## PROPERTIES OF BENIGN AND MALIGNANT TUMORS

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### **Objectives**

- Compare between benign & malignant tumors in terms of differentiation, rate of growth, local invasion & metastases.
- Identify the morphological features that differentiate between benign & malignant tumors.
- Define the terms: differentiation & anaplasia.
- List the pathways by which malignant tumors spread.
- Define the terms: dysplasia & carcinoma in situ.

#### Introduction

- Features to distinguish between benign & malignant tumors:
  - Differentiation & anaplasia
  - Rate of growth
  - Local invasion
  - Metastasis

- Differentiation & anaplasia are characteristics seen only in the parenchymal cells that constitute the transformed elements of neoplasms.
- Differentiation: the extent to which the parenchymal cells of the tumor resemble their normal counterparts morphologically and functionally

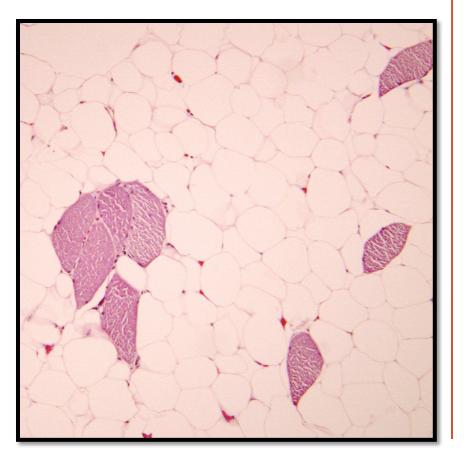
- Differentiation:
  - Well differentiated = closely resemble their normal counterparts
  - Moderately differentiated
  - Poorly differentiated
  - Undifferentiated (Anaplasia)

- Benign neoplasms are composed of well-differentiated cells that closely resemble their normal counterparts.
  - Lipoma: mature fat cells laden with cytoplasmic lipid vacuoles.
  - Chondroma: mature cartilage cells that synthesize their usual cartilaginous matrix (evidence of morphologic and functional differentiation)
- In well-differentiated benign tumors, mitoses are usually rare and are of normal configuration.

- The more differentiated the tumor cell, the more completely it retains the functional capabilities of its normal counterparts.
  - e.g. benign neoplasms and even well-differentiated cancers of endocrine glands frequently elaborate the hormones characteristic of their origin.

- The stroma carrying the blood supply is crucial to the growth of tumors but does not aid in the separation of benign from malignant ones.
- However the amount of stromal connective tissue determines the consistency of a neoplasm.
  - e.g. certain cancers induce a dense, abundant fibrous stroma (*desmoplasia*), making them hard, so-called *scirrhous* tumors.

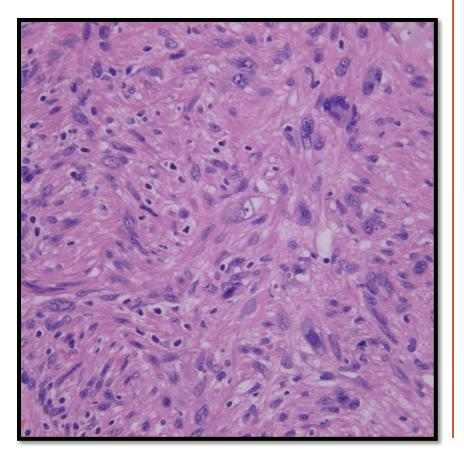
#### Lipoma



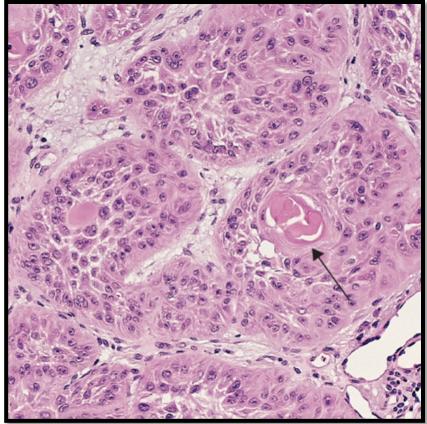
Chondroma

- Malignant neoplasms are characterized by a wide range of parenchymal cell differentiation: from well differentiated to completely undifferentiated.
- Between the two extremes lie tumors loosely referred to as moderately differentiated.

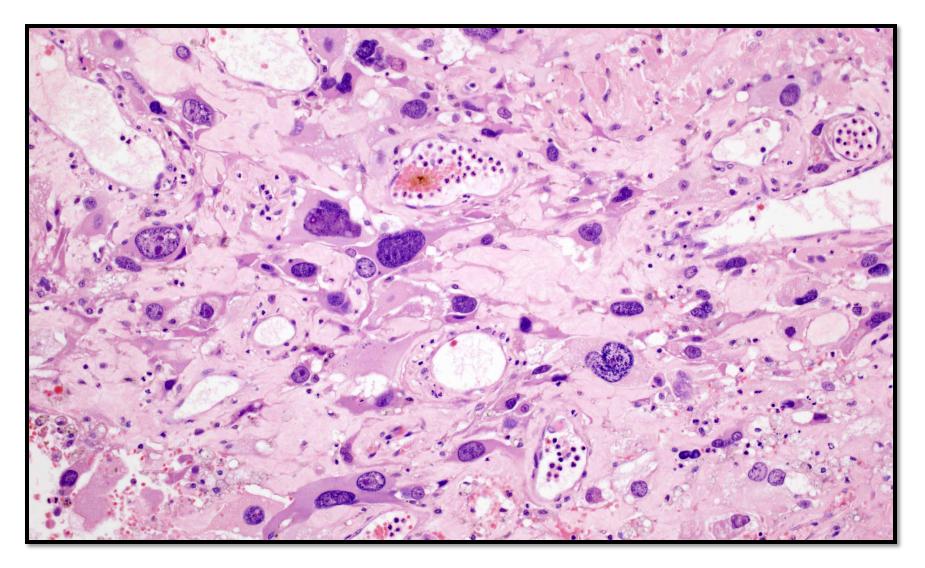
#### Leiomyosarcoma



#### Squamous cell carcinoma

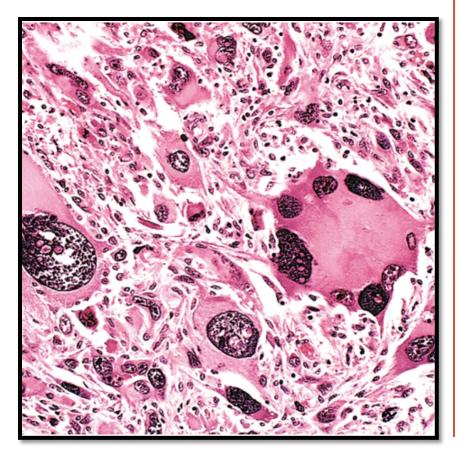


- Malignant neoplasms that are composed of undifferentiated cells are said to be *anaplastic*.
- Anaplasia: loss of the structural and functional differentiation. It is a hallmark of malignancy.

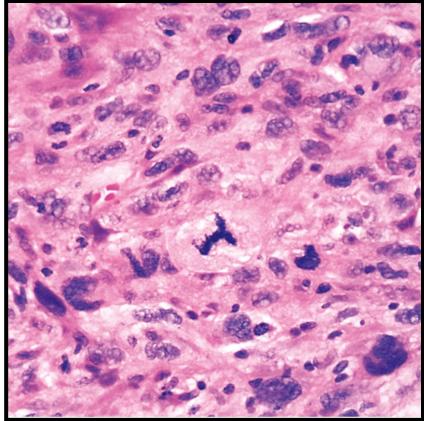


- It is important to recognize the following histopathological features in any neoplasm:
  - Pleomorphism: variation in size and shape
  - Enlarged nuclei resulting in an increase of nuclear to cytoplasm ratio (that may approach 1:1 instead of the normal 1:4 or 1:6)
  - Hyperchromasia (dark nuclei) due to coarse & clumped chromatin
  - Prominent nucleoli
  - Mitoses (typical or atypical forms)
  - *Giant cells*: larger than their neighbors & possess either one enormous nucleus or several nuclei.

#### **Tumor Giant Cells**

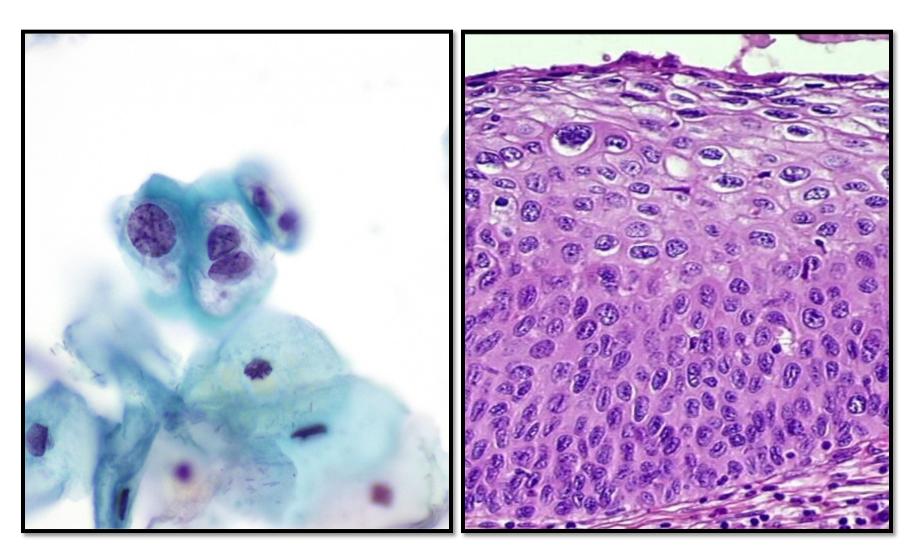


**Atypical Mitosis** 



- Definition: a loss in the uniformity of the individual cells and a loss in their architectural orientation.
- It is a non-neoplastic process but a premalignant condition.
- It occurs mainly in the epithelia.
- Dysplastic cells show a degree of: pleomorphism, <sup>N</sup>:C ratio, hyperchrmasia, irregular nuclei, increased mitoses, loss of polarity & a disordered maturation or total failure of maturation.

- Dysplasia does not mean cancer.
- Dysplasia does not necessarily progress to cancer.
- Dysplasia may be reversible.
- The risk of invasive cancer varies with:
  - grade of dysplasia (mild, moderate, severe)
  - duration of dysplasia
  - site of dysplasia



- Differences between dysplasia & cancer:
  - Lack of invasiveness.
  - Reversibility

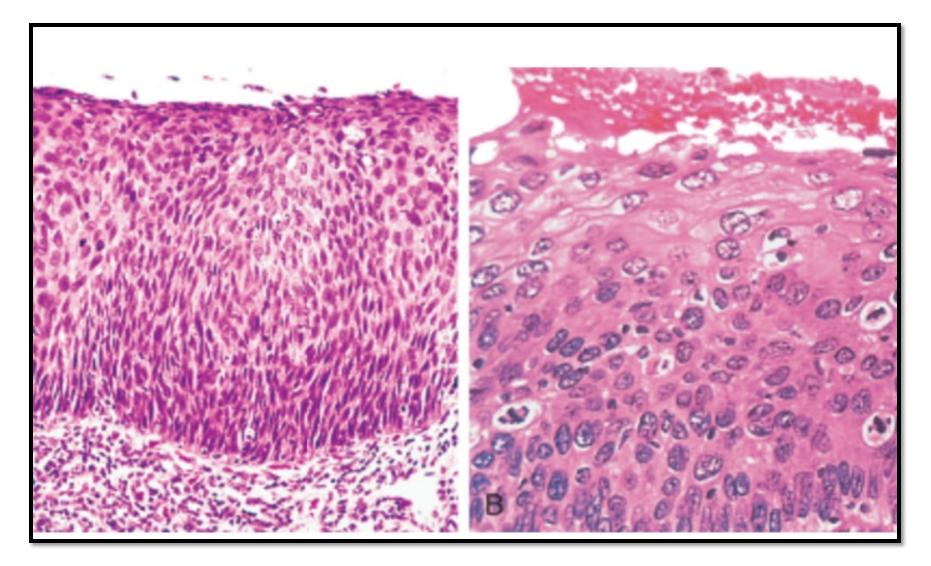
#### Carcinoma in Situ

- If dysplastic changes involve the entire thickness of the epithelium it is called: *carcinoma in-situ*.
- Definition: an intraepithelial malignancy in which malignant cells involve the entire thickness of the epithelium without penetration of the basement membrane.

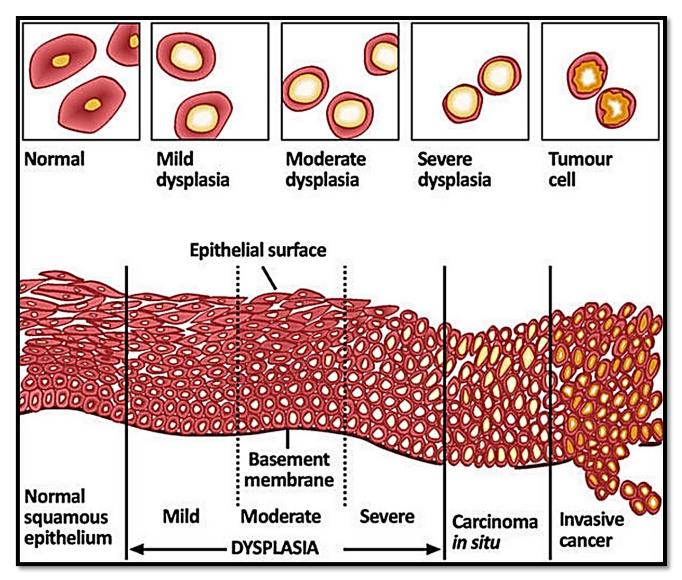
#### Carcinoma in Situ

- It is applicable only to epithelial neoplasms.
- It is a true neoplasm with all of the features of malignant neoplasm except invasiveness.
- It displays the cytological features of malignancy without invading the basement membrane.

#### Carcinoma in Situ



#### Dysplasia & Carcinoma in Situ



#### Reminder...

- Features to distinguish between benign & malignant tumors:
  - Differentiation & anaplasia
  - Rate of growth
  - Local invasion
  - Metastasis

#### Rate of Growth

- Benign tumors:
  - They usually grow slowly.
  - Their growth is affected by: adequate blood supply, location or hormones e.g. leiomyoma of the uterus.

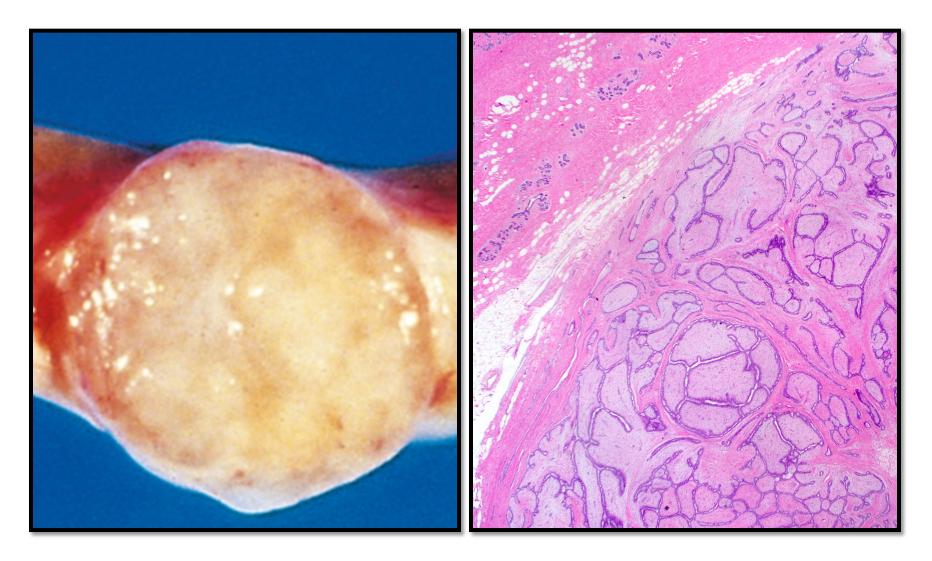
#### Rate of Growth

- Malignant tumors:
  - They usually grow fast.
  - The rate of growth of malignant tumors usually correlates inversely with their level of differentiation.

#### Local Invasion

- Benign tumors:
  - They remain localized.
  - They cannot invade.
  - They are *usually* encapsulated.

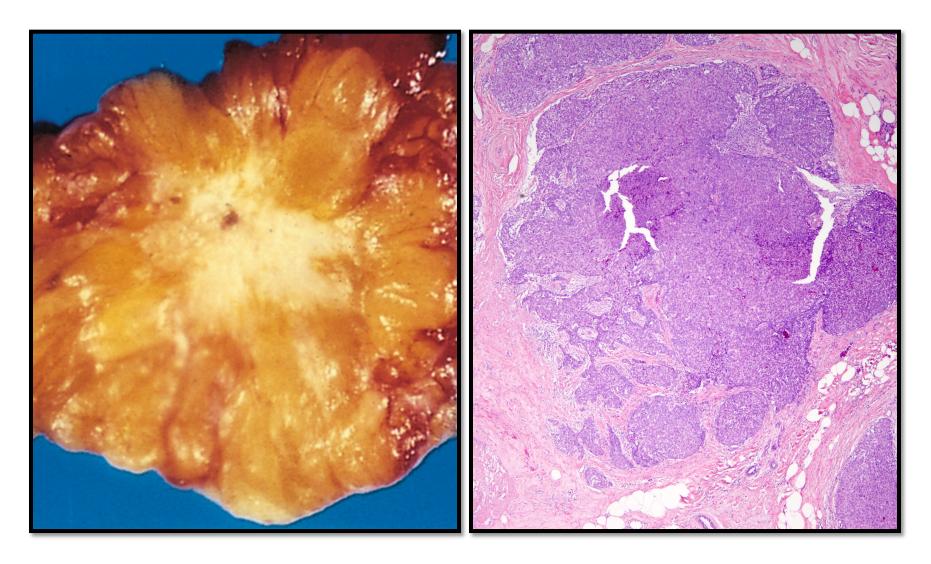
#### Local Invasion



#### Local Invasion

- Malignant tumors:
  - They invade the underlying basement membrane or stroma.
  - They are destructive.
  - They are *usually* not encapsulated.

#### Local Invasion\*



- Definition: it is the development of secondary implants of a tumor that are discontinuous with the primary tumor & located in remote tissues.
- More than any other attribute, the property of metastasis identifies a neoplasm as malignant.

- Cancer have different ability to metastasize.
- Approximately 30% patients present with clinically evident metastases.
- Generally, the more anaplastic and the larger the primary tumor, the more likely it metastasizes.

- Malignant neoplasms disseminate by one of three pathways:
  - (1) seeding within body cavities
  - (2) lymphatic spread
  - (3) hematogenous spread

- Spread by seeding occurs when neoplasms invade a natural body cavity.
- This mode of dissemination is particularly characteristic of cancers of the ovary, which often cover the peritoneal surfaces widely.

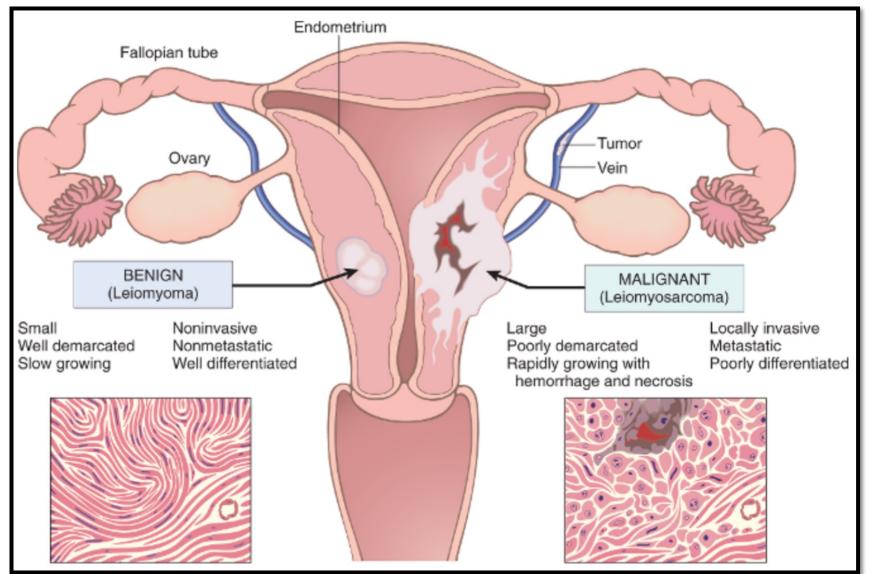
- Lymphatic spread is more typical of carcinomas.
  - Breast carcinoma  $\rightarrow$  axillary lymph node
  - Lung carcinomas  $\rightarrow$  bronchial lymph nodes

- Hematogenous spread is favored by sarcomas but can also occur in carcinomas.
- Veins are more commonly invaded.

 The liver and lungs are the most frequently involved secondary sites.



#### Summary



#### Summary



#### **Characteristics of Benign and Malignant Tumors**

- Benign and malignant tumors can be distinguished from one another based on the degree of differentiation, rate of growth, local invasiveness, and distant spread.
- Benign tumors resemble the tissue of origin and are well differentiated; malignant tumors are poorly or completely undifferentiated (anaplastic).
- Benign tumors are slow-growing, whereas malignant tumors generally grow faster.
- Benign tumors are well circumscribed and have a capsule; malignant tumors are poorly circumscribed and invade the surrounding normal tissues.
- Benign tumors remain localized to the site of origin, whereas malignant tumors are locally invasive and metastasize to distant sites.

Kumar V, Abbas AK, Aster JC. Robbins Basic Pathology.
10<sup>th</sup> ed. Elsevier; 2018. Philadelphia, PA.

# END OF LECTURE

Thank You