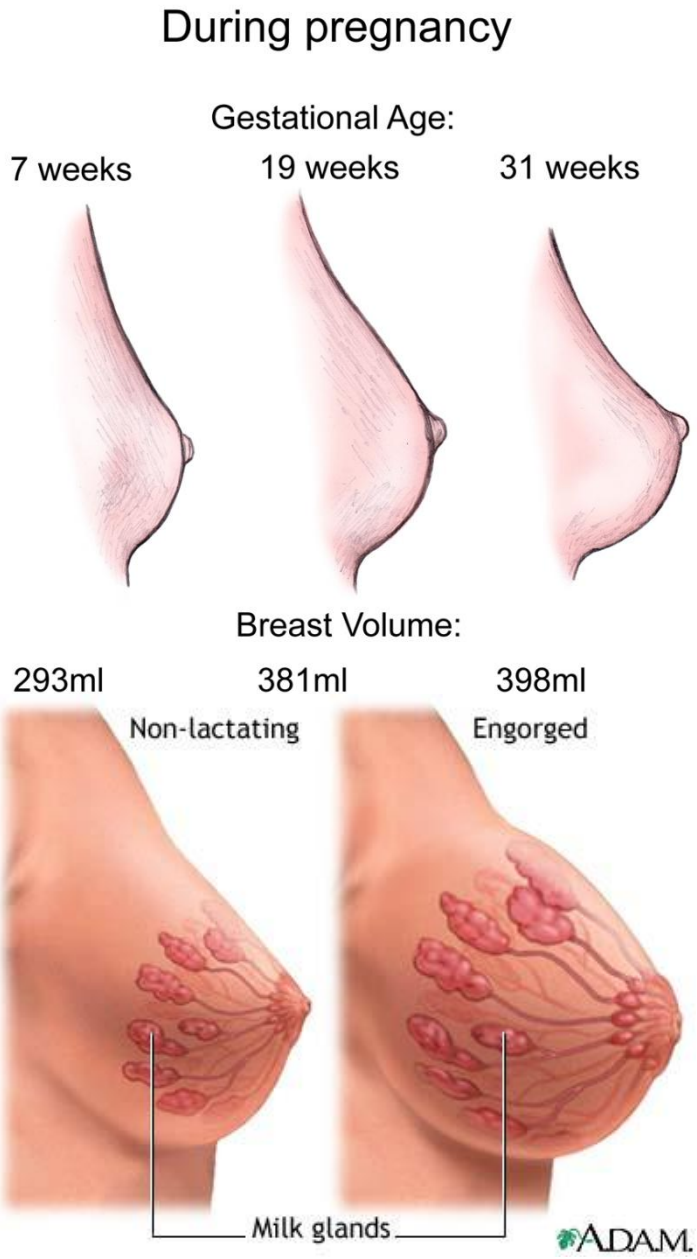
- **Do all neoplasms follow the same naming system?**
- Not really. There are several exceptions to this naming system. Example?
- Hematoma!!! It is in fact a collection of blood, not a neoplasm.
- A few additional types of malignant neoplasms of nonepithelial or ambiguous origin are named separately. Example?
- Leukemia, and malignant lymphoma.

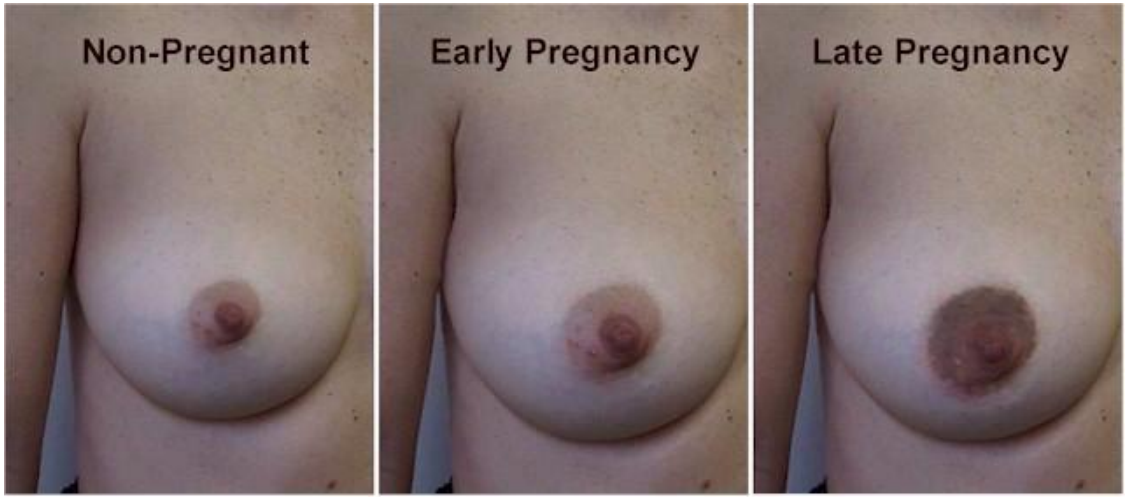
Morphologic features

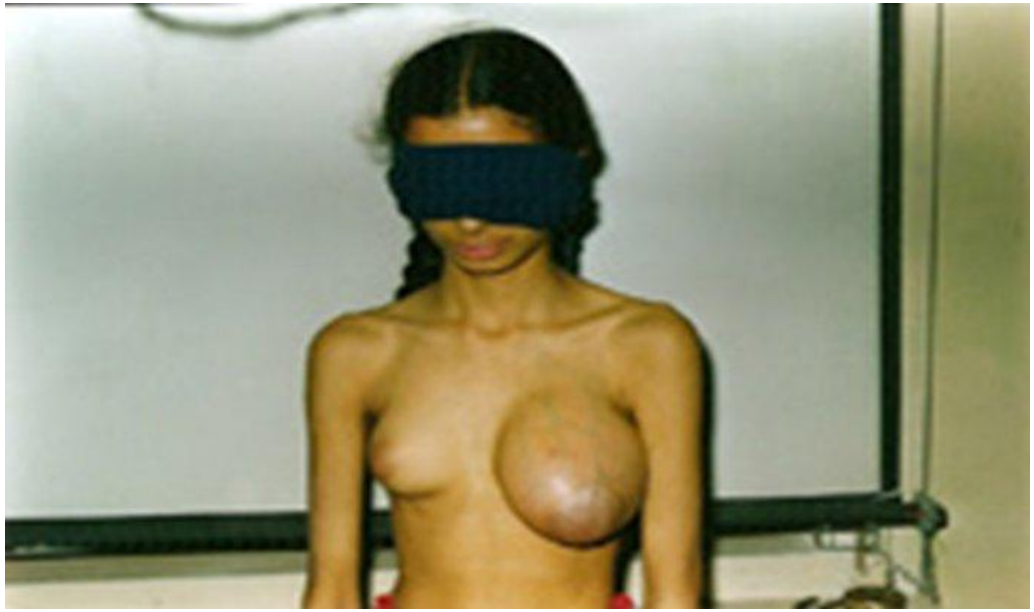
- **What is morphology?**

- The branch of biology concerned with the form and structure of organisms. Why is it important to understand the morphologic features of neoplasms?
- So differentiation between hyperplasisas, hypertrophies, benign, and malignant neoplasms can be made to select the most appropriate prevention or treatment plan.
- ***Hyperplasias:***
- They represent a very diverse group of conditions about which it is difficult to generalize.
- They are generally characterized by an increase in the normal cellular elements of the organ. Example?
- Lymph node hyperplasia, breast hyperplasia common during pregnancy, and enlarged thyroid.

Morphologic features





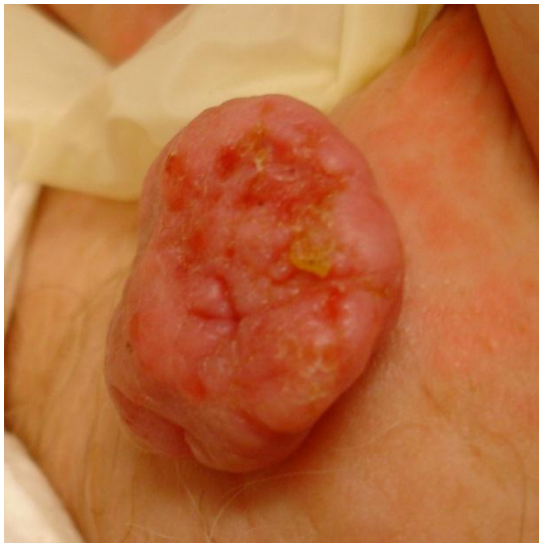


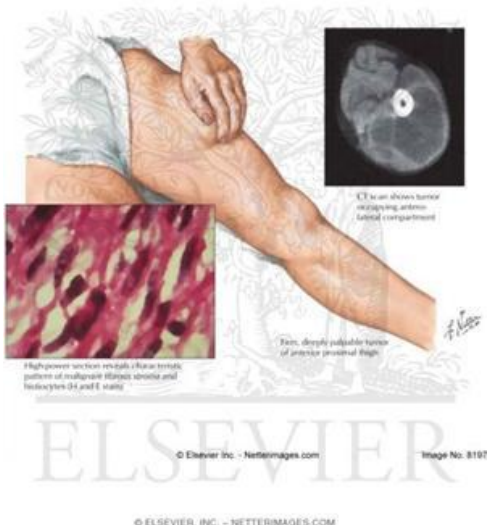
Morphologic features

- Hyperplasias of epithelial surface cells, such as skin, oral cavity and cervix are particularly important as sites of cancer development.
- They develop into lesions that can be visualized grossly and appear more opaque than surrounding surface.
- Some surface hyperlasias could be confused with inflammation. In this case pathologists should confirm the condition microscopically and determine whether it is a simple hyperplasia or premalignant hyperplasia.
- A premalignant hyperplasia lesion is one in which there is an increased likelihood of cancer compared to adjacent normal tissue.

Morphologic features

- ***Benign neoplasms.***
- The morphologic features of benign neoplasms are relatively easy to recognize grossly and microscopically, because they produce a single mass that is discrete from surrounding tissue.
- When originating on a body surface, benign neoplasms extend outwardly, producing a *polyp*.
- When originating within solid organs or connective tissue, benign neoplasms compress tissue around them to form a fibrous rim (capsule).

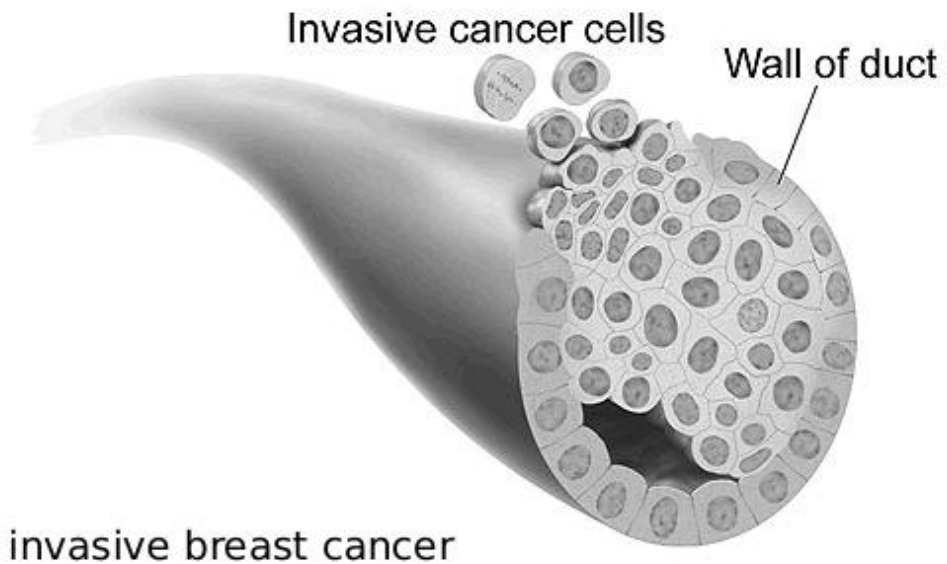




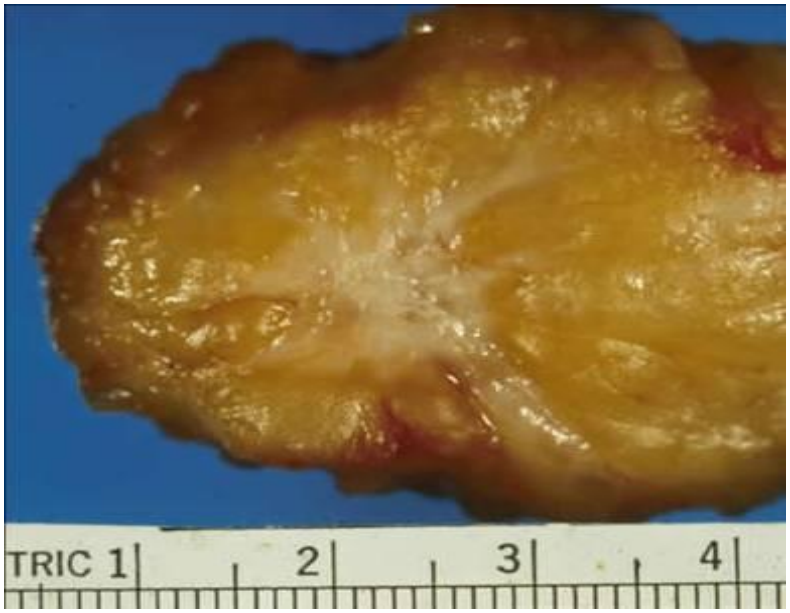
Morphologic features

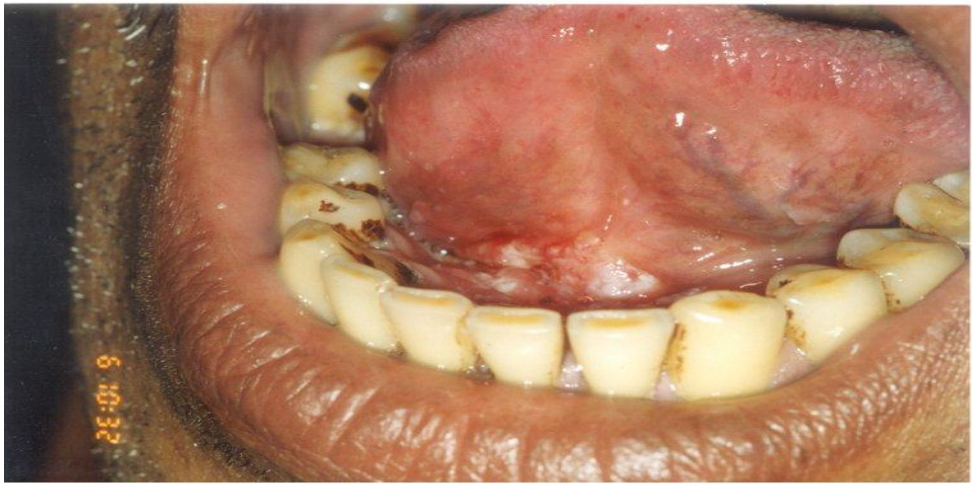
- ***Malignant neoplasms.***
- Early lesions are hardest to diagnose but are most important.
- Two criteria are required for the diagnosis of malignant neoplasm including establishing that the cells are neoplastic and demonstrating invasion.
- Invasion and metastasis are the principal criteria used to distinguish benign and malignant neoplasms.
- Invasion is a more commonly used criterion for cancer than metastasis. Invasion is characterized by infiltration of cancer cells with poor respect for tissue boundaries.
- Invasion is characterized by irregularity of tumor tissue margins, failure of the tumor to separate from surrounding tissue during removal, and when advanced, direct spread beyond the organ of origin.

Morphologic features



invasive breast cancer





Life history & spread of cancer

- **How long is cancer life history?**

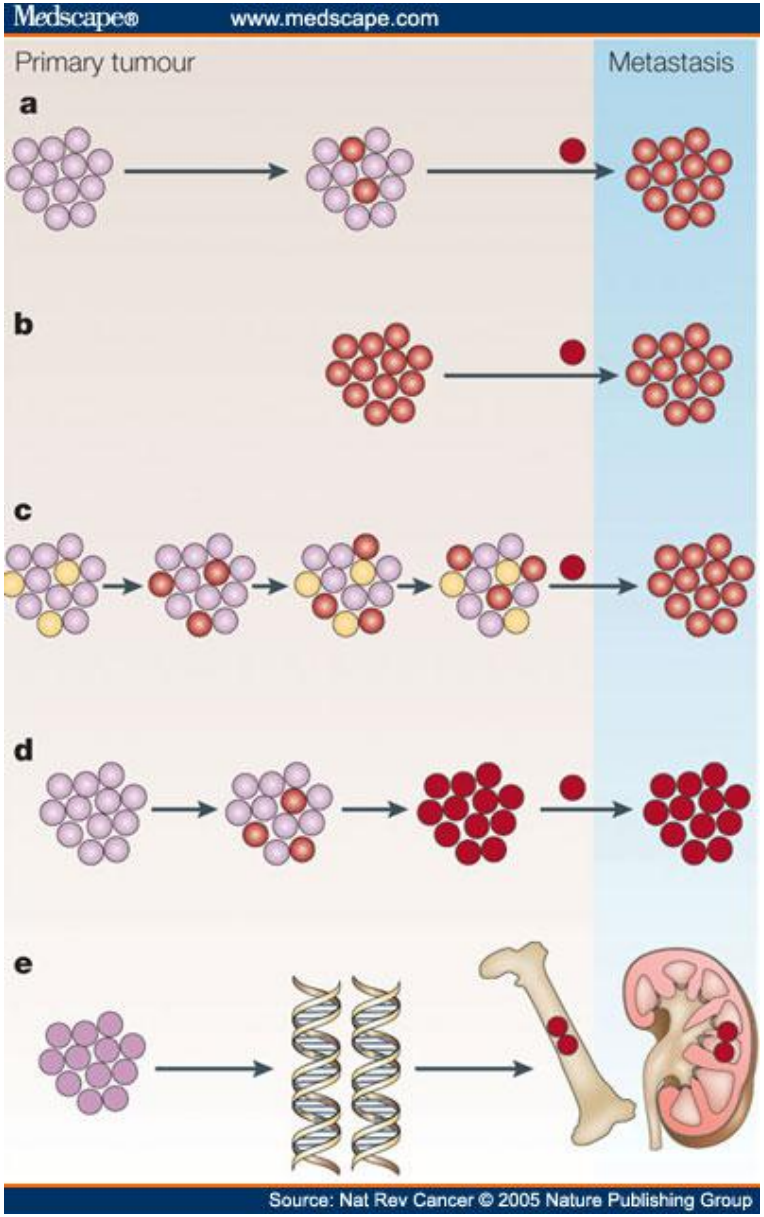
- They have a very long life history and most occur before there is any lesion that can be called cancer.
- Genetic alteration is the basis for development of cancer, but of all the mutations that occur in cells, very few lead to cancer.
- So what alterations are needed to develop cancer in cells?

a. *Initiation:* series of alterations to acquire the growth potential referred to as cancer.

b. *Carcinogens:* agents that alter cells and could be physical, chemical or biological.

c. *Promoter:* another agent that furthers the expression of the cancer in that cell and its progeny (outcome).

Life history & spread of cancer



Models of the metastatic process. **a**, The traditional model of metastasis suggests that only subpopulations of tumor cells (red) acquire metastatic capacity late in tumor - genesis. **b**, Spontaneous metastasis assays indicate that all tumor cells have the capability to develop a metastasis. **c**, The 'dynamic heterogeneity' model proposes that the frequency with which metastatic variants arise within the primary tumor determines its metastatic potential. **d**, The 'clonal dominance' theory proposes that metastatic subclones within a primary tumor can overgrow and dominate the tumor mass itself. **e**, The 'genometastasis hypothesis' proposes that metastasis occurs through transfection of susceptible cells in distant organs.

Grading & staging

- **Is there a difference between grading & staging cancer?**

- Yes. What is the difference?
- Grading refers to the histologic differentiation of cancer in which the degree of resemblance of the cancer to its tissue of origin is evaluated.
- Cancer are commonly graded as; well-differentiated, moderately differentiated, poorly differentiated, or undifferentiated.
- Staging reflects the degree of local invasion and regional distant metastasis.
- Rules for staging involve evaluation for in situ change, localization to the organ of origin, direct spread beyond the organ, and distant metastasis.

Enough is enough for today…